MITSUBISHI ELECTRIC

Mitsubishi Electric Industrial Robot

CR800 series controller
CR750/CR751 series controller

Ethernet Function Instruction Manual

MELFA

BFP-A3379-H

■ Revision History

Print Date	Instruction Manual No.	Revision Content
2015-03-18	BFP-A3379	・First print
2017-04-28	BFP-A3379-A	・Descriptions about the CR800 controller have been added.
2017-11-10	BFP-A3379-B	・Descriptions about FR Series CC-Link IE Filed Network Basic function have been added.
2018-02-01	BFP-A3379-C	・The CR800-Q controller was added.
2020-10-30	BFP-A3379-D	・Amended the precautions regarding the prevention of unauthorized access. ・Corrected mistakes in the table in section 3.6.5 "Support of robot I/O signals and link devices". ・Added precautions regarding subnet masks to section 2.2.2 "Details of parameters".
2022-11-30	BFP-A3379-E	・Added the following parameters: RCDUETH, RCDUIP ・Corrected other mistakes and changed some sections.
2023-09-14	BFP-A3379-F	・Added the CR860 controller. ・Changed some sections.
2024-04-05	BFP-A3379-G	・Amended images in "3.4.1 Overview". ・Amended images in "3.4.3 Setup". ・Corrected other mistakes.
2026-01-30	BFP-A3379-H	・Added an explanation of the Modbus TCP communication function.

⚠ Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠CAUTION All teaching work must be carried out by an operator who has received special training.
(This also applies to maintenance work with the power source turned ON.)
→Enforcement of safety training

⚠CAUTION For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan.
(This also applies to maintenance work with the power source turned ON.)
→Preparation of work plan

⚠WARNING Prepare a device that allows operation to be stopped immediately during teaching work.
(This also applies to maintenance work with the power source turned ON.)
→Setting of emergency stop switch

⚠CAUTION During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc.
(This also applies to maintenance work with the power source turned ON.)
→Indication of teaching work in progress

⚠DANGER Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→Installation of safety fence

⚠CAUTION Establish a set signaling method to the related operators for starting work, and follow this method.
→Signaling of operation start

⚠CAUTION As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→Indication of maintenance work in progress

⚠CAUTION Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

DANGER When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.

CAUTION Use the robot within the environment given in the specifications. Failure to do so could lead to faults or a drop of reliability.
(Temperature, humidity, atmosphere, noise environment, etc.)

CAUTION Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

CAUTION Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

CAUTION Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

CAUTION Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

CAUTION Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque.
Exceeding these values could lead to errors or faults.

WARNING Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

WARNING Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

CAUTION Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

WARNING When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

CAUTION Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

CAUTION After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

CAUTION Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

CAUTION Never carry out modifications based on personal judgments, non-designated maintenance parts. Failure to observe this could lead to faults or failures.

WARNING When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

CAUTION Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected. Also a dropped or coasted robot arm could collide with peripheral devices.

CAUTION Do not turn OFF the robot controller's main power while rewriting the robot controller's internal information, such as a program and parameter. Turning OFF the robot controller's main power during automatic operation or program/parameter writing could break the internal information of the robot controller.

DANGER Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

DANGER Do not connect the Handy GOT to a programmable controller when using an iQ Platform compatible product with the CR750-Q/CR751-Q/CR800-R/CR800-Q/ CR860-R/CR860-Q controller.
Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

DANGER Do not remove the SSCNET III cable while power is supplied to the multiple CPU system or the servo amplifier when using an iQ Platform compatible product with the CR750-Q/CR751-Q/CR800-R/CR800-Q/CR860-R/CR860-Q controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables of the Motion CPU or the servo amplifier. Eye discomfort may be felt if exposed to the light.
(Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC 60825-1 (domestic standards in Japan).)

DANGER Do not remove the SSCNET III cable while power is supplied to the controller.
Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light.
(Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

DANGER Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

CAUTION Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

CAUTION Use the network equipments (personal computer, USB hub, LAN hub, etc.) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

CAUTION To maintain the security (confidentiality, integrity, and availability) of the robot and the system against unauthorized access, DoS[*1] attacks, computer viruses, and other cyberattacks from unreliable networks and devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions. Mitsubishi Electric shall have no responsibility or liability for any problems involving robot trouble and system trouble by unauthorized access, DoS attacks, computer viruses, and other cyberattacks.
*1 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

■ Symbols in instruction manual

⚠ **DANGER**	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
⚠ **WARNING**	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
⚠ **CAUTION**	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.

Contents

1. Before use....1-1
1.1. How to use the instruction manual....1-1
1.1.1. Content of instruction manual....1-1
1.2. Terms used in the instruction manual....1-2
1.3. Confirmation of product....1-3
1.4. Ethernet function....1-3
1.4.1. Function of Ethernet....1-3
2. Preparation before use....2-1
2.1. Connection of Ethernet cable....2-1
2.2. Parameter setting....2-4
2.2.1. Parameter list....2-4
2.2.2. Details of parameters....2-6
2.2.3. Parameter setting example 1 (When the Support Software is used)....2-9
2.2.4. Parameter setting example 2-1 (When the data link function is used: When the controller is the server)....2-10
2.2.5. Parameter setting example 2-2 (When the data link function is used: When the controller is the client)....2-11
2.2.6. Parameter setting example 3 (for using the real-time external control function)....2-12
2.3. Connection confirmation....2-13
2.3.1. Checking the connection with the Windows ping command....2-13
3. Description of functions....3-1
3.1. Controller communication function....3-2
3.1.1. Connecting the controller and personal computer....3-2
3.1.2. Setting the personal computer network....3-2
3.1.3. Setting the controller parameters....3-2
3.1.4. Setting the personal computer support software communication....3-3
3.1.5. Communication....3-4
3.2. Data link function....3-5
3.2.1. MELFA-BASIC V/VI Commands....3-5
3.2.2. Using data link function....3-9
3.2.3. Ending....3-12
3.3. Real-time external control function....3-13
3.3.1. Explanation of command....3-15
3.3.2. Explanation of communication data packet....3-17
3.3.3. Using real-time external control function....3-21
3.3.4. Ending....3-23
3.4. Real-time monitor function....3-24
3.4.1. Overview....3-24

3.4.2. Supported version 3-25
3.4.3. Setup 3-26
3.4.4. Start of monitor / End of monitor 3-28
3.4.5. Explanation of communication data packet 3-29
3.4.6. Data type ID 3-32
3.4.7. Parameters 3-33
3.4.8. Error 3-33
3.5. SLMP Connection 3-34
3.5.1. Function Overview 3-34
3.5.2. Supported version 3-34
3.5.3. Specifications 3-34
3.5.4. Parameters 3-34
3.5.5. SLMP Communication Procedure 3-35
3.5.6. Message Format 3-37
3.5.7. Commands 3-45
3.5.8. End Code 3-80
3.6. CC-Link IE Field Network Basic function 3-81
3.6.1. Overview 3-81
3.6.2. Supported version 3-82
3.6.3. Specifications 3-82
3.6.4. Parameters 3-83
3.6.5. Support of robot I/O signals and link devices 3-84
3.6.6. Setup procedure 3-85
3.7. Modbus TCP communication function 3-95
3.7.1. Overview 3-95
3.7.2. Supported version 3-95
3.7.3. Specifications 3-96
3.7.4. Parameters 3-97
3.7.5. Standard MODBUS functions 3-98
3.7.6. Setup procedure 3-112
4. Appendix 4-1
4.1. Error list 4-1
4.2. Sample program 4-3
4.2.1. Sample program of data link 4-3
4.2.2. Sample program for real-time external control function 4-15
4.3. Viewing option card information 4-26

1. Before use

This chapter describes the confirmation items and cautionary items which must be read before practical use of the Ethernet.

1.1. How to use the instruction manual

1.1.1. Content of instruction manual

Through the following configuration, this document introduces the Ethernet function. As for the functions available in the standard robot controller and the operation method, please refer to the "Instruction Manual" provided with the robot controller.

Table 1.1 Content of the instruction manual

Chapter	Title	Content
1	Before use	In addition to the using method of the instruction manual, the confirmation items and cautionary items are introduced to use the Ethernet function.
2	Preparation before use	The preparatory work is introduced to use the Ethernet function. Referring to the chapter, apply the cabling and wiring and confirm the other setting items.
3	Description of functions	Using the system configured in "2. Preparation before use" in this manual, it introduces a series of the operating methods from the start-up to the stop. Referring to each introduction, understand the basic operating method. The following items will be introduced. · Controller communication function (connection with computer support software RT ToolBox2/3) · Data link function (transmit values/text strings with the robot commands Open/Print/Input) · Real-time external control function (operation control using motion control cycles from a computer) · Real-time monitoring function (monitor the current position and more in real time via a computer) · SLMP connection (read from and write to a robot controller device by using SLMP) · CC-Link IE Field Network Basic function (send and receive transmissions by using FA network) · Modbus TCP communication function (Input/output of signals and registers using standard MODBUS functions)
4	Appendix	Since the added errors when indexing the terms or using the Ethernet function are herein described, refer to this chapter as necessary.

1.2. Terms used in the instruction manual

The following terms are used in this document.

(1) Ethernet function

The robot controller has various network functions that use the Ethernet.

(2) Network personal computer

The personal computer is a commercially available one which provides the network function, integrating the Ethernet interface card. Windows 11 is used as the operating system.

(3) MELFA-BASIC V/VI command

This is a type of robot language.

(4) Series name

The following are the series described in this instruction manual.

Name	Description
CR800 series	Indicates the CR800 and CR860 controllers.
CR800-D series	Indicates the CR800-D and CR860-D controllers.
CR800-Q series	Indicates the CR800-Q and CR860-Q controllers.
CR800-R series	Indicates the CR800-R and CR860-R controllers.

1.3. Confirmation of product

The standard configuration of the product supplied by the customer is as follows. Confirm the configuration.

In addition to the standard robot system configuration, the following is necessary. These devices are separately procured by the customer.

No.	Part name	Type	Qty.
1)	Network personal computer (Network interface is necessary.)	Computer running Windows 11. Computer with TCP/IP network functions, such as Linux OS (Operation is not verified.)	1 or more
2)	Ethernet cable (Select the straight cable or cross cable depending on the connection system.)	Cable	1 or more

Prepare the following as necessary.

3)	Hub (Necessary if it is used in the LAN environment.)	(Goods on the market)	1
4)	Robot controller programming aiding tool corresponding to Windows for Robot controller of our company	(An optional) Personal computer Support Software	1
5)	Application for network communication program production corresponding to Windows	(Goods on the market) Microsoft. Visual Studio etc.	1

1.4. Ethernet function

1.4.1. Function of Ethernet

The Ethernet installed as a standard on the robot controller has the following functions.

(1) The connections with 100BASE-TX (for CR750/CR751/CR800-R/CR800-Q/CR860-R/CR860-Q) and with 1000BASE-T (for CR800-D/CR860-D) are supported.

(2) TCP/IP protocol is used to allow the communication with the personal computer on the Ethernet.

(3) The sampling program (corresponding to Microsoft Visual Basic Express 2008/Visual C++ Express 2008) of the personal computer is equipped.

The following is provided as the samples. (Refer to Chapter 4 Appendix.)

• The data link function is used to transmit and receive the variables of personal computer and robot (characters and numerical values). (OPEN/INPUT#/PRINT#)

Here, approve that the result of the operation of the application which the customer produces on the basis of the sample is out of the responsibility with our company.

(4) The Ethernet functions are described below.

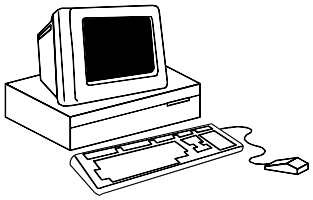
Refer to the section "3. Description of functions" for details on each function.

No.	Outline of function	Remarks	Reference page
1)	Controller communication function Data can be communicated with the robot controller via Ethernet. (Program upload/download, status monitor, etc.) Personal computer support software (optional) is available as an application.	* Communication with up to 16 clients is possible.	Chapter 1 General Chapter 2 General Chapter 3.1 Chapter 4.1
2)	Data link function The value and position data can be linked between the robot program and personal computer using MELFA-BASIC V/VI language (OPEN/PRINT/INPUT command).	* By changing the communication open destination COM No., communication with applications in up to 8 clients is possible.	Chapter 1 General Chapter 2 General Chapter 3.2 Chapter 4.1 Chapter 4.2.1
3)	Real-time external control function The position command data can be retrieved and operated at the robot motion control cycle unit. Joint, XYZ or motor pulse can be designated for the position data. It is also possible to monitor the input/output signals or output the signals simultaneously. Control is started with the MXT command (MELFA-BASIC V/VI language).	* The user must create an application program on the personal computer side to control the robot. * Communication is carried out one-on-one. * UDP communication is used.	Chapter 1 General Chapter 2 General Chapter 3.3 Chapter 4.1 Chapter 4.2.2
4)	Real-time monitoring function The current position, speed at the tip of the arm, and other measurements can be monitored by a PLC or computer in real time at the robot motion control cycle unit.	* Use UDP.	Chapter 1 General Chapter 2 General Chapter 3.4 Chapter 4.1
5)	SLMP connection The server functions of SLMP communications can be used from the robot controller. Data can be read from and written to a robot controller device from a PLC or computer via the Ethernet.	* Supported by CR800 series only. Not supported by CR750/CR751 series.	Chapter 1 General Chapter 2 General Chapter 3.5 Chapter 4.1
6)	CC-Link IE Field Network Basic function CC-Link IE Field Network Basic local stations are supported, and the signals and registers of robot controllers can be input and output via periodic communication (cyclic transmission) with a PLC, computer, or other master station.	* Supported by CR800 series only. Not supported by CR750/CR751 series.	Chapter 1 General Chapter 2 General Chapter 3.6 Chapter 4.1 Chapter 4.3
7)	Modbus TCP communication function Modbus TCP slave stations are supported, and the signals and registers of robot controllers can be input and output via communication (standard MODBUS functions) with a PLC, computer, or other master station.	* Supported by CR800 series only. Not supported by CR750/CR751 series.	Chapter 1 General Chapter 2 General Chapter 3.7 Chapter 4.1 Chapter 4.3

⚠CAUTION These functions can all be used simultaneously, but be aware that when the network handles large loads, communications slow down and may not reflect real-time information.

* The personal computer used to communicate with the robot controller must be located on the same network. Communication cannot be carried out over firewalls (from internet) or over gateways (from different adjacent network, etc.). Consider operation with a method that communicates via a server (i.e., HTTP server, etc.) connected to the same network as the robot controller. Pay special attention to safety and response in this case.

Ethernet

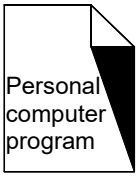


1) Controller communication function
Program creation, editing
Debugging startup support, maintenance

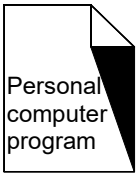
2) Data link function
Transmission/reception of value and position data

3) Real-time external control function
Transmission/reception of real-time position data at control cycle

Personal computer support software
(Mitsubishi option)

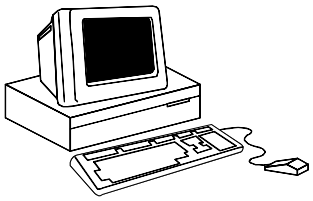


Data link application
(Customer-created)



Real-time external control application
(Customer-created)

Ethernet

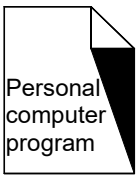


1) Controller communication function
Program creation, editing
Debugging startup support, maintenance

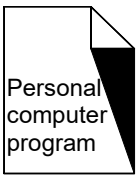
2) Data link function
Transmission/reception of value and position data

3) Real-time external control function
Transmission/reception of real-time position data at control cycle

Personal computer support software
(Mitsubishi option)



Data link application
(Customer-created)



Real-time external control application
(Customer-created)

<<MEMO>>

2. Preparation before use

What is done before use is described.

Connection of Ethernet cable … Refer to 2.1.

↓

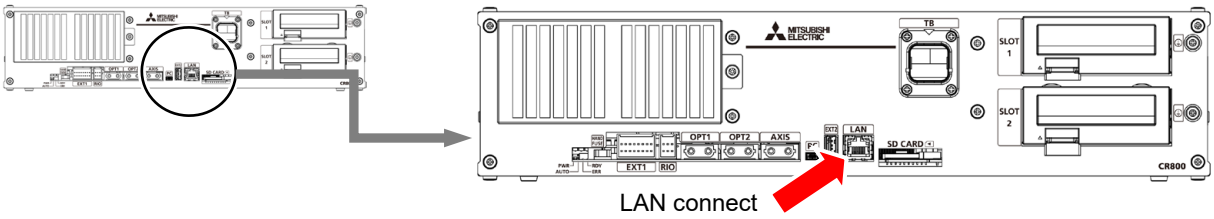
Parameter setting … Refer to 2.2.

2.1. Connection of Ethernet cable

As shown below, connect the Ethernet cable to the connector.
When the hub is used, use the straight cable. Or when the personal computer and controller are connected to each other one to one, use the cross cable.

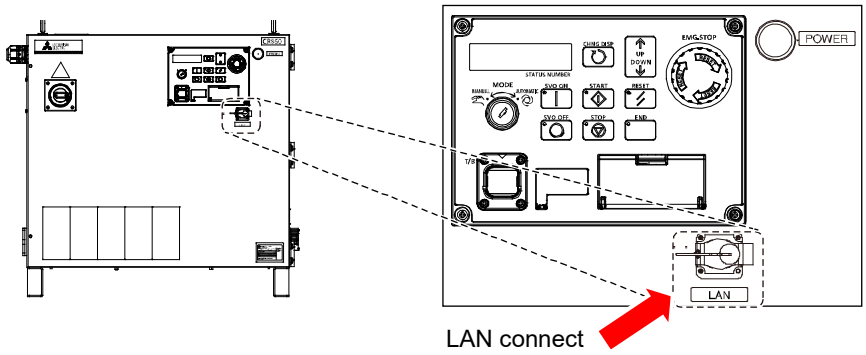
<CR800-D controller>

CR800-D controller front



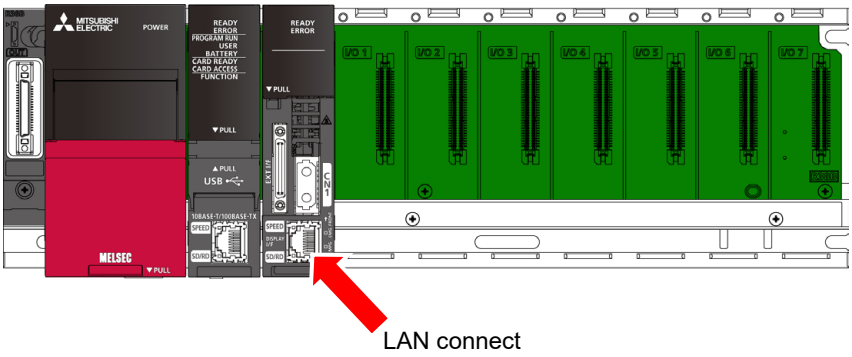
<CR860-D controller front>

Enlarged view of the CR860-D controller operation panel



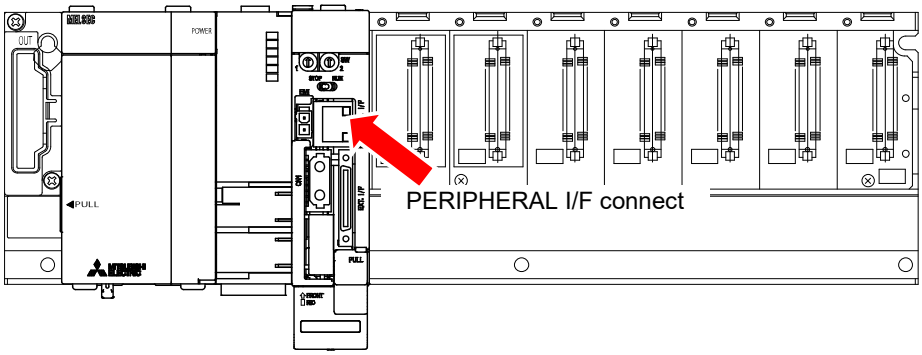
<CR800-R/CR860-R controllers>

Robot CPU unit front



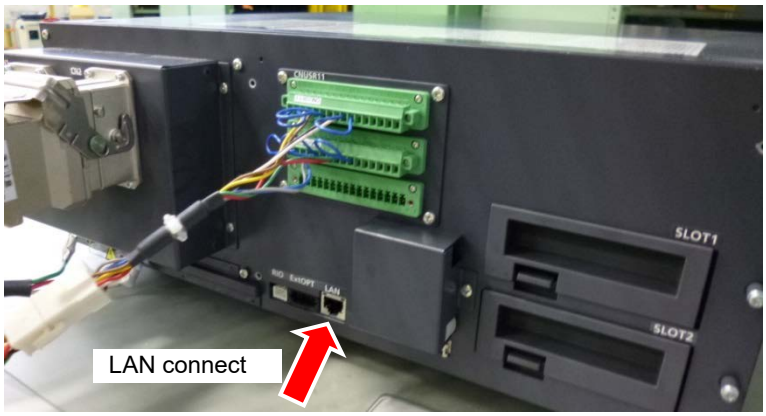
<CR800-Q/CR860-Q controllers>

Robot CPU unit front



<CR750 controller>

CR750 controller back

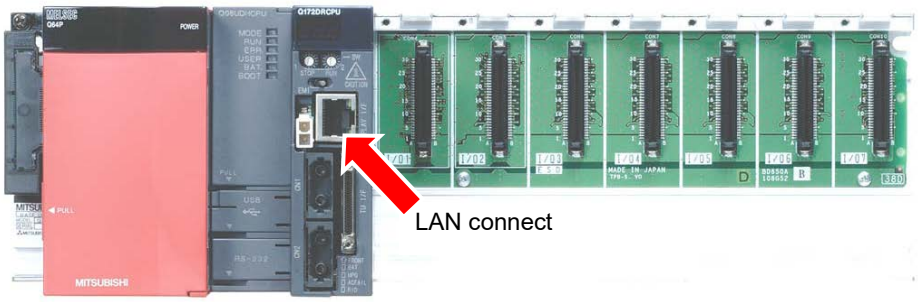


<CR751 controller>

CR751 controller front

<CR750-Q/CR751-Q controller>

Robot CPU unit front



2.2. Parameter setting

Before use, it is necessary to set the following parameters. The parameters which are set on the robot controller are shown in the following list. For the method to set the parameter, refer to the instruction manual of the controller.

⚠CAUTION After changing the parameters, turn the power supply of the controller from OFF to ON. Unless this is done, the changed parameters will not become valid.

2.2.1. Parameter list

The parameters are listed below. For details of the parameters, refer to "2.2.2. Details of parameters".

O ... Setting is necessary
- ... Setting is unnecessary

Parameter list

Parameter name	Details	Number of elements	Default value	Controller communication function	Data link function	Real-time control function	Real-time monitoring function	SLMP	CC-Link IEF Basic
NETIP	IP address of robot controller	Character string 1	"192.168.0.20"	O	O	O	O	O	-
NETMSK	Sub-net-mask	Character string 1	"255.255.255.0"	O	O	O	O	O	-
NETPORT	Port No. Range 0 to 32767 For function expansion (reserved), ---------- Correspond to OPT 11-19 of COMDEV (OPT11) (OPT12) (OPT13) (OPT14) (OPT15) (OPT16) (OPT17) (OPT18) (OPT19)	Numerical value 10	10000, 10001, 10002, 10003, 10004, 10005, 10006, 10007, 10008, 10009	O	O	O	-	-	-
CPRCE11 CPRCE12 CPRCE13 CPRCE14 CPRCE15 CPRCE16 CPRCE17 CPRCE18 CPRCE19	Protocol 0: No-procedure 1: Procedure, 2: Data link (1: Procedure has currently no function.) Correspond to OPT 11-19 of COMDEV (OPT11) (OPT12) (OPT13) (OPT14) (OPT15) (OPT16) (OPT17) (OPT18) (OPT19)	Numerical value 9	0 0 0 0 0 0 0 0 0	-	O	-	-	-	-

Parameter name	Details	Number of elements	Default value	Controller communication function	Data link function	Real-time control function	Real-time monitoring function	SLMP	CC-Link IEF Basic
COMDEV	Definition of device corresponding to COM1: to 8 Definition of device corresponding to COM1:, Definition of device corresponding to COM2:, Definition of device corresponding to COM3:, Definition of device corresponding to COM4:, Definition of device corresponding to COM5:, Definition of device corresponding to COM6:, Definition of device corresponding to COM7:, Definition of device corresponding to COM8: . When the data link is applied, setting is necessary. OPT11 to OPT19 are allocated.	Character string 8	, , , , , , ,	-	O	-	-	-	-
NETMODE	Server designation (1: Server, 0: Client) (OPT11) (OPT12) (OPT13) (OPT14) (OPT15) (OPT16) (OPT17) (OPT18) (OPT19)	Numerical value 9	1 , 1 , 1 , 1 , 1 , 1 , 1 , 1 , 1	-	O	-	-	-	-
NETHSTIP	The IP address of the data communication destination server. * It is valid if specified as the client by NETMODE only. (OPT11) (OPT12) (OPT13) (OPT14) (OPT15) (OPT16) (OPT17) (OPT18) (OPT19)	Character string 9 .	192.168.0.2 , 192.168.0.3 , 192.168.0.4 , 192.168.0.5 , 192.168.0.6 , 192.168.0.7 , 192.168.0.8 , 192.168.0.9 , 192.168.0.10	-	O	-	-	-	-
MXTTOUT	Timeout time for executing real-time external control command (CR750/CR751 series: 7.11 msec, CR800 series: 3.5 msec (*If user mechanical is set, approx. 7.11 msec), Set -1 to disable timeout)	Value 1 (0-32767)	-1	-	-	O	-	-	-
NETGW	Gateway address	Character string 1	192.168.0.254	O	O	O	O	O	-
MONMODE	Real-time monitoring function, enable/disable	Numerical value 1	1	-	-	-	O	-	-
MONPORT	Real-time monitoring function, port number (Inbound, outbound)	Numerical value 2	12000, 0	-	-	-	O	-	-
RCDUETH	Enabling/disabling of Ethernet communication between robot CPU module and robot controller	Integer 1	0	-	-	-	-	-	-
RCDUIP	IP address of robot controller (Special setting when the CR800-R, CR800-Q, CR860-R, or CR860-Q controller is used)	Character string 1	192.168.0.20	-	-	-	-	-	-

2.2.2. Details of parameters

The parameters are herein described in details.

(1) NETIP (IP address of robot controller)

The IP address of the robot controller is set. IP address is like the address of the mail.

The format of IP address is composed of 4 numbers of 0 to 255 and the dot (.) between the numbers.

For example, it is set as 192.168.0.1 or 10.97.11.31.

If the controller and network personal computer are directly connected to each other one-to-one, it is allowed to set default value (a random value) but if it is connected to the local area network (LAN), IP address must be set as instructed by the manager of customer's LAN system.

If any IP addresses are overlapped, the function will not properly operate. Therefore, take care to prevent it from being overlapped with another during setting.

The personal computer used for communication with the robot controller.

(2) NETMSK (sub-net-mask)

Set the sub-net-mask of the robot controller. Among the IP addresses, the sub-net-mask is set to define the sub-net-work.

The format of the sub-net-mask is composed of 4 numbers of 0 to 255 and the dot (.) between the numbers.

For example, it is set as 255.255.255.0 or 255.255.0.0.

As usual, it is allowed to set default value. If it is connected to the local area network (LAN), the sub-net-mask must be set as instructed by the manager of customer's LAN system.

⚠CAUTION

If the robot controller subnet mask is not correct, the high-performance teaching pendants (R56TB/R57TB) will not communicate via Ethernet. Set the subnet mask so that the robot controller IP address and the high-performance teaching pendant IP address are not on the same network.

・Robot controller Ethernet IP address: 192.168.0.20 (initial value)
・Robot controller subnet mask: 255.255.255.0 (initial value)
・High-performance teaching pendant communication IP address: 192.168.100.1 (initial value)
・High-performance teaching pendant IP address: 192.168.100.50 (initial value)

Good example: 192.168.0.20 and 192.168.100.1 (on different networks).
・Subnet mask: 255.255.192.0 (network range is 192.168.0 to 192.168.63.255)

Bad example: 192.168.0.20 and 192.168.100.1 (on the same network).
・Subnet mask: 255.255.0.0 (network range is 192.168.0 to 192.168.255.255)
・Subnet mask: 255.255.128.0 (network range is 192.168.0 to 192.168.127.255)

(3) NETPORT (port No.)

The port No. of the robot controller is set. The port No. is like the name of the mail.

For the nine elements, the port numbers are each expressed with a value.

The first element (element No. 1) is used for real-time control.

The second to ninth elements (elements No. 2 to 9) are used for the support software or data link.

Normally, the default value does not need to be changed. Make sure that the port numbers are not duplicated.

(4) CRRCE11 to 19 (protocol)

When using the data link function, the setup is necessary.

Sets the protocol (procedure) for communication. The protocol has three kinds of no-procedure, procedure and data link.

0... No-procedure: The protocol is applied to use the personal computer Support Software .

1... Procedure: Reserved. (Since it is not any function, don't set it by mistake.)

2... Data link: The protocol is used to use OPEN/INPUT/PRINT commands for communication.

(5) COMDEV (Definition of devices corresponding to COM1: to 8)

When using the data link function, the setup is necessary.

Definition of device corresponding to COM1: to 8 is set. COM1: to 8 is used for OPEN command of the robot program.

Be sure to set it only when the data link is specified on setting of the protocol (CPRCE11 to 19).

The setting values of the Ethernet function correspond to the port Nos. which are set at the parameter NETPORT.

* In the following parameters NETOPORT (n) and COMDEV(n), n indicates the element No. of that parameter.

n	The device name set up by COMDEV(n)	Port number
1	OPT11	The port number specified by NETPORT(2)
2	OPT12	The port number specified by NETPORT(3)
3	OPT13	The port number specified by NETPORT(4)
4	OPT14	The port number specified by NETPORT(5)
5	OPT15	The port number specified by NETPORT(6)
6	OPT16	The port number specified by NETPORT(7)
7	OPT17	The port number specified by NETPORT(8)
8	OPT18	The port number specified by NETPORT(9)
9	OPT19	The port number specified by NETPORT(10)

For example, if the port No. specified at NETPORT(3) is allocated to the data link of COM:3, the following will be applied.

COMDEV(3) = OPT13 * OPT13 is set at 3rd element of COMDEV.

CPRCE13 = 2 * Set up as a data link.

(6) NETMODE (server specification)

Set up, when using the data link function.

Set the TCP/IP communication in the data link function of the robot controller as the server or the client.

It is necessary to change with the application of the equipment connected to the robot controller.

(7) NETHSTIP (The IP address of the server of the data communication point)

Set up, when using the robot controller as a client by the data link function.

Specify the IP address of the partner server which the robot controller connects by the data link function.

Set up, when only set the robot controller to the client by server specification of NETMODE.

(8) MXTTOUT (Timeout setting for executing real-time external control command)

This is changed when using real-time external control command and setting the timeout time for communication with the robot controller.

Set a multiple of the control cycle (refer to the following).

Controller	Control cycle
CR750/CR751 series	Approx. 7.11 msec
CR800 series	Approx. 3.5 msec (*If user mechanical is set, approx. 7.11 msec)

When the real-time external control command is executed, the timeout time during which no communication data is received by the robot controller from the personal computer is counted up. If the count reaches the value set in MXTTOUT, the operation will stop with the error (#7820). For example, to generate an error when there is no communication for approx. 7 seconds, set 1000 for the CR750/CR751 series, and 2000 for the CR800 series (1000 when user mechanical is set).

This setting is set to -1 (timeout disabled) as the default.

(9) NETGW (Gateway address)

Specify the gateway address to communicate with the PC of on other network.

(10) MONPORT (Real-time monitoring function, port number)
Specify the inbound port number and the outbound port number of the real-time monitoring function. (0 to65535)
First element: Inbound port number
Second element: Outbound port number
Take note that 0 is a special value for the second element, which replies to the sender port number that is set in the UDP header information of the packet data start that the robot controller has received.
When the Ethernet communication device is a Windows application, if the outbound port number is not designated on the application side, it remains the initial value of 0.
To explicitly specify the port number to reply to, the value must be set on the Ethernet communication device. (Example: 12000, 12001)

(11) MONMODE (Real-time monitoring function, enable/disable)
Switch to enable or disable real-time monitoring.
0: Disable
1: Enable

(12) RCDUETH (Ethernet communication between robot CPU module and robot controller, enable/disable)
Switch to enable or disable the Ethernet communication function between robot CPU module and robot controller when the CR800-R, CR800-Q, CR860-R, or CR860-Q controller is used.
0: Disable
1: Enable

(13) RCDUIP
This is the IP address of the robot controller when the CR800-R, CR800-Q, CR860-R, or CR860-Q controller is used. It is enabled only when RCDUETH = 1.
Set an IP address that differs from NETIP (IP address of the robot CPU module).

⚠CAUTION If you change a port number from its initial value, be sure that it does not overlap with any other port numbers. If there is any overlap, an error will occur when the controller starts, and it will not work properly.

⚠CAUTION Use RCDUETH and RCDUIP only when using a special function (for example, iQ Care MELFA Support). If you do not use the related functions, setting is not required.

2.2.3. Parameter setting example 1 (When the Support Software is used)

The setting example to use the Support Software is shown below.

Set the parameters for the robot controller, and the network for the personal computer OS being used.

Conditions for example 1

IP address of robot controller	192.168.0.20
IP address of personal computer	192.168.0.10
Port No. of robot controller	10001

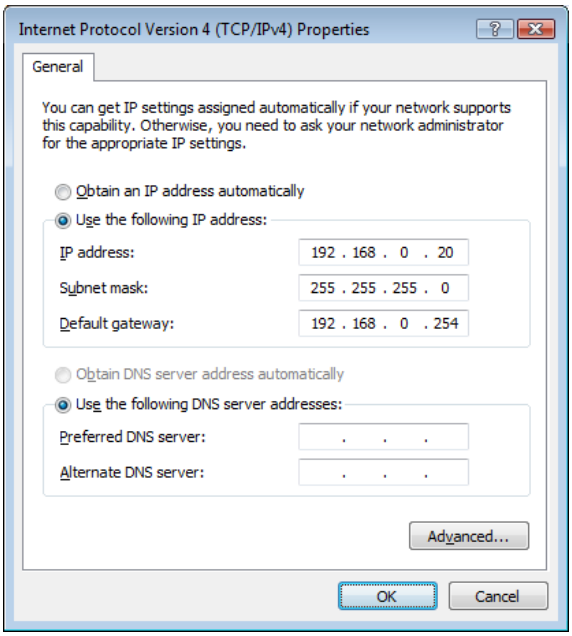
Set the robot controller parameters as shown below.

If the default settings are to be used, the parameters do not need to be changed.

Parameter setting for example 1

Parameter	Before/after change	Parameter value
NETIP	Before	192.168.0.20
	After	192.168.0.20 (unchanged)
NETPORT	Before	10001
	After	10001 (unchanged)

Next, set the personal computer IP address to 192.168.0.10. Set this value on the Network Properties screen.



The personal computer IP address is set with the Windows TCP/IP Property Network setting (property in network computer). Because the set-up screen differs with versions of Windows, refer to the manuals enclosed with Windows, etc., for details on setting this address.

Refer to the instruction manuals enclosed with the personal computer support software for details on setting and using the personal computer support software.

2.2.4. Parameter setting example 2-1

(When the data link function is used: When the controller is the server)

Shows the example of the setting, when the controller is server by the data link function.

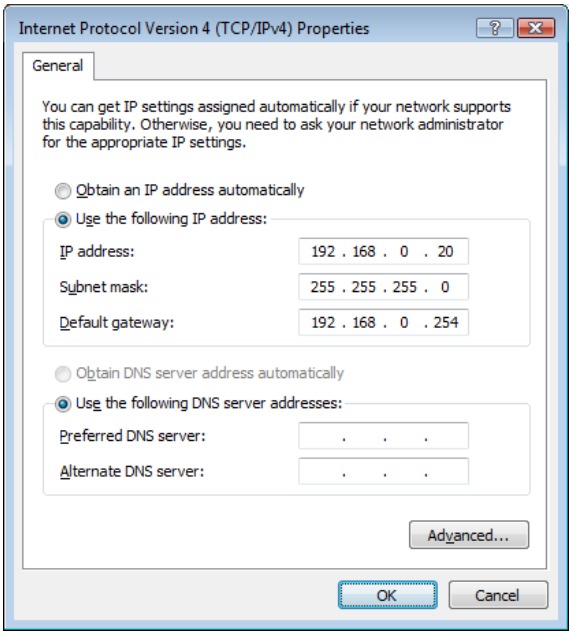
Conditions for example 2-1

Robot controller IP address	192.168.0.20
Personal computer IP address	192.168.0.10
Robot controller port No.	10003
Communication line No. <For MELFA-BASIC V/VI> OPEN command COM No.	 COM3:

Parameter setting for example 2-1

Parameter	Before/after change	Parameter value
NETIP	Before	192.168.0.20
	after	192.168.0.20 (unchanged)
NETPORT	Before	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009
	after	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009 (unchanged)
CPRCE13	Before	0
	after	2
COMDEV	Before	, , , , , , ,
	after	, , OPT13, , , , ,

Next, set the personal computer IP address to 192.168.0.10. Set this value on the Network Properties screen.



The personal computer IP address is set with the Windows TCP/IP Property Network setting (property in network computer). Because the set-up screen differs with versions of Windows, refer to the manuals enclosed with Windows, etc., for details on setting this address.

Refer to the instruction manuals enclosed with the personal computer support software for details on setting and using the personal computer support software.

2.2.5. Parameter setting example 2-2

(When the data link function is used: When the controller is the client)

Shows the example of the setting, when the controller is client by the data link function.

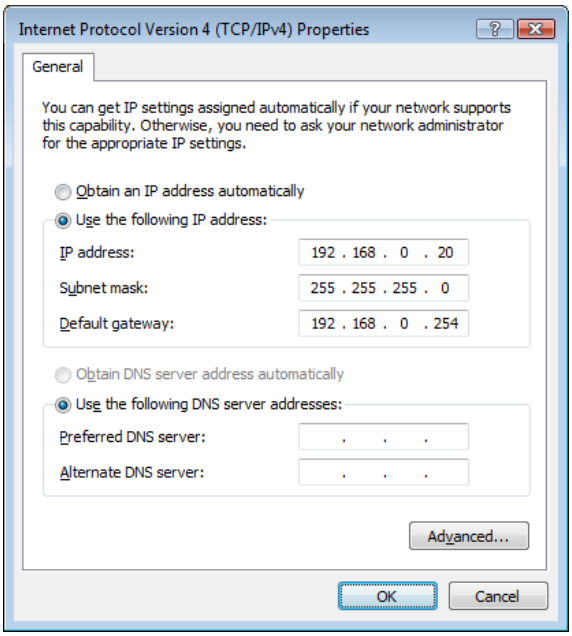
Conditions for example 2-2

Robot controller IP address	192.168.0.20
Personal computer IP address	192.168.0.10
Robot controller port No.	10003
Communication line No. <For MELFA-BASIC V/VI> OPEN command COM No.	 COM3:

Parameter setting for example 2-2

Parameter	Before/after change	Parameter value
NETIP	Before	192.168.0.20
	After	192.168.0.20 (unchanged)
NETPORT	Before	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009
	After	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009 (unchanged)
CPRCE13	Before	0
	After	2
COMDEV	Before	, , , , , , ,
	After	, , OPT13, , , , ,
NETMODE	Before	1,1,1,1,1,1,1,1,1,1
	After	1,1,0,1,1,1,1,1,1,1
NETHSTIP	Before	192.168.0.2, 192.168.0.3, 192.168.0.4, 192.168.0.5, 192.168.0.6, 192.168.0.7, 192.168.0.8, 192.168.0.9, 192.168.0.10
	After	192.168.0.2, 192.168.0.3, 192.168.0.2, 192.168.0.5, 192.168.0.6, 192.168.0.7, 192.168.0.8, 192.168.0.9, 192.168.0.10

Next, set the personal computer IP address to 192.168.0.10. Set this value on the Network Properties screen.



The personal computer IP address is set with the Windows TCP/IP Property Network setting (property in network computer). Because the set-up screen differs with versions of Windows, refer to the manuals enclosed with Windows, etc., for details on setting this address.

Refer to the instruction manuals enclosed with the personal computer support software for details on setting and using the personal computer support software.

2.2.6. Parameter setting example 3 (for using the real-time external control function)

An example of the settings for using the real-time external control function is shown below.

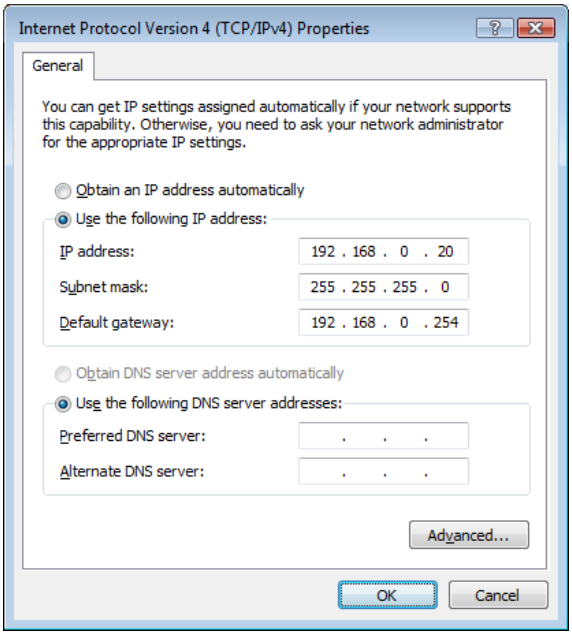
Conditions for example 3

Robot controller IP address	192.168.0.20
Personal computer IP address	192.168.0.10
Robot controller port No.	10000

Parameter setting for example 3

Parameter	Before/after change	Parameter value
NETIP	Before	192.168.0.20
	after	192.168.0.20 (unchanged)
NETPORT	Before	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009
	after	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009 (unchanged)
MXTTOUT	Before	-1
	after	-1 (unchanged)

Next, set the personal computer IP address to 192.168.0.10. Set this value on the Network Properties screen.



The personal computer IP address is set with the Windows TCP/IP Property Network setting (property in network computer). Refer to the manuals enclosed with Windows, etc., for details on setting this address.

Refer to the instruction manuals enclosed with the personal computer support software for details on setting and using the personal computer support software.

2.3. Connection confirmation

Before use, confirm the following items again.

Connection confirmation

No.	Confirmation item	Check
1	Is the teaching pendant securely fixed?	
2	Is the Ethernet cable properly connected between the controller and personal computer? (Refer to 2.1 in this manual.)	
3	Is any proper Ethernet cable used? (This cross cable is used to connect the personal computer and controller one-on-one. When using a hub with LAN, use a straight cable.)	
4	Is the parameter of the controller properly set? (Refer to 2.2 in this manual.)	
5	Is the power supply of the controller turned off once after the parameter set?	

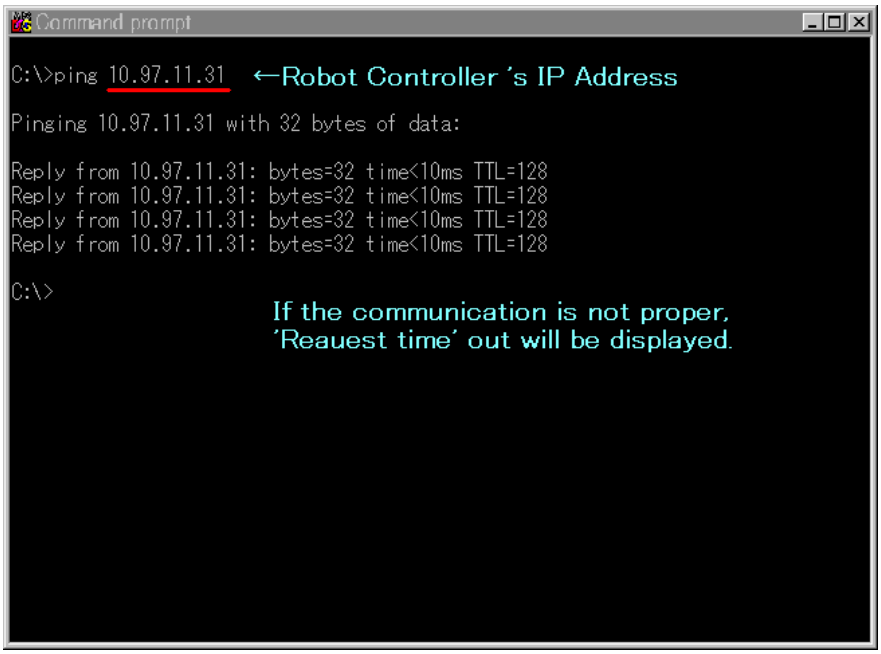
2.3.1. Checking the connection with the Windows ping command

The method for checking the connection with the Windows ping command is shown below.

Start up the " MS-DOS Prompt " from the Windows " Start " - " Programs " menu, and designate the robot controller IP address as shown below.

If the communication is normal, " Reply from ... " will appear as shown below.

If the communication is abnormal, " Request time out " will appear.



<<MEMO>>

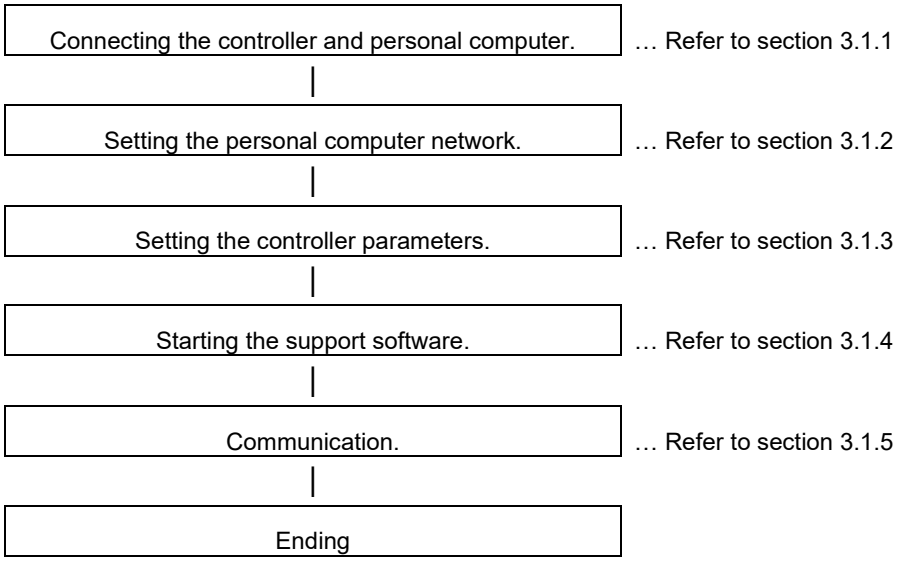
3. Description of functions

This chapter explains the methods for using the six Ethernet option functions with a system in which the controller and network personal computer are connected with a one-on-one cross cable.

(1) Using the controller communication function ... Refer to Chapter 3.1
(2) Using the data link function ... Refer to Chapter 3.2
(3) Using the real-time external control function ... Refer to Chapter 3.3
(4) Using the real-time monitoring function ... Refer to Chapter 3.4
(5) Using SLMP ... Refer to Chapter 3.5
(6) Using the CC-Link IE Field Network Basic function ... Refer to Chapter 3.6

3.1. Controller communication function

The operations for communicating with the personal computer support software are explained in this section.



3.1.1. Connecting the controller and personal computer

Connect the controller and the personal computer with the following Ethernet cable.

Controller	Ethernet cable
CR750/CR751 series	100BASE-TX compatible cable
CR800-R/CR800-Q series	100BASE-TX compatible cable
CR800-D series	1000BASE-TX compatible cable

Refer to the connection described in section "2.1 Ethernet cable".

3.1.2. Setting the personal computer network

Refer to section "2.2.3 Example of setting the parameters 1 (for using the support software)" and set the network.

3.1.3. Setting the controller parameters

Turn ON the robot controller power, and set the parameters as shown below.

If the default settings are to be used, the parameters do not need to be changed.

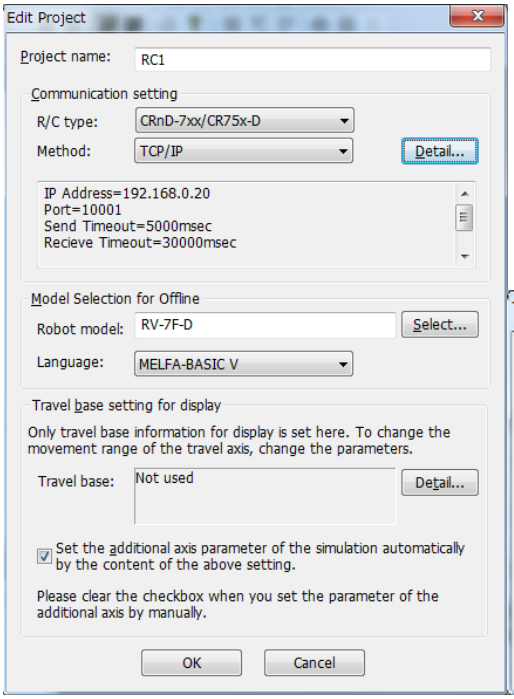
Name of parameter to change	Before/after changes	Parameter value
NETIP	Before	192.168.0.20
	After	192.168.0.20 (Default value)
NETPORT	Before	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009
	After	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009 (Default value)

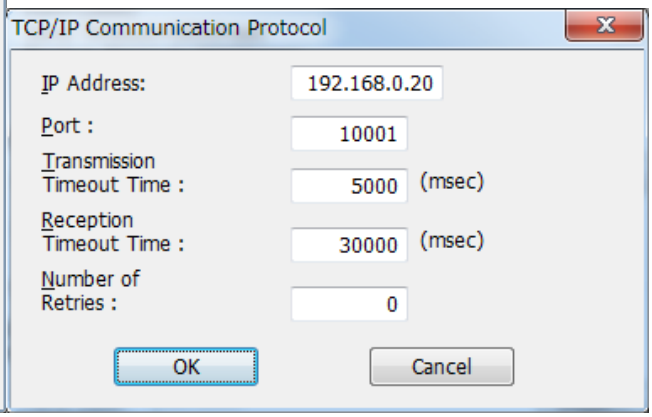
After setting the parameters, turn the robot controller power OFF and ON.

Refer to the instruction manual enclosed with the robot controller for details on setting the parameters.

3.1.4. Setting the personal computer support software communication

Start the personal computer support software and make the communication settings. Set the communication method to TCP/IP, and the IP Address to 192.168.0.20.

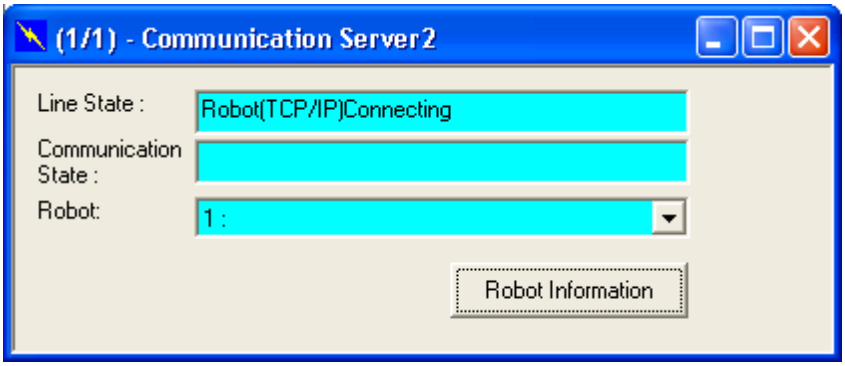




Refer to the instruction manual enclosed with the personal computer support software for details on setting the personal computer support software.

3.1.5. Communication

Communicate with the personal computer support software.
Communication can be carried out with the Ethernet TCP/IP.



Refer to the instruction manual enclosed with the personal computer support software for details on using the personal computer support software.

If communication is not possible, refer to section "2.3 Checking the connection" and check the state.

⚠CAUTION

When the robot controller power is turned OFF and ON, the connection will be disconnected and communication will be disabled.
In this case, end the application software on the personal computer once, and then restart.

3.2. Data link function

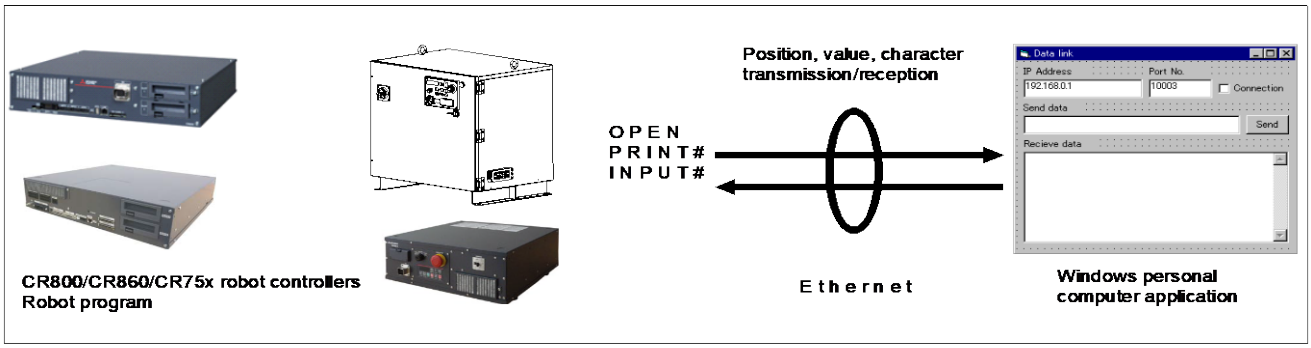
OPEN/PRINT/INPUT of the robot language can be used in the Ethernet.

For each robot language, refer to the instruction manual appended to the robot controller.

[Statement example] To set port No. 10003 as communication destination and open as #1

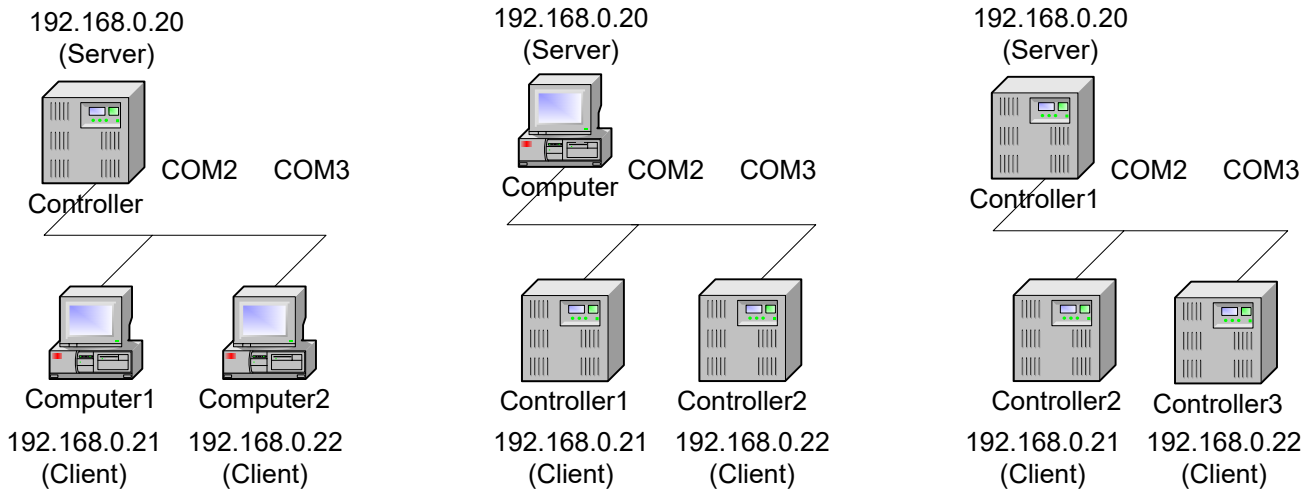
Set parameter COMDEV (element No. 3) to OPT13, NETPORT to 10003.

```
1 OPEN “COM3:” AS #1        ’Set port No.
2 INPUT #1, C1$             'Read
3 PRINT #1, ”Reply”, C1$    ‘Writing
4 CLOSE #1                  ‘Line closing
5 HLT                       ‘Stop
```



The data link function of the Ethernet has the two kinds shown below.

* Uses the robot controller as the server.
* Uses the robot controller as the client.



Two or more clients are not connectable with the one line number COMn.
Change the line number, when using the robot controller as the server and connecting two or more clients.

3.2.1. MELFA-BASIC V/VI Commands

This section describes the robot language (MELFA-BASIC V/VI).

For more information about OPEN, CLOSE, INPUT# and PRINT# used for data linking, refer to the INSTRUCTION MANUAL Detailed explanations of functions and operations.

M_OPEN

[Function]
Indicates whether or not the file has been opened.

[Format]

<Numeric variable> = M_OPEN [(<file number>)]

[Terminology]

<Numeric variable>	Specify a numeric variable to be assigned.
<File number>	Specify a file number constant between 1 and 8 for the communication line that was opened by the OPEN instruction. If omitted, 1 is set. If 9 or higher is specified, an error occurs when executed.

[Reference Program]

```
1 ' Client Program ----------
2 M1=0
3 M_TIMER(1)=0                                  'Resets the timer to 0.
4 *LOPEN:OPEN "COM2:" AS #1                     'Opens the line.
5 IF M_TIMER(1)>10000.0 THEN *LERROR            'Jumps when 10 seconds elapses.
6 IF M_OPEN(1)<>1 THEN GOTO *LOPEN              'Loops if no connection is made.
7 DEF ACT 1,M_OPEN(1)=0 GOSUB *LHLT2            'Monitors the down state of the server using an interrupt.
8 ACT 1=1                                       'Starts monitoring.
9 *LOOP:M1=M1+1
10 IF M1<10 THEN C1$="MELFA" ELSE C1$="END"     'Sends END after sending the "MELFA" string nine times.
11 PRINT #1,C1$                                 'Sends a character string.
12 INPUT #1,C2$                                 'Receives a character string.
13 IF C1$="END" THEN *LHLT                      'Jumps to CLOSE after sending "END."
14 GOTO *LOOP                                   'Loops.
15 *LHLT:CLOSE #1                               'Closes the line.
16 HLT                                          'Halts the program.
17 END                                          'Ends.
18 *LERROR:ERROR 9100                           'Generates error 9100 if no connection can be made to the
                                                 server.
19 CLOSE #1
20 HLT
21 END
22 ERROR 9101                                   'Generates error 9101 if the server is down during
                                                 processing.
23 *LHLT2:CLOSE #1
24 HLT
25 END
```

[Explanation]

(1) This command is used in a combination with the OPEN instruction. The following lists the meanings and values for the types of the files specified by the OPEN instruction.

Type of file to be opened	Meaning		Value
File	Indicates whether or not the file has been opened. 1 is always returned after executing the OPEN instruction.		1: Already opened. -1: The file number is undefined (not opened).
Communication line Ethernet	Indicates whether or not connection is made with the counterpart.	For server setting	1: Client is already connected. 0: Client is not connected. -1: The file number is undefined (not opened).
		For client setting	1: Already connected to the server. (Connection has been made.) 0: Not connected to the server. (Connection has not been made. Equivalent to when the server is down after being opened.) -1: The file number is undefined. (When the file has not been opened, or has been opened while the server is down.)

[Related Instruction]

OPEN

[Related Parameters]

COMDEV, CPRE**, NETMODE

C_COM

[Function]

Sets the parameters for the line to be opened by the OPEN instruction. This is used when the communication destination is changed frequently.

* Character string type
* Only for a client with the Ethernet option.

[Format]

C_COM (<communication line number>) = “ETH: <server side IP address> [, <port number>]”

[Terminology]

ETH:	An identifier to indicate that the target is an Ethernet
<Communication line number>	The number of the COM to be specified by the OPEN instruction (The line type is assigned by the COMDEV parameter.) Specify 1 through 8.
<Server side IP address>	Server side IP address (May be omitted.)
<Port number>	Port number on the server side (If omitted, the set value of the NETPORT parameter is used.)

[Reference Program]

Example when OPT12 is set in the second element of the COMDEV parameter

```
1 C_COM(2)="ETH:192.168.0.10,10010"   ' Set the IP address of the communication destination server
                                        corresponding to communication line COM2
2 *LOPEN1:OPEN "COM2:" AS #1          ' As 192.168.0.10 and the port number as 10010, and then open the line.
3 IF M_OPEN(1)<>1 THEN *LOPEN1        ‘ Loops if unable to connect to the server.
4 PRINT #1, "HELLO"                   ‘ Sends a character string.
5 INPUT #1, C1$                       ‘ Receives a character string.
6 CLOSE #1                            ‘ Closes the line.
7 C_COM(2)="ETH:192.168.0.11,10011"   ‘ Set the IP address of the communication destination server
                                        corresponding to communication line COM2
8 *LOPEN2:OPEN "COM2:" AS #1          ‘ As 192.168.0.11 and the port number as 10011, and then open the line.
9 IF M_OPEN(1)<>1 THEN *LOPEN2        ‘ Loops if unable to connect to the server.
10 PRINT #1, C1$                      ‘ Sends a character string.
11 INPUT #1, C2$                      ‘ Receives a character string.
12 CLOSE #1                           ‘ Closes the line.
13 HLT                                ‘ Halts the program.
14 END                                ‘ Ends.
```

[Description]

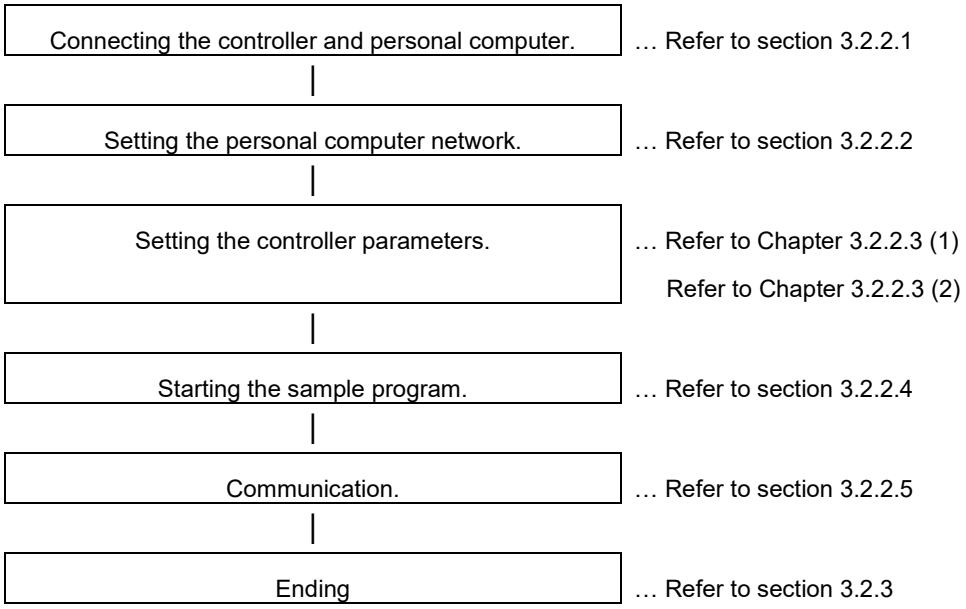
(1) It is not necessary to use this command when the communication counterpart of the robot controller is specified with the NETHSTIP and NETPORT parameters and the specified communication counterpart will not be changed at all.
(2) Currently, this function is valid only for a client of a data link with the Ethernet.
(3) Because the communication parameters of the OPEN instruction are set, it is necessary to execute this command before the OPEN instruction.
(4) When the power is turned on, the set values specified by the NETHSTIP and NETPORT parameters are used. When this command is executed, the values specified by the parameters of this command are changed temporarily. They are valid until the power is turned off. When the power is turned on again, the values revert to the original values set by the parameters.
(5) If this command is executed after the OPEN instruction, the current open status will not change. In such a case, it is necessary to close the line with the CLOSE instruction once, and then execute the OPEN instruction again.
(6) If an incorrect syntax is used, an error occurs when the program is executed, not when the program is edited.

[Related Parameters]

NETHSTIP, NETPORT

3.2.2. Using data link function

This section explains the operations for starting the sample program given in "4.2.1 Sample program for data link function" and communicating with a system in which the controller and network personal computer are connected with a one-on-one cross cable.



3.2.2.1. Connect the controller and personal computer.

Connect the controller and personal computer with a cross cable.
Refer to the connection described in section "2.1 Ethernet cable".

3.2.2.2. Setting the personal computer network.

Set one of the following clauses as reference corresponding to the customer's system configuration. (The controller is the server or the client)

- 2.2.4 Parameter setting example 2-1 (When the data link function is used: When the controller is the server.)
- 2.2.5 Parameter setting example 2-2 (When the data link function is used: When the controller is the client.)

3.2.2.3. Setting the controller parameters.

The contents of the setting of parameter differ, when the robot controller is specified as server and client of TCP/IP connection.

Turn ON the robot controller power, and set the parameters as shown below.

The NETIP/NETPORT parameters do not need to be changed when using the default values.

After setting the parameters, turn the robot controller power OFF and ON.

Refer to the instruction manual enclosed with the robot controller for details on setting the parameters.

(1) When the controller is specified as the server

Parameter	Before/after change	Parameter value
NETIP	Before	192.168.0.20
	After	192.168.0.20 (unchanged)
NETPORT	Before	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009
	After	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009 (unchanged)
CPRCE13	Before	0
	After	2
COMDEV	Before	, , , , , , ,
	After	, , OPT13, , , , ,

(2) When the controller is specified as the client

Parameter	Before/after change	Parameter value
NETIP	Before	192.168.0.20
	After	192.168.0.20 (unchanged)
NETPORT	Before	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009
	After	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009 (unchanged)
CPRCE13	Before	0
	After	2
COMDEV	Before	, , , , , , ,
	After	, , OPT13, , , , ,
NETMODE	Before	1,1,1,1,1,1,1,1,1,1
	After	1,1,0,1,1,1,1,1,1,1
NETHSTIP	Before	192.168.0.2, 192.168.0.3, 192.168.0.4, 192.168.0.5, 192.168.0.6, 192.168.0.7, 192.168.0.8, 192.168.0.9, 192.168.0.10
	After	192.168.0.2, 192.168.0.3, 192.168.0.2, 192.168.0.5, 192.168.0.6, 192.168.0.7, 192.168.0.8, 192.168.0.9, 192.168.0.10

3.2.2.4. Starting the sample program

The test program is an example for establishing a data link between the robot and personal computer. COM3 is used.

(1) Using the teaching pendant or personal computer support software, register the following robot program with an appropriate program name.

<Robot program>

1) Example for MELFA-BASIC V

```
1 OPEN "COM3:" AS #1                ' Open as communication line COM3
2 PRINT #1,"START"                  ' Send START character string
3 *LOOP:INPUT #1,DATA               ' Wait for reception of value in DATA variable
4 IF DATA<0 THEN GOTO *LEND         ' If DATA is negative, jump to line 7 and end
5 PRINT #1,"DATA=";DATA             ' Reply DATA = value
6 GOTO *LOOP                        ' Jump to line 3 and repeat
7 *LEND:PRINT #1,"END"              ' Send END character string
8 END                               ' End
```

(2) Start the personal computer data link program

Refer to section "4.2.1 Sample program for data link function" and create the execution file. (The created execution file will be sample.exe.)

Start Windows Explorer, and double-click on sample.exe.

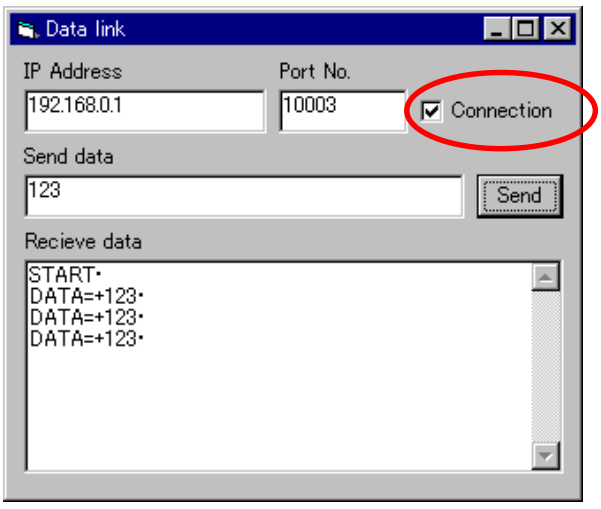
Set the IP address and port No., click on the connection check box, and open the communication line with the controller.

If the Send button is not validated, check that the IP address matches NETIP set with the controller.

If the button is still not validated, refer to section "2.3 Checking the connection", and check the connection cable or restart the controller and sample.exe.

(3) Start the robot program.

Press the START button on the robot controller's operating panel, and start the robot program.



3.2.2.5. Communication

(1) When the robot controller program is started, first the following data will be sent to the personal computer.

"START"(CR) (CR) indicates the CR code.

(2) When the personal computer receives the data, the characters will appear in the received data area.

START•

(3) Send value data from the personal computer.

For example, input the value data 123 in the transmission data area, and click on the Send button with the mouse.

(4) When the robot controller receives the value data in the DATA variable, it will reply data to the personal computer.

DATA=123 will appear in the personal computer's received data area.

If communication cannot be carried out correctly, refer to section "2.3 Checking the connection" in this manual.

⚠CAUTION

When the robot controller power is turned OFF and ON, the connection will be disconnected and communication will be disabled.
In this case, end the application software on the personal computer once, and then restart.

3.2.3. Ending

(1) Press the END button on the robot controller operating panel, and enter cycle operation.

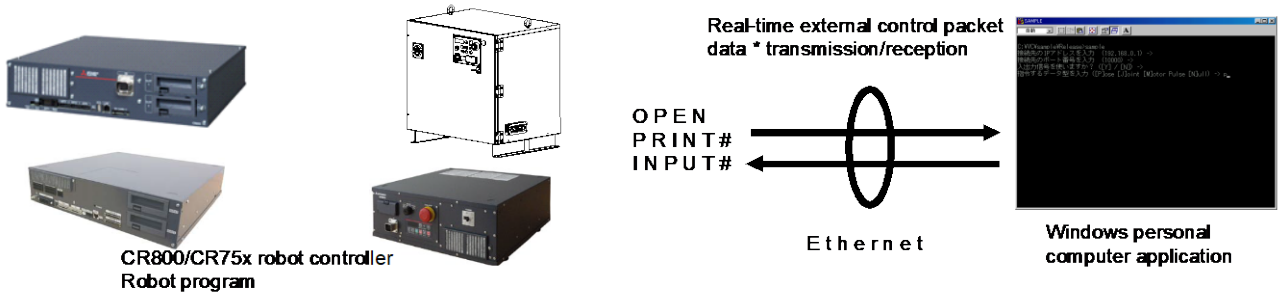
(2) Input the value -1 from the personal computer, and end the program.

(3) End the personal computer's sample program.

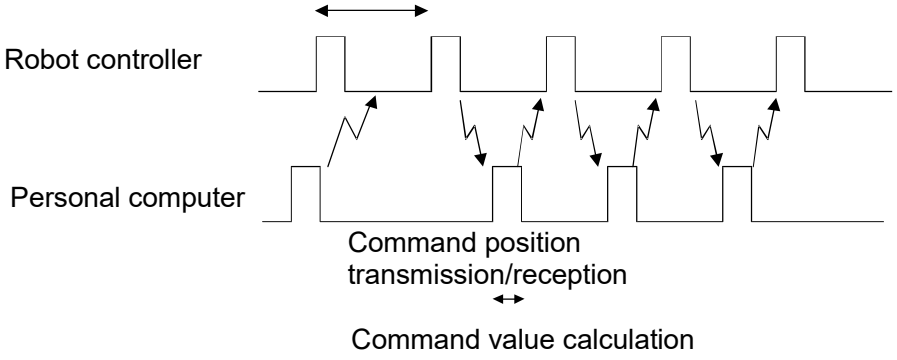
(4) Turn OFF the robot controller's power.

3.3. Real-time external control function

The robot motion movement control can retrieve the position command at real-time in cycle units, and move to the commanded position. It is also possible to monitor the input/output signals or output the signals simultaneously.
Using the robot language MXT command, real-time communication (command/monitor) is carried out with communication.



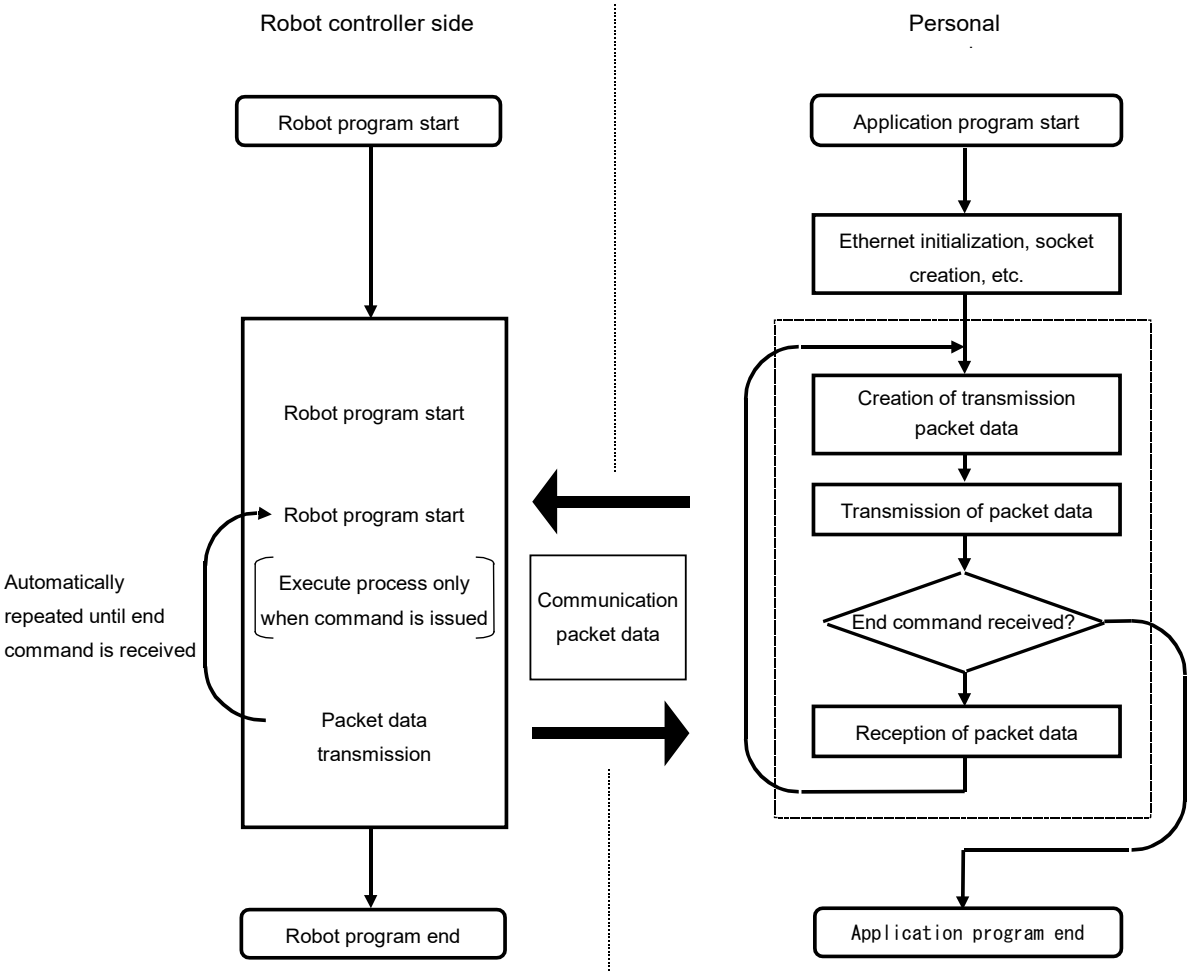
Motion movement control cycle (CR750/CR751 series: approx. 7.1 ms,
CR800 series: approx. 3.5 ms (If user mechanical is set, approx. 7.1 ms))



The following table lists the position command data for giving the target move position from the personal computer to the robot for each hour of the motion operation control cycle, and the monitor data types from the robot.
For more information about communication data, see Section 3.3.1, “Command Explanation” and Section 3.3.2, “Communication Data Packet Explanation” in this document.

Position command data type	Monitor data type
[1] Rectangular coordinate data [2] Joint coordinate data [3] Motor pulse coordinate data	[1] Rectangular coordinate data [2] Joint coordinate data [3] Motor pulse coordinate data [4] Rectangular coordinate data (command value after filter processing) [5] Joint coordinate data (command value after filter processing) [6] Motor pulse coordinate data (after filter processing) [7] Rectangular coordinate data (encoder feedback value) [8] Joint coordinate data (encoder feedback value) [9] Motor pulse coordinate data (encoder feedback value) [10] Current command (%) [11] Current feedback (%)

* Flow of real-time external control



3.3.1. Explanation of command

Either the MELFA-BASIC V command languages can be used with the real-time external control function.
Note that the meanings of the arguments differ for the MELFA-BASIC V commands. (Refer to following format and terminology.)
Refer to section "3.3.2 Explanation of communication data packet" for details on the structure of the communication data packet used with this function.

MXT (Move External)

[Function]

The absolute position data is retrieved from an external source at each controller control time, and the robot is directly moved. The controller control time is approx. 7.11 msec with the CR750/CR751 series, and approx. 3.5 msec with the CR800 series (approx. 7.11 msec when user mechanical is set).

[Format]

MXT <File No.>, <Reply position data type> [, <Filter time constant>]

[Terminology]

<File No.>	Describe a number between 1 and 8 assigned with the OPEN command. If the communication destination is not designated with the OPEN command, an error will occur, and communication will not be possible. In addition, data received from a source other than the communication destination will be ignored.
<Replay position data type>	Designate the type of the position data to be received from the personal computer. A XYZ/joint/motor pulse can be designated. 0: XYZ coordinate data 1: Joint coordinate data 2: Motor pulse coordinate data
<Filter time constant>	Designate the filter time constant (msec). If 0 is designated, the filter will not be applied. (0 will be set when omitted.) A filter is applied on the reception position data, an obtuse command value is created and output to the servo.

[Reference Program]

```
1 OPEN "ENET:192.168.0.2" AS #1     'Ethernet communication destination IP address
2 MOV P1                            'Move to P1
3 MXT1,1,50                         'Move with real-time external control with filter time constant set to
                                     50msec
4 MOV P1                            'Move to P1
5 HLT                               'Halt program
```

[Explanation]

* When the MXT command is executed, the position command for movement control can be retrieved from the personal computer connected on the network. (One-on-one communication)
* One position command can be retrieved and operated at the operation control time. The operation control time is approx. 7.11 msec with the CR750/CR751 series, and approx. 3.5 msec with the CR800 series (approx. 7.11 msec when user mechanism is set).
* Operation of MXT command
  1) When this command is executed with the controller, the controller enters the command value reception enabled state.
  2) When the controller receives the command value from the personal computer, it will output the received command value to the servo within the next control process cycle.
  3) After the command value is sent to the servo, the controller information, such as the current position is sent from the controller to the personal computer.
  4) A reply is made from the controller to the personal computer only when the command value from the personal computer is sent to the controller.
  5) If the data is not received, the current position is maintained.
  6) When the real-time external command end command is received from the personal computer, the MXT command is ended.
  7) When the operation is stopped from the operating panel or external input, the MXT command will be halted, and the transmission/reception will also be halted until restart.
* The timeout is designated with the parameter MXTTOUT.
* One randomly designated (head bit, bit width) input/output signal can be transmitted and received simultaneously with the position data.
* A personal computer with sufficient processing speed must be used to command movement in the movement control time.

3.3.2. Explanation of communication data packet

The structure of the communication data packet used with the real-time external control function is explained in this section. The same communication data packet for real-time external control is used for commanding the position and for monitoring. The contents differ when transmitting (commanding) from the personal computer to the controller and when receiving (monitoring) from the controller to the personal computer.

Create an application referring to the communication data packet structure described in the following table and section "4.2.2. Sample program for real-time external control function". Note that the following table shows the data types in the C language.

(1) Communication data packet.

Name	Data type	Explanation
Command	unsigned short (2-byte)	Designate the validity of the real-time external command, and the end. 0 // Real-time external command invalid 1 // Real-time external command valid 255 // Real-time external command end
Transmission data type designation SendType	unsigned short (2-byte)	1) When transmitting (commanding) from the personal computer to the controller, designate the type of position data transmitted from the personal computer. There is no data at the first transmission. 0 // No data 1 // XYZ data 2 // Joint data 3 // Motor pulse data 2) When receiving (monitoring) from the controller to the personal computer, indicate the type of position data replied from the controller. 0 // No data 1 // XYZ data 2 // Joint data 3 // Motor pulse data 4 // XYZ data (Position after filter process) 5 // Joint data (Position after filter process) 6 // Motor pulse data (Position after filter process) **7 // XYZ data (Encoder feedback value)** **8 // Joint data (Encoder feedback value)** **9 // Motor pulse data (Encoder feedback value)** **10 // Current command [%]** **11 // Current feedback [%]** * It is the same as RecvType. You may use whichever.

Name	Data type	Explanation
Reply data type designation RecvType	unsigned short (2-byte)	1) When transmitting (commanding) from the personal computer to the controller, designate the type of data replied from the controller. 0 // No data 1 // XYZ data 2 // Joint data 3 // pulse data 4 // XYZ data (Position after filter process) 5 // Joint data (Position after filter process) 6 // Motor pulse data (Position after filter process) **7 // XYZ data (Encoder feedback value)** **8 // Joint data (Encoder feedback value)** **9 // Motor pulse data (Encoder feedback value)** **10 // Current command [%]** **11 // Current feedback [%]** 2) When receiving (monitoring) from the controller to the personal computer, indicate the type of position data replied from the controller. 0 // No data 1 // XYZ data 2 // Joint data 3 // Motor pulse data 4 // XYZ data (Position after filter process) 5 // Joint data (Position after filter process) 6 // Motor pulse data (Position after filter process) **7 // XYZ data (Encoder feedback value)** **8 // Joint data (Encoder feedback value)** **9 // Motor pulse data (Encoder feedback value)** **10 // Current command [%]** **11 // Current feedback [%]** * It is the same as RecvType. You may use whichever.
Reservation reserve	unsigned short (2byte)	Not used.
Position data Pos / jnt / pls	POSE, JOINT or PULSE (40-byte) * Refer to strdef.h in the sample program for details on each data structure.	1) When transmitting (commanding) from the personal computer to the controller, designate the command position data transmitted from the personal computer. Set this to the same data type as that designated for the transmission data type designation. 2) When receiving (monitoring) from the controller to the personal computer, this indicates the position data replied from the controller. The data type is shown in SendType (= RecvType) . The contents of data are common to command/monitor. POSE // XYZ type [mm/rad] JOINT // Joint type [rad] PULSE // Motor pulse type [the pulse] or Current type [%].

Name	Data type	Explanation
Transmission input/output signal data designation SendIOType	unsigned short (2-byte)	1) When transmitting (commanding) from the personal computer to the controller, designate the data type of the input/output signal transmitted from the personal computer. Designate "No data" when not using this function. 2) When receiving (monitoring) from the controller to the personal computer, this indicates the data type of the input/output signal replied from the controller. The contents of the data are common. 0 // No data 1 // Output signal 2 // Input signal
Reply input/output signal data designation RecvIOType	unsigned short (2-byte)	1) When transmitting (commanding) from the personal computer to the controller, designate the data type of the input/output signal replied from the controller. Designate "No data" when not using this function. 0 // No data 1 // Output signal 2 // Input signal 2) When receiving (monitoring) from the controller to the personal computer, Not used.

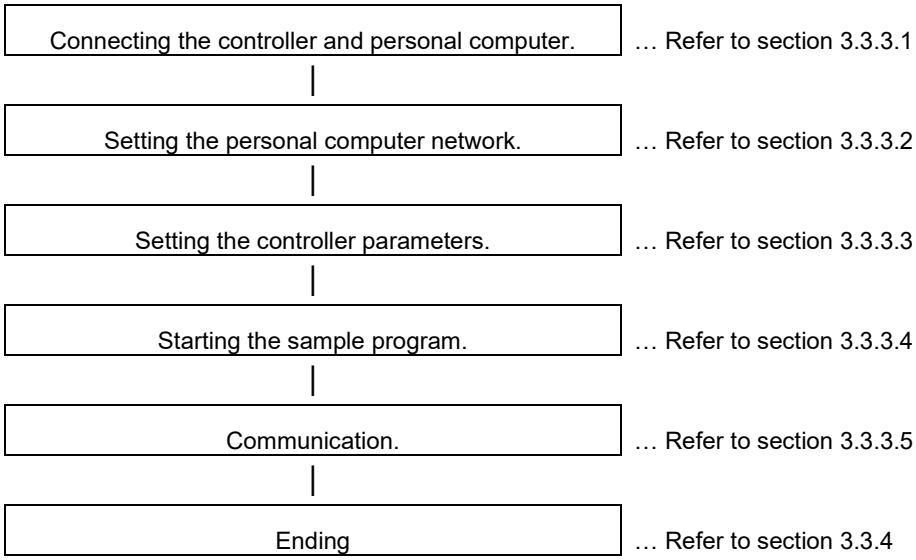
Input/output signal data
BitTop
BitMask
IoData
	unsigned short
	unsigned short
	unsigned short
	(2-byte x 3)
		1) When transmitting (commanding) from the personal computer to the controller, designate the output signal data transmitted from the personal computer.
		
		2) When receiving (monitoring) from the controller to the personal computer, this indicates the input/output signal data replied from the controller.
		
		The contents of the data are common.
		BitTop; // Head bit No. of input or output signal
		BitMask; // Bit mask pattern designation (valid only for commanding)
		IoData; // Input or output signal data value (for monitoring)
		Output signal data value (for commanding)
		* Data is 16-bit data

Timeout time counter value Tcount	unsigned short (2-byte)	1) When transmitting (commanding) from the personal computer to the controller, Not used. 2) When receiving (monitoring) from controller to personal computer, if the timeout time parameter MXTTOUT is a value other than -1, this indicates the No. of times communication with the controller was not possible. When the No. of times is counted and reaches the maximum value, the value will return to the minimum value 0, and the count will be repeated. This is set to 0 when the MXT command is started.
Counter value for communication data Ccount	unsigned long (4-byte)	1) When transmitting (commanding) from the personal computer to the controller. 2) When receiving (monitoring) from controller to personal computer, this indicates the No. of communication times.

Name	Data type	Explanation
Reply data-type specification addition 1 RecvType1	**unsigned short (2-byte)**	**It is the same as reply data-type specification (RecvType). Do not use it for instructions.**
Reservation 1 reserve1	**unsigned short (2-byte)**	**Not used.**
Data addition 1 pos / jnt / pls	**Any of POSE/JOINT/PULSE. (40-byte)**	**It is the same as data of pos/jnt/pls. Do not use it for instructions.**
Reply data-type specification addition 2 RecvType2	**unsigned short (2-byte)**	**It is the same as reply data-type specification (RecvType). Do not use it for instructions.**
Reservation 2 Reserve2	**unsigned short (2-byte)**	**Not used.**
Data addition 2 pos / jnt / pls	**Any of POSE/JOINT/PULSE. (40-byte)**	**It is the same as data of pos/jnt/pls. Do not use it for instructions.**
Reply data-type specification addition 3 RecvType3	**unsigned short (2-byte)**	**It is the same as reply data-type specification (RecvType). Do not use it for instructions.**
Reservation 3 Reserve3	**unsigned short (2-byte)**	**Not used.**
Data addition 3 pos / jnt / pls	**Any of POSE/JOINT/PULSE. (40-byte)**	**It is the same as data of pos/jnt/pls. Do not use it for instructions.**

3.3.3. Using real-time external control function

This section explains the operations for starting the sample program given in "4.2.2 Sample program for real-time external control function" and communicating with a system in which the controller and network personal computer are connected with a one-on-one cross cable.



3.3.3.1. Connecting the controller and personal computer

Connect the controller and personal computer with a cross cable.
Refer to the connection described in section "2.1 Ethernet cable".

3.3.3.2. Setting the personal computer network

Refer to section "2.2.6 Example of setting the parameters 3 (for using the real-time external control function)" and set the network.

3.3.3.3. Setting the controller parameters

Turn ON the robot controller power, and set the parameters as shown below.
If the default settings are to be used, the parameters do not need to be changed.

After setting the parameters, turn the robot controller power OFF and ON.
Refer to the instruction manual enclosed with the robot controller for details on setting the parameters.

Name of parameter to change	Before/after changes	Parameter value
NETIP	Before	192.168.0.20
	After	192.168.0.20 (Default value)
NETPORT	Before	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009
	After	10000,10001,10002,10003,10004,10005,10006,10007,10008,10009 (Default value)
MXTTOUT	Before	-1
	After	-1 (Default value)

3.3.3.4. Starting the sample program

The test program is an example of communicating in real-time between the robot and personal computer. The XYZ position data X axis or joint position data J1 axis is commanded from the personal computer to the robot and controlled.

(1) Using the teaching pendant or personal computer support software, register the following robot program with an appropriate program name.

<Robot program>

1) Example for MELFA-BASIC V

```
1 OPEN "ENET:192.168.0. 20" AS #1     ' Designate personal computer side IP address as Ethernet in file No. 1
2 MOV P1                              ' Move to default position P1 (teach random position as P1)
3 MXT1,0                              ' Move according to command value issued from file No. 1
                                        Current XYZ position is replied from controller to personal computer
4 MOV P1                              ' After external control mode ends, move to default position P1 with joint
                                        interpolation
5 HLT                                 ' Halt
6 END                                 ' End
```

(2) Start the robot program.

Press the START button on the robot controller's operating panel, and start the robot program.

The robot will move to the default position P1, and real-time external control will be executed with the MXT command.

(3) Start the personal computer's real-time external control sample program.

Refer to section "4.2.2 Sample program for real-time external control function" and create the execution file. (The created execution file will be sample.exe.)

Start Windows Explorer, and double-click on sample.exe.

3.3.3.5. Moving the robot

Specify and input the following values for the numerical value displayed on the screen according to the message of the sample program.

*The IP address (192.168.0.20) of the robot controller of the connection point

*The port number (10001)

*The data type of command

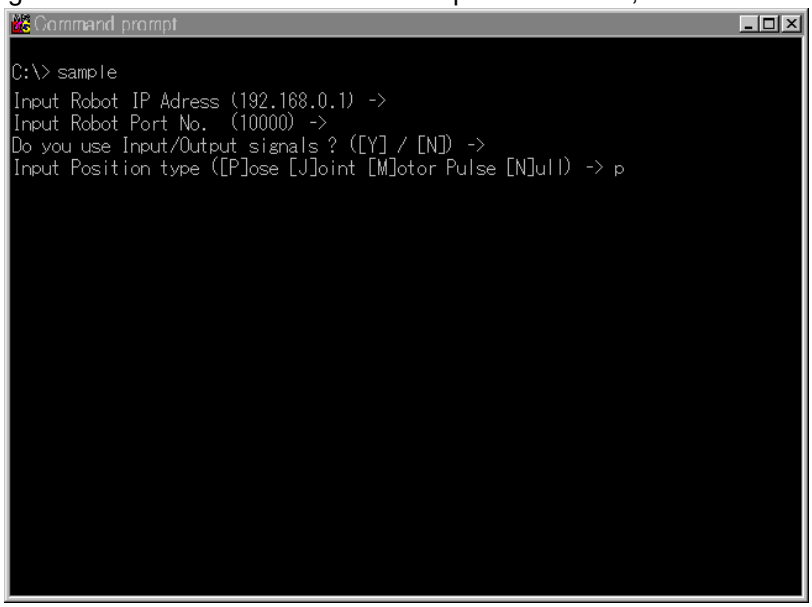
*The data type of monitoring, etc.

Fit the data type of command to the argument of the MXT command of the robot program

Key operation is as follows. For details, refer to the sample program.

Key	Contents
Z or X .	The robot moves.
C	The instruction value is set to 0 and the robot stops.
D	Each time the MOVE key is pressed, change the display / un-displaying of the monitor data
ENTER	End the MXT command.

If the amount of instructions becomes too large or the movement range of the robot is exceeded, an error is generated and the robot controller stops. In this case, reset the robot controller.



If communication cannot be carried out correctly, refer to section "2.3 Checking the connection", and check the connection cable or restart the controller and sample.exe.

⚠CAUTION

When the robot controller power is turned OFF and ON, the connection will be disconnected and communication will be disabled.
In this case, end the application software on the personal computer once, and then restart.

3.3.4. Ending

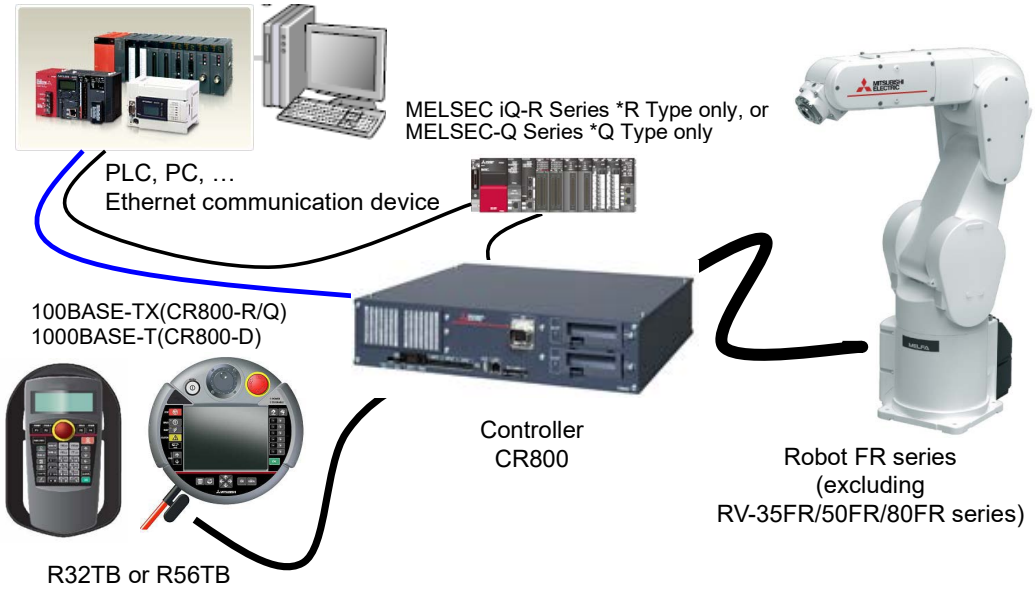
(1) Press the END button on the robot controller operating panel, and enter cycle operation.
(2) End the personal computer's sample program.
When the [ENTER] key is pressed, the MXT command will end, the robot will return to the default position, and the robot program will stop.
The sample program will also end.
(3) Turn OFF the robot controller's power.

3.4. Real-time monitor function

3.4.1. Overview

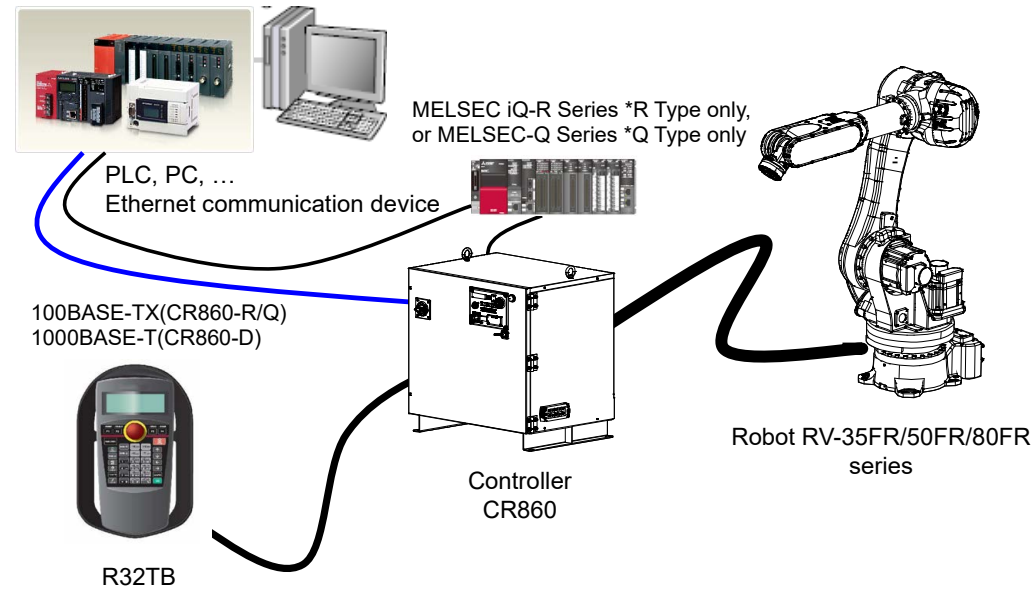
In using such communication equipment as PLC and personal computers, this function is used to monitor orthogonal and joint position data of the current position of the robot controller in real-time using Ethernet UDP communication.

3.4.1.1. CR800 controller



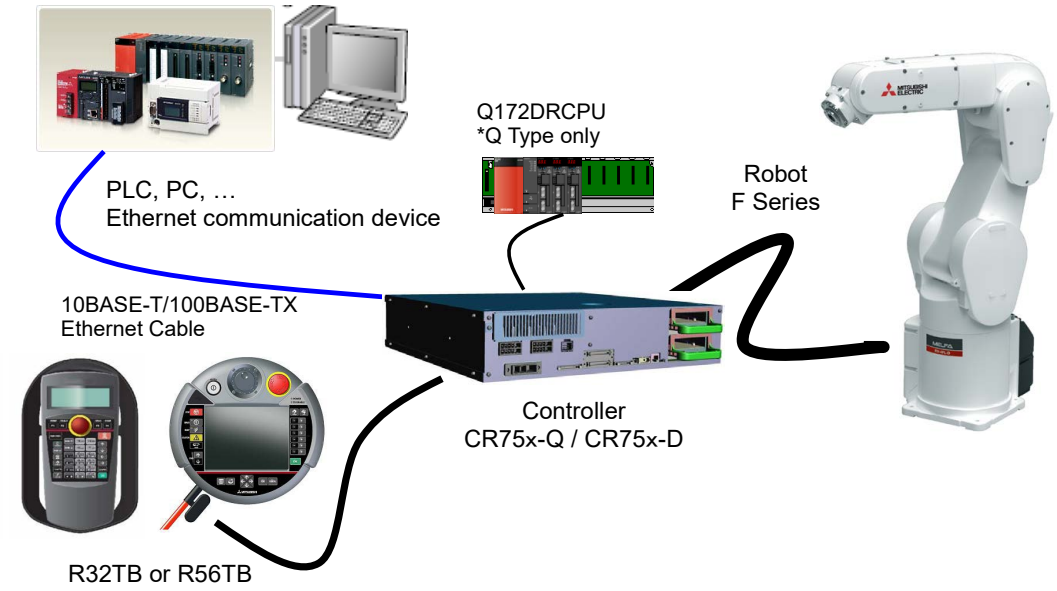
System configuration (Example)

3.4.1.2. CR860 controller



System configuration (Example)

3.4.1.3. CR75n series



System configuration (Example)

3.4.2. Supported version

Controller type	Version	Remarks
CR75x-Q	Ver.R3n	RT2 Oscillograph function corresponding Ver.R4b or later
CR75x-D	Ver.S3n	RT2 Oscillograph function corresponding Ver.R4b or later

The CR800 controller is supported by all the software versions.

3.4.3. Setup

It is a set-up procedure of example conditions.

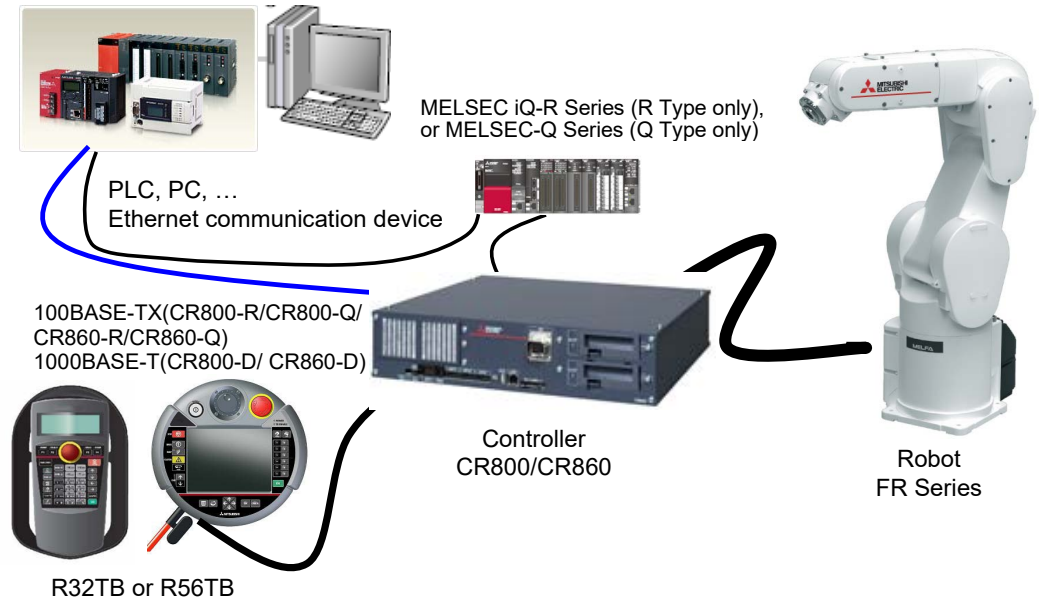
3.4.3.1. CR800 series

List conditional example

IP address of Robot controller	192.168.0.20
IP address of PC	192.168.0.2
Port number for Real-time monitor	12000, 12001 Receive port = 12000 , Send port = 12001

(1) Connecting the controller and personal computer

Connect the Ethernet cable to the connector of the controller. When the hub is used, use the straight cable. Or when the personal computer and controller are connected to each other one to one, use the cross cable.



(2) Setting the controller parameters

Set the parameters of the robot controller as shown in Table. For more information about parameters, see 3.4.7.

Parameter setting example

Parameter	Before/after change	Parameter value
NETIP	before	192.168.0.20 (D type Robot controller) 192.168.0.10 (R type Robot controller)
	after	Same as above (unchanged)
MONMODE	before	0
	after	1
MONPORT	before	12000, 0
	after	12000, 12001* Only when a change is required

(3) Setting the personal computer

To suit your network, please perform the communication settings. Please specify the UDP protocol of Ethernet communication.

Set the same inbound port number for the Ethernet communication device to receive data as the value of the second element of the MONPORT parameter set on the robot controller.

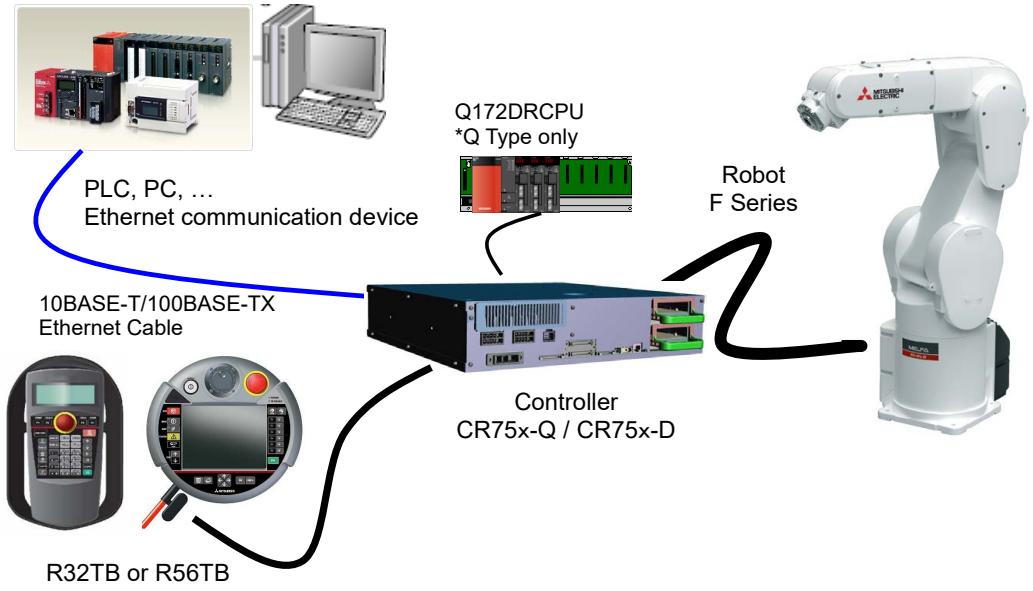
3.4.3.2. CR75n series

Example of conditions

IP address of Robot controller	192.168.0.20 (D type Robot controller)
IP address of PC	192.168.0.2
Port number for Real-time monitor	12000, 12001 Receive port = 12000 , Send port = 12001

(1) Connecting the controller and personal computer

Connect the Ethernet cable to the connector of the controller. When the hub is used, use the straight cable. Or when the personal computer and controller are connected to each other one to one, use the cross cable.



(2) Setting the controller parameters

Set the parameters of the robot controller as shown in Table. For more information about parameters, see 3.4.7.

Parameter setting example

Parameter	Before/after change	Parameter value
NETIP	before	192.168.0.20 (D type Robot controller) 192.168.100.1 (Q type Robot controller)
	after	Same as above (Default value)
MONMODE	before	0
	after	1
MONPORT	before	12000, 0
	after	12000, 12001* Only when a change is required

(3) Setting the personal computer

To suit your network, please perform the communication settings. Please specify the UDP protocol of Ethernet communication.

Set the same inbound port number for the Ethernet communication device to receive data as the value of the second element of the MONPORT parameter set on the robot controller.

3.4.4. Start of monitor / End of monitor

Explain start of monitor and end of the monitor.

(1) Start of monitor

Set the data type ID as a starting packet data, set data output start (1) on the command, you want to monitor the return data type 1-4 In addition, it sends to the robot controller.

If the start packet data is accepted normally, the robot controller continuously sends reply packet data (output data) to the Ethernet communication device by every control cycle of the robot controller (refer to the following).

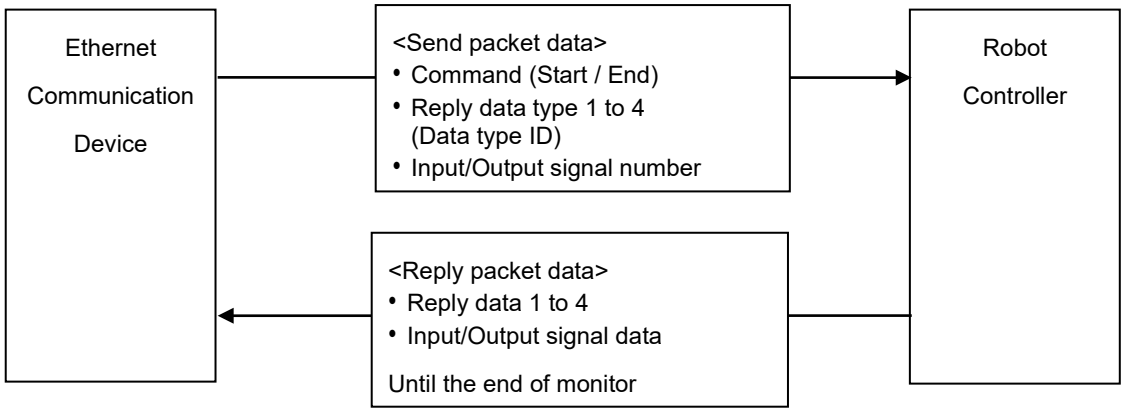
Controller	Control cycle (*1)
CR750/CR751 series	Approx. 7.11 msec
CR800 series	Approx. 3.5 msec (*If user mechanical is set, approx. 7.11 msec)

*1 Because it depends on the performance of the communication path and the communication device, the period is not guaranteed.

(2) End of monitor

It will be sent to the robot controller by setting the data output end (255) to the command end packet data. If accepted, the robot controller to exit the sending of the reply packet data.

If you want to change the type of output data on the monitor the way, it sends a start packet data.



About communication device

• Communication device is the only one. It is not possible to communicate with the other device of two or more.

• It is disconnected from the communication device in communication first, and then communicates with a corresponding later

⚠Caution

The data output from the robot, for that is sent (UDP) communication via Ethernet without the retransmission process, because there is the case that such noise environments, such as the transmission of data or a wrong data dropout occurs, the guarantee of data is not possible. Use the data output from the robot only for monitoring. When the data needs to be used for control, check the data for consistency on the receiving side by comparing the data with the previous value of the communication data counter or the monitoring counter of the robot information (refer to section 3.4.4). If the check shows the data is incorrect, take appropriate measures, such as stopping the equipment safely, before use.

3.4.5. Explanation of communication data packet

It describes the structure of the communication packet data to be used in real-time monitoring function. To the robot controller, I will use the same packet structure on both send and receive from Ethernet communication device. Storage method of data is little-endian. Real data in 32-bit real number is IEEE754 standard method. Data packet size is 196 bytes fixed.

Table 3-1 Data packet

Name	Data type	Explanation	Address
Command	unsigned short 2 byes	Specifies the start or end of the real-time monitoring function. 1 // Start of the real-time monitor 255 // End of the real-time monitor	0-1
Not used(reserve)	2 byes	Not used	2-3
Reply data type 1	unsigned short 2 byes	1) Communication device → Robot controller Specifies the <Data type ID> of the data that you want to monitor. 2) Robot controller → Communication device Echo back of send 1) *Data type ID see [3.4.6 Data type ID]	4-5
Not used(reserve)	2 byes	Not used	6-7
Reply data 1	Data structure POSE, JOINT, PULSE, ROBMON, FORCE or FLOAT8 40 bytes * Each data structure is described in Table Table 3-2, Table 3-3 Table 3-4, Table 3-5 Table 3-6, Table 3-7	1) E Communication device → Robot controller Not used. Set to zero. 2) Robot controller → Communication device The output data sent back from the controller. Data type is seeing in the return data type. *Data structure POSE // XYZ type [mm/rad] JOINT // Joint type [rad] PULSE // Motor pulse type [pulse] or Current type[%] FORCE // Force sensor type ROBMON // Robot movement information FLOAT8 // General purpose, float×8	8-47
Input signal number of the top * Ver.R4b/S4b or later	unsigned short 2 byes	1) Communication device → Robot controller Input signal number of the top (0 to 32767) 2) Robot controller → Communication device Echo back of send 1)	48-49
Output signal number of the top * Ver.R4b/S4b or later	unsigned short 2 byes	1) Communication device → Robot controller Output signal number of the top (0 to 32767) 2) Robot controller → Communication device Echo back of send 1)	50-51
Input signal data * Ver.R4b/S4b or later	unsigned long 4 byes	1) Communication device → Robot controller Not used. Set to zero. 2) Robot controller → Communication device Input signal data(0x00000000-0xffffffff)	52-53
Output signal data * Ver.R4b/S4b or later	unsigned long 4 byes	1) Communication device → Robot controller Not used. Set to zero. 2) Robot controller → Communication device Output signal data(0x00000000-0xffffffff)	56-57
Communication data counter	unsigned long 4 byes	1) Communication device → Robot controller Not used. Set to zero. 2) Robot controller → Communication device The number of communications. To return to the minimum value 0 and the maximum value by integrating.	60-63
Reply data type 2	unsigned short 2 byes	Same Reply data type 1	64-65
Not used(reserve)	2 byes	Not used	66-67
Reply data 2	POSE, JOINT, PULSE, ROBMON, FORCE or FLOAT8 40 bytes	Same Reply data 1	68-107
Reply data type 3	unsigned short 2 byes	Same Reply data type 1	108-109
Not used (reserve)	2 byes	Not used	110-111
Reply data 3	POSE, JOINT, PULSE, ROBMON, FORCE or FLOAT8 40 bytes	Same Reply data 1	112-151
Reply data type 4	unsigned short 2 byes	Same Reply data type 1	152-153
Not used (reserve)	2 byes	Not used	154-155
Reply data 4	POSE, JOINT, PULSE, ROBMON, FORCE or FLOAT8 40 bytes	Same Reply data 1	156-195

Table 3-2 POSE (XYZ) data structure

X element	4 bytes float	XYZ data [mm / rad], 40 bytes * Data type 1 and 7 is unit of radians. Data type 1001 and 1007 is unit of degrees.
Y element	4 bytes float	
Z element	4 bytes float	
A element	4 bytes float	
B element	4 bytes float	
C element	4 bytes float	
L1 element	4 bytes float	
L2 element	4 bytes float	
FL1(Structure flag 1)	4 bytes long	
FL2(Structure flag 2)	4 bytes long	

Table 3-3 JOINT data structure

J1 element	4 bytes float	Joint data [rad], 32 bytes * Data type 2 and 8 is unit of radians. Data type 1002 and 1008 is unit of degrees.
J2 element	4 bytes float	
J3 element	4 bytes float	
J4 element	4 bytes float	
J5 element	4 bytes float	
J6 element	4 bytes float	
J7 element	4 bytes float	
J8 element	4 bytes float	
Not used	8 bytes	Not used. Value is zero.

Table 3-4 PULSE (Pulse/%) data structure

M1 element	4 bytes long	Motor pulse data or current data [0.1% rate] , 32 bytes
M2 element	4 bytes long	
M3 element	4 bytes long	
M4 element	4 bytes long	
M5 element	4 bytes long	
M6 element	4 bytes long	
M7 element	4 bytes long	
M8 element	4 bytes long	
Not used	8 bytes	Not used. Value is zero.

Table 3-5 FORCE (N/Nm) data structure

F1 element	4 bytes float	Force sensor data[N, Nm] , 32 bytes
F2 element	4 bytes float	
F3 element	4 bytes float	
F4 element	4 bytes float	
F5 element	4 bytes float	
F6 element	4 bytes float	
Not used	16 bytes	Not used. Value is zero.

Table 3-6 ROBMON (Robot information) data structure

Tool point speed (feedback)	4 bytes float	Speed of a tool center point (feedback) [mm/s]
Remaining distance (feedback)	4 bytes float	The remaining distance to the target position (in mm) while the robot is moving (feedback).
Tool point speed (command)	4 bytes float	Speed of a tool center point (command) Same as status variable values “M_RSpd”
Remaining distance (command)	4 bytes float	The remaining distance to the target position (in mm) while the robot is moving (command). Same as status variable values “M_RDst”.
Gap of command and feedback	4 bytes float	The gap of a command position and a feedback position. Same as status variable values “M_Fbd”.
Transport factor (command)	2 bytes integer	Speed of a tool center point (feedback)
Acceleration state (command)	2 bytes integer	The current acceleration/deceleration status. (command) [0=Stopped,1=Accelerating, 2= Constant speed, 3= Decelerating] Same as status variable values “M_AclSts”.
Step number	2 bytes integer	Step number (Only slot 1), (1-32767)
Program name	6 bytes character	Program name (Only slot 1) Max Program name is 6 characters
Controller temperature	2 bytes integer	Controller temperature [0.1°C]
Not used	2 bytes	Not used.
Monitoring counter	4 bytes long	After power-on, +1 is counted from 0 in an operation control cycle unit (64/9 (*1)). The counting repeats in the range of 0 to 4294967295.

(*1) CR750/CR751 series: approx. 7.111 ms, CR800 series: approx. 3.5 ms (If user mechanical is set, approx. 7.1 ms)

Table 3-7 FLOAT8 (short real) data structure

float 1	4 bytes float	float (short real), 32 bytes
float 2	4 bytes float	
float 3	4 bytes float	
float 4	4 bytes float	
float 5	4 bytes float	
float 6	4 bytes float	
float 7	4 bytes float	
float 8	4 bytes float	
Not used	8 bytes	Not used. Value is zero.

3.4.6. Data type ID

The type of data that can be monitored in real-time monitor function.

Table 3-8 Data type ID

ID	Contents	Data structure	Ver.
0	no data	–	R3n/S3n or later
1	XYZ position (Command) *Angle in radians	POSE	
2	Joint position (Command) *Angle in radians	JOINT	
3	Motor pulse position (Command)	PULSE (Long×8)	
7	XYZ position (Feedback) *Angle in radians	POSE	
8	Joint position (Feedback) *Angle in radians	JOINT	
9	Motor pulse position (Feedback)	PULSE (Long×8)	
10	Current command [0.1% rate]	PULSE (Long×8)	
11	Current feedback [0.1% rate]	PULSE (Long×8)	
12	Robot information	ROBMON	
13	Position droop	PULSE (Long×8)	R4b/S4b or later
14	Speed (Command) [rpm]	PULSE (Long×8)	
15	Speed (Feedback) [rpm]	PULSE (Long×8)	
16	Axis load level [%]	FLOAT8(Float×8)	
17	Encoder temperature [°C]	PULSE (Long×8)	
18	Encoder misscount	PULSE	
19	Motor voltage [V]	PULSE (Long×8)	
20	Regeneration level [%]	PULSE (Long×8)	
21	Tolerable command + [0.1% rate]	PULSE (Long×8)	
22	Tolerable command - [0.1% rate]	PULSE (Long×8)	
23	RMS current [0.1% rate]	PULSE (Long×8)	
101	Force sensor current position xyz[N]abc[Nm]	FORCE (Float×8)	R3n/S3n or later
102	Force sensor original data (after offset cancel) xyz[N]abc[Nm]	FORCE (Float×8)	
103	Force sensor original data (before offset cancel) xyz[N]abc[Nm]	FORCE (Float×8)	
104	Position command of the force sensor correction	POSE	
111	COL presumed torque [0.1% rate]	PULSE (Long×8)	
112	COL threshold + [0.1% rate]	PULSE (Long×8)	
113	COL threshold - [0.1% rate]	PULSE (Long×8)	
1001	XYZ position (Command) *Angle in degrees	POSE	R4b/S4b or later
1002	Joint position (Command) *Angle in degrees	JOINT	
1007	XYZ position (Feedback) *Angle in degrees	POSE	
1008	Joint position (Feedback) *Angle in degrees	JOINT	
1010	Current command [Arms]	FLOAT8 (Float×8)	
1011	Current feedback [Arms]	FLOAT8 (Float×8)	
1012	Tolerable command + [Arms]	FLOAT8 (Float×8)	
1013	Tolerable command - [Arms]	FLOAT8 (Float×8)	
1014	RMS current [Arms]	FLOAT8 (Float×8)	

3.4.7. Parameters

Table 3-9 Parameter

Parameter	Parameter name	No. of arrays	Details explanation	Factory setting
Ethernet real-time monitor	MONMODE	Integer 1	Switch to enable or disable real-time monitoring function 0: Disable 1: Enable	1
	MONPORT	Integer 2	Specify the receive port number and the send port number of real-time monitor function. (0 to 65535) First element: Receive port number Second element: Send port number Second element: 0 is special value, reply to the sender port number that is set to UDP header information in the packet data start the robot controller has received	12000, 0

3.4.8. Error

Table 3-10 Error

Error number	Error cause and measures	
L.7810	Error message	NETPORT/MONPORT parameter error
	Cause	The element of NETPORT(1) and MONPORT(1/2) overlap.
	Measures	Please set not to overlap to another port number.
	Detail	UDP port number to be used for real-time monitoring function and real-time external control is duplicated. That you cannot use the same port number, please change to a different port number.

3.5. SLMP Connection

3.5.1. Function Overview

Please note that the functions listed here apply only to the CR800 series, and not the CR750/CR751 series.
SLMP is a common protocol for seamless communication between applications. Users do not have to be concerned with network layers or boundaries. SLMP communications are available among devices that can transfer messages by SLMP (programmable controllers, personal computers, HMIs and others). (For the details of the SLMP compatibility of external devices, refer to the Instruction Manual of external devices.)
The CR800 Series supports the SLMP communication server function.

3.5.2. Supported version

Controller type	Version	Remarks
CR800-R, CR800-D, CR860-R, CR860-D	All versions	CR75x-Q and CR75x-D are not supported
CR800-Q, CR860-Q	A2 or later	

3.5.3. Specifications

The following section describes the specifications of the SLMP-compatible device and SLMP communication.

3.5.3.1. SLMP Specifications

The SLMP specifications for the message sent by an external device or with the communication protocol support function are as follows.

Item	Communication data code	Description	Reference
SLMP	· ASCII code · Binary code	This is the same message format as that for MC protocol QnA-compatible 3E frame and 4E frame.	3.5.6.1 Request Message

Compared to communication with ASCII code, communication with binary code involves approximately half the amount of communication data.

CAUTION If the Modbus TCP function is enabled, the SLMP function is disabled.

3.5.4. Parameters

Specify settings with the following parameters.

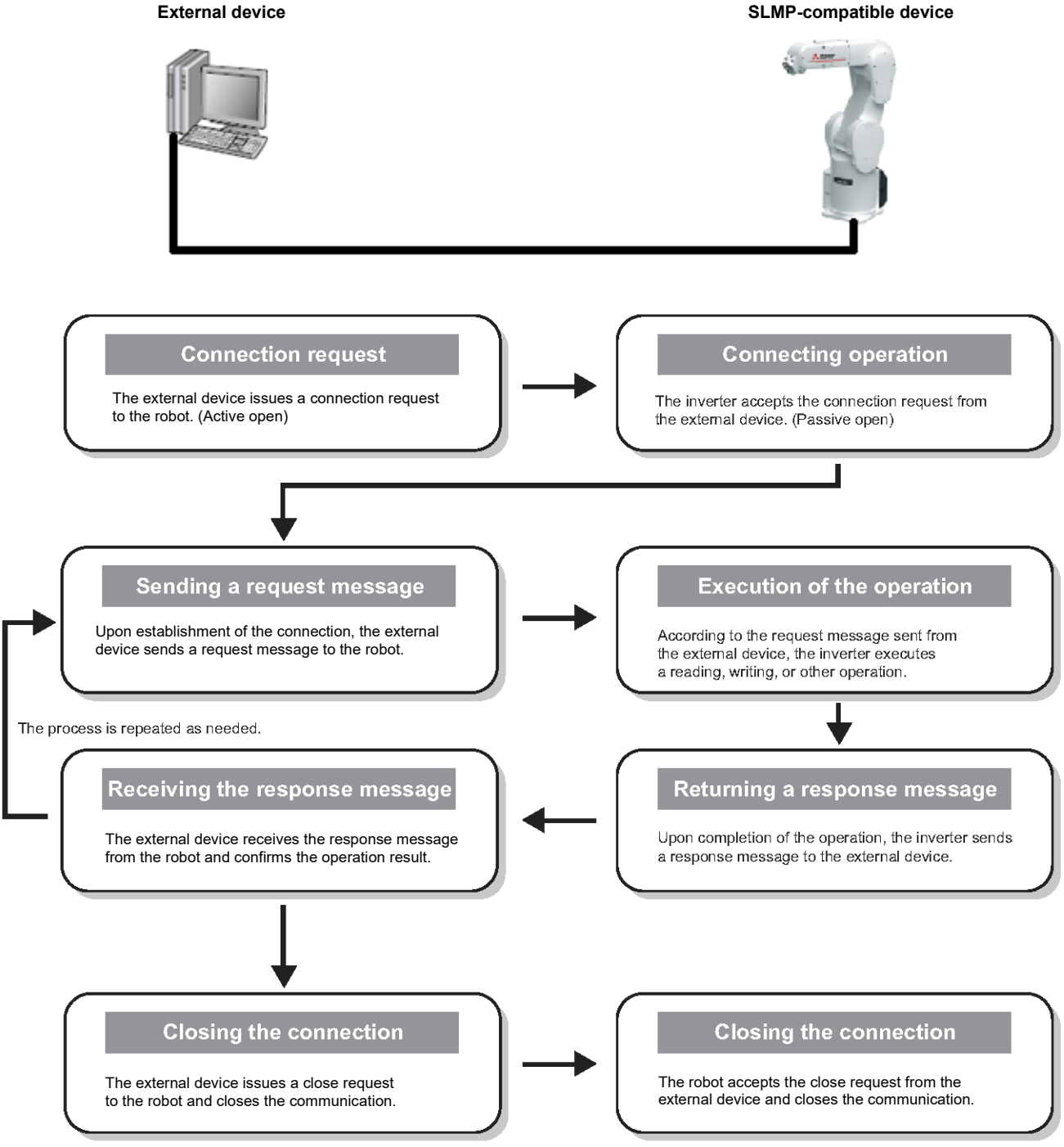
Parameter name	No. of arrays No. of characters	Description	Factory setting
SLMPPORT	Integer 1	Set the SLMP server communication port No. (1024 to 65535)	45237
SLMPCP	Integer 1	Set the SLMP server communication protocol. 0: TCP 1: UDP	1
SLMPNWNO	Integer 1	Set the SLMP network number. (1 to 239)	1
SLMPNDID	Integer 1	Set the SLMP station number. (1 to 120)	1

3.5.5. SLMP Communication Procedure

An external device and an SLMP-compatible device communicate as follows.

3.5.5.1. Using TCP/IP

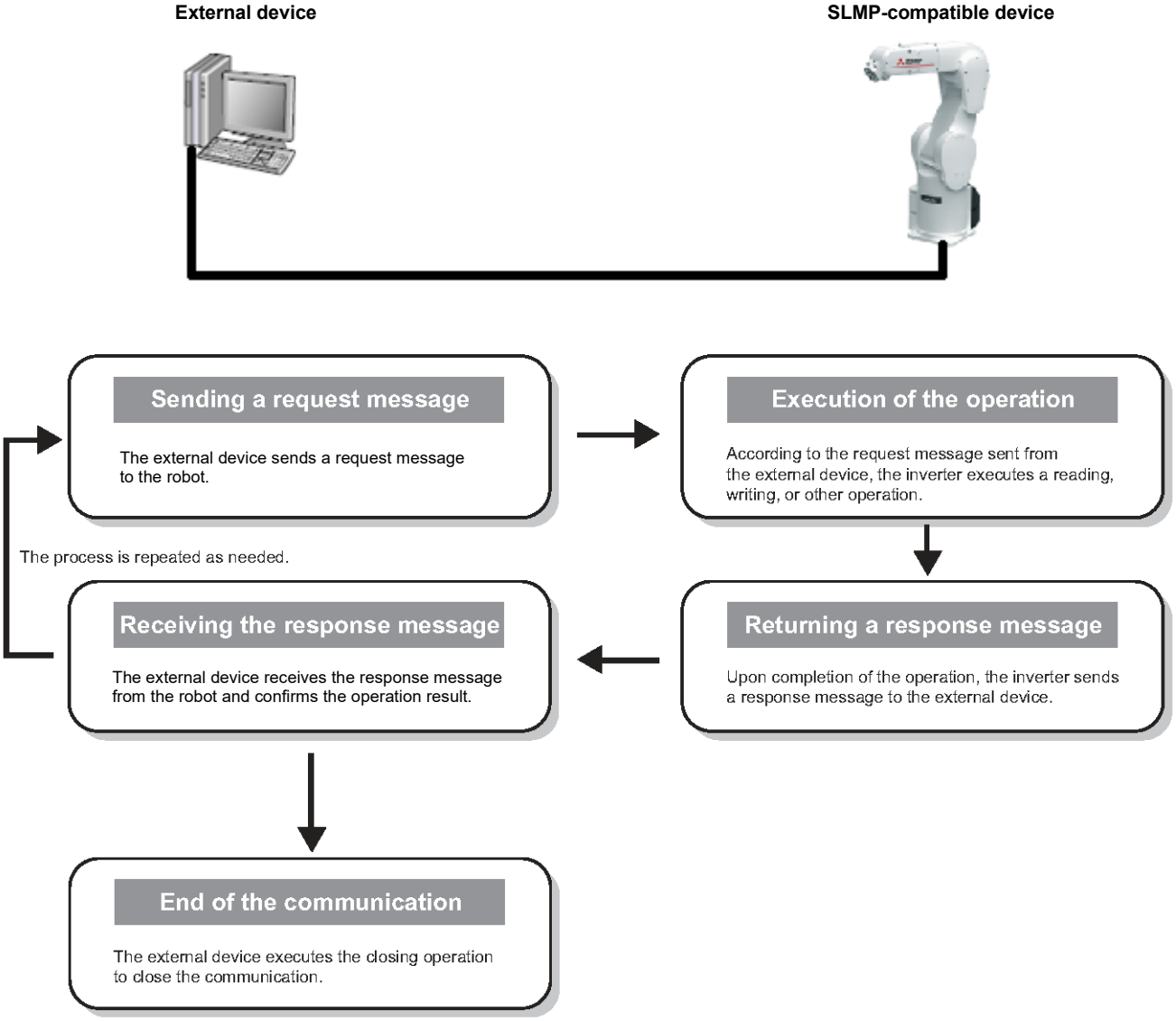
The following is the communication procedure when performing SLMP communication with TCP/IP.
With TCP/IP, connections are established when updating, and whether data is received normally or not is checked to ensure reliability of data. However, the line load is high as compared to UDP/IP.



3.5.5.2. Using UDP/IP

The following is the communication procedure when performing SLMP communication with UDP/IP.

With UDP/IP, connections are not established when communication is executed, and whether data is received normally or not is not checked. Therefore, the line load is low. However, data is less reliable as compared to TCP/IP.



3.5.6. Message Format

The following section describes the SLMP message format.

3.5.6.1. Request Message

The following is the format of a request message sent from an external device to an SLMP-compatible device.

Header	Subheader	Destination network No.	Destination station No.	Destination unit I/O No.	Destination multidrop station No.	Request data length	Monitoring timer	Request data	Footer

■ Header

This is the header for TCP/IP or UDP/IP. The header is added by the external device before transmission. Note that the header is normally added automatically by the external device.

■ Subheader

This will differ depending on whether a serial No. is added.

The serial No. is an arbitrary number for message recognition added at the external device. When a serial No. is added and a request message sent, the same serial No. is added to the response message. Serial Nos. are used when multiple request messages are sent from an external device to the same SLMP-compatible device.

When adding a serial No. to the request message (When the serial No. is 1234H)	**When not adding a serial No. to the request message**
ASCII code: (Fixed value) 5 4 0 0 (35H 34H 30H 30H); Serial No. 1 2 3 4 (31H 32H 33H 34H); (Fixed value) 0 0 0 0 (30H 30H 30H 30H) Binary code: (Fixed value) 54H 00H; Serial No. 34H 12H; (Fixed value) 00H 00H	ASCII code: (Fixed value) 5 0 0 0 (35H 30H 30H 30H) Binary code: (Fixed value) 50H 00H

- Use and manage serial Nos. at the external device side.
- When transmitting the message in ASCII code, the serial No. is stored in the order from higher-order byte to lower-order byte.
- When transmitting the message in binary code, the serial No. is stored in the order from lower-order byte to higher-order byte.

■ Request destination network No., request destination station No.

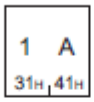
Specify the access destination network No. and station No. Specify the network No. and station No. in hexadecimal. Send the request destination network No. and request destination station No. in the order from higher-order byte to lower-order byte.

- Network No. range
  Host station: 00H
  Other station: 01H to EFH (1 to 239)
- Station No. range
  Host station: FFH (when the network No. is 00H)
  Other station: 01H to 78H (1 to 120)

Example

When 1AH(26) is specified as the request destination network No.

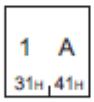
ASCII code



Binary code

When 1AH(26) is specified as the request destination station No.

ASCII code



Binary code

The host station has a network No. of 00H and a station No. of FFH. Other stations have other values. The request data addressed to the own station is received regardless of the network No. and station No. settings.

Furthermore, the request data addressed to the other stations is received when the SLMPNWNO and SLMPNDID settings are the same.

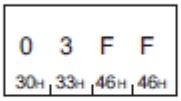
■ Destination unit I/O No.

Specify the access destination unit (fixed to 03FFH).

Example

When 03FFH is specified as the request destination unit I/O No.

ASCII code



Binary code

- When performing data communication in ASCII code
  Send data in the order higher-order byte to lower-order byte.
- When performing data communication in binary code
  Send data in the order lower-order byte to higher-order byte.

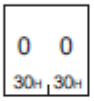
■ Request destination multidrop station No.

Specify the access destination multidrop station (fixed to 00H).

Example

When 0 is specified as the request destination multidrop station No.

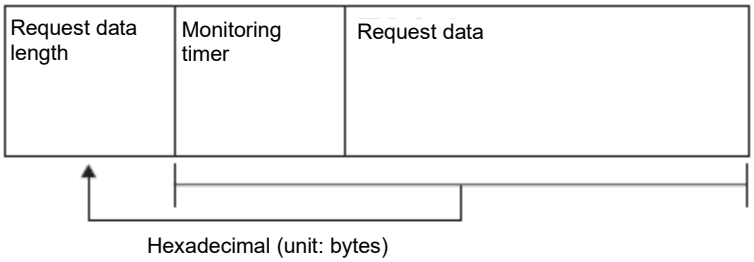
ASCII code



Binary code

■ Request data length

Specify the data length from the monitoring timer to the request data in hexadecimal. (Units: bytes)



Example

When the request data length is 24 bytes

ASCII code

0	0	1	8
30H	30H	31H	38H

Binary code

18H	00H

- When performing data communication in ASCII code
  Send data in the order from higher-order byte to lower-order byte.
- When performing data communication in binary code
  Send data in the order from lower-order byte to higher-order byte.

■ Monitoring timer

Not used (fixed to 0000H)

Example

When 10H specified for monitoring timer

ASCII code

0	0	1	0
30H	30H	31H	30H

Binary code

10H	00H

3.5.6.2. Response Message Format

The following is the format of a response message sent from an SLMP-compatible device to an external device.

(Normal completion)

Header	Subheader	Destination network No.	Destination station No.	Destination unit I/O No.	Destination multidrop station No.	Response data length	End code	Response data	Footer

(Failed completion)

Header	Subheader	Destination network No.	Destination station No.	Destination unit I/O No.	Destination multidrop station No.	Response data length

End code	Network No. (responding station)	Station No. (responding station)	Destination unit I/O No.	Destination multidrop station No.	Command	Subcommand	Footer

Error information

* The following items contain the same information described in section 3.5.6.1 of this manual.

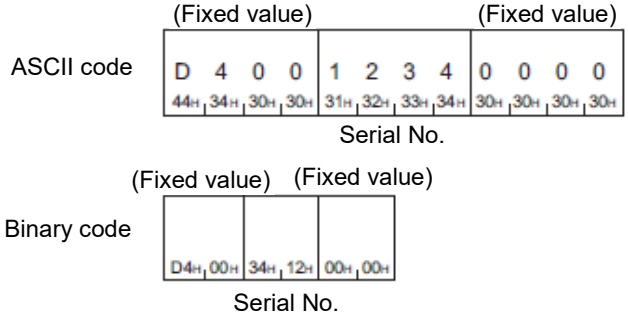
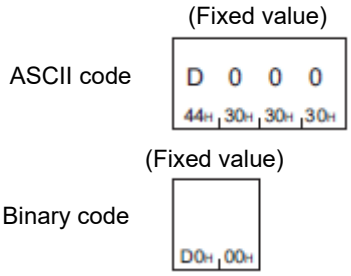
- Request destination network No.
- Request destination station No.
- Request destination unit I/O No.
- Request destination multidrop station No.

■ Header

Contains the Ethernet header.

■ Subheader

Contains the subheader for the request message.

When adding a serial No. to the request message (when the serial No. is 1234H)	When not adding a serial No. to the request message
	

- When performing data communication in ASCII code

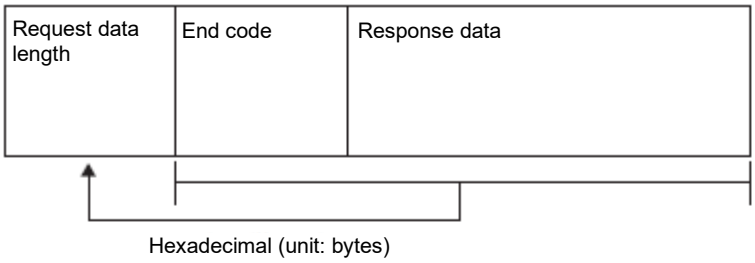
  Serial Nos. are stored in the order from higher-order byte to lower-order byte.
- When performing data communication in binary code

  Serial Nos. are stored in the order from lower-order byte to higher-order byte.

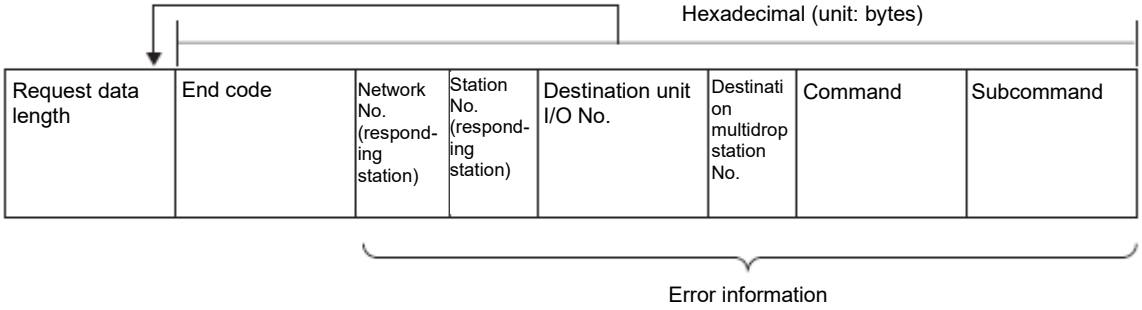
■ Response data length

The data length from the end code to the response data (successful completion) or error information (failed completion) is stored in hexadecimal. (Units: bytes)

(Normal completion)



(Failed completion)



Example

When the response data length is 22 bytes

ASCII code

0	0	1	6
30H	30H	31H	36H

Binary code

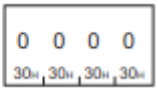
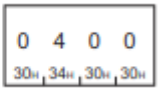
16H	00H

- When performing data communication in ASCII code
  Send data in the order from higher-order byte to lower-order byte.
- When performing data communication in binary code
  Send data in the order from lower-order byte to higher-order byte.

■ End code

The command processing result is stored.

The value "0" is stored for normal completion. An error code is stored if processing ends in error. (See section 3.5.8 of this manual.)

Successful completion	Failed completion (0400H)
ASCII code 	ASCII code 
Binary code	Binary code

- When performing data communication in ASCII code

  The command processing result is stored in the order from higher-order byte to lower-order byte.
- When performing data communication in binary code

  The command processing result is stored in the order from lower-order byte to higher-order byte.

■ Response data

When the command is completed successfully, data such as the read data corresponding to the command is stored.

Refer to the "Response data" section in the command description for details on response data.

■ Error information

The command and the subcommand, etc. for which an error occurred are stored.

3.5.7. Commands

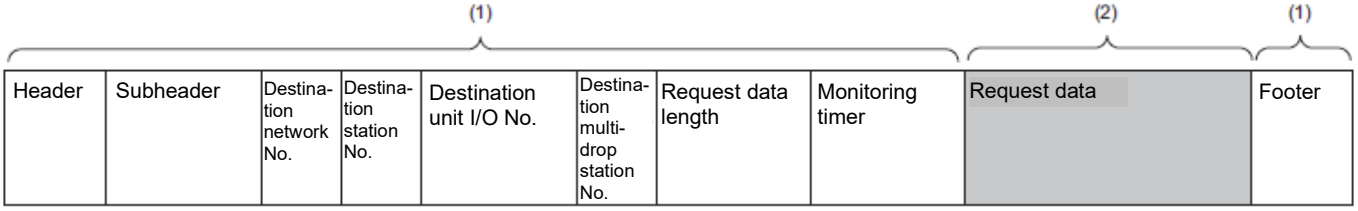
The following section describes SLMP commands.

Refer to section 3.5.6 of this manual for details on message formats for other than the command sections.

■ Request message format

(1) 3.5.6.1 Request Message

(2) Request data contains both commands and subcommands. Refer to section 3.5.7.2 onward in this manual for details.

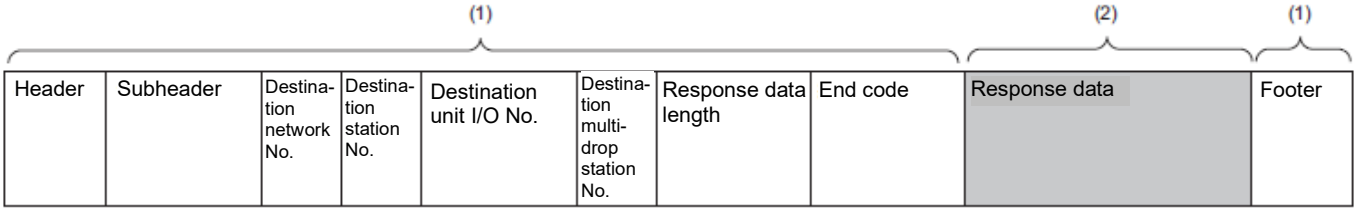


■ Response message format

● Normal completion

(1) 3.5.6.2 Response Message Format

(2) Refer to section 3.5.7.2 onward in this manual.



● Failed completion

Refer to section 3.5.6.2 onward in this manual.

3.5.7.1. List of Commands

The following is a list of commands. The following "Subcommands" will differ depending on the device specified. Refer to section 3.5.7.2 onward in this manual.

Item		Command	Subcommand	Description	Reference
Category	Operation				
Device	Read	0401	00□1 00□3	The value is read in bit devices (with consecutive device numbers) in 1-bit units.	3.5.7.2.2 Read
			00□0 00□2	● The value is read in bit devices (with consecutive device numbers) in 16-bit units. ● The value is read in word devices (with consecutive device numbers) in 1-word units.	
	Write	1401	00□1 00□3	The value is written to bit devices (with consecutive device numbers) in 1-bit units.	3.5.7.2.3 Write
			00□0 00□2	● The value is written to bit devices (with consecutive device numbers) in 16-bit units. ● The value is written to word devices (with consecutive device numbers) in 1-word units.	
	Read Random	0403	00□0 00□2	The value is read in the devices with the specified numbers. The devices with non-consecutive numbers can be specified. The value is read from the word devices in 1-word or 2-word units.	3.5.7.2.4 Read Random
	Write Random	1402	00□1 00□3	The value is written to the bit devices with the specified device numbers (each set of 1 bits has a device number). The devices with non-consecutive numbers can be specified.	3.5.7.2.5 Write Random
			00□0 00□2	● The value is written to the bit devices with the specified device numbers (each set of 16 bits has a device number). The devices with non-consecutive numbers can be specified. ● The value is written to the word devices with the specified device numbers (each word or each set of two words has a device number). The devices with non-consecutive numbers can be specified.	
Self Test		0619	0000	Performs a test to determine whether communication with external devices is normal.	3.5.7.3 Self Test (Loopback Test)

3.5.7.2. Device (Device Access)

The following section describes commands used to perform device reading and writing.

3.5.7.2.1. Data Used in Commands

- Device code

  Access destination devices are specified in request data with the following device codes.

  For subcommands 0001 and 0000, specify the device code enclosed in parentheses ( ).

Device	Category	Device code		Device No. range		Remarks
		ASCII code *1	Binary code			
Special relay (SM)	Bit	SM** (SM)	0091H (91H)	SM0 to SM4095	Decimal	—
Special register (SD)	Word	SD** (SD)	00A9H (A9H)	SD0 to SD4095	Decimal	—
Input (X)	Bit	X*** (X*)	009CH (9CH)	R type: X0 to XFFF D type: X0 to X1FFF	Hexadecimal	—
Output (Y)		Y*** (Y*)	009DH (9DH)	R type: Y0 to YFFF D type: Y0 to Y1FFF	Hexadecimal	—
Internal relay (M)		M*** (M*)	0090H (90H)	M0 to M18431	Decimal	Cannot be specified with D type.
Data register (D)	Word	D*** (D*)	00A8H (A8H)	D0 to D5119	Decimal	—
CPU buffer memory access device	See section 3.5.7.2.6 of this manual.					Cannot be specified with D type.

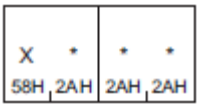
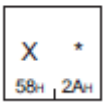
*1: When performing data communication in ASCII code, specify device codes with 4 digits for subcommands 00□3 and 00□2. For device codes with 3 digits or less, add an asterisk (*) (ASCII code: 2AH) or a space (ASCII code: 20H) after the device code.

Specify device codes with 2 digits for subcommands 00□1 and 00□0. For device codes with 1 digit, add an asterisk (*) (ASCII code: 2AH) or a space (ASCII code: 20H) after the device code.

- When performing data communication in ASCII code

  Use device codes by converting them to ASCII code (2 or 4 digits), and send them in the order higher-order byte to lower-order byte. Use codes in upper case characters for letters of the alphabet.

  With subcommands 0003, 0002 and 0001, 0000, the number of digits converted to ASCII code will differ.

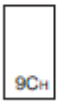
Subcommand	Number of digits	Example
0003 0002	Conversion to 4 ASCII code digits	If input (X) (4 digits) *1 
0001 0000	Conversion to 2 ASCII code digits	If input (X) (2 digits) *1 

*1: Send input relay device codes in order from "X". Note that asterisks (*) from the second character onward may also be specified with a space (code: 20H).

- When performing data communication in binary code

  Use numerical values (1 or 2 bytes), and send data in the order lower-order byte to higher-order byte.

  With subcommands 0003, 0002 and 0001, 0000, the data size of the numerical values will differ.

Subcommand	Number of digits	Example
0003 0002	2 bytes	If input (X) (2 bytes)
0001 0000	1 byte	If input (X) (1 byte) 

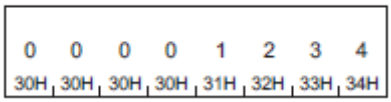
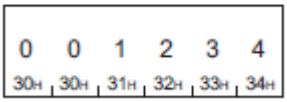
- First device No. (device No.)

  Specify the device No. for reading/writing data. When consecutive devices are specified, specify the first device No. Specify the first device No. in decimal or hexadecimal depending on the device type.

  - When performing data communication in ASCII code

    Use device Nos. by converting them to ASCII code (6 or 8 digits), and send them in the order higher-order byte to lower-order byte.

    With subcommands 0003, 0002 and 0001, 0000, the number of digits converted to ASCII code will differ.

Subcommand	Number of digits	Example
0003 0002	Conversion to 8 ASCII code digits	If device No. is 1234 (8 digits) *1 
0001 0000	Conversion to 6 ASCII code digits	If device No. is 1234 (6 digits) *1 

*1: Send in order from 0. The higher-order digit 0 can also be specified with a space (code: 20H).

  - When performing data communication in binary code

    Use numerical values (3 or 4 bytes), and send data in the order from lower-order byte to higher-order byte. When the device No. is a decimal device, convert it to a hexadecimal value and send.

    With subcommands 0003, 0002 and 0001, 0000, the data size of the numerical values will differ.

Subcommand	Number of digits	Example
0003 0002	4 bytes	If internal relay M1234, link relay B1234 (4 bytes) *1
0001 0000	3 bytes	If internal relay M1234, link relay B1234 (3 bytes) *2

*1: The device number for internal relay M1234 is in decimal, and must therefore be converted to hexadecimal. This will be 000004D2H, and should be sent in the order D2H, 04H, 00H, 00H. This will be 00001234H for link relay B1234, and should be sent in the order 34H, 12H, 00H, 00H.

*2: The device number for internal relay M1234 is in decimal, and must therefore be converted to hexadecimal. This will be 0004D2H, and should be sent in the order D2H, 04H, 00H. This will be 001234H for link relay B1234, and should be sent in the order 34H, 12H, 00H.

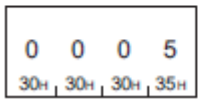
- Number of devices
  Specify the number of devices for reading/writing data.

  - When performing data communication in ASCII code
    Use the number of devices by converting them to 4 ASCII code digits (hexadecimal), and send them in the order from higher-order byte to lower-order byte. Use codes in upper case characters when specifying letters of the alphabet.

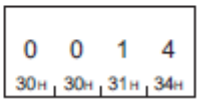
    Example

    Number of devices: 5 / 20

    5 devices

    20 devices

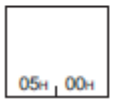
    

  - When performing data communication in binary code
    Use a 2-byte numerical value to indicate the number of processing devices, and send in the order from lower-order byte to higher-order byte.

    Example

    Number of devices: 5 / 20

    5 devices

    20 devices

- Read data / write data

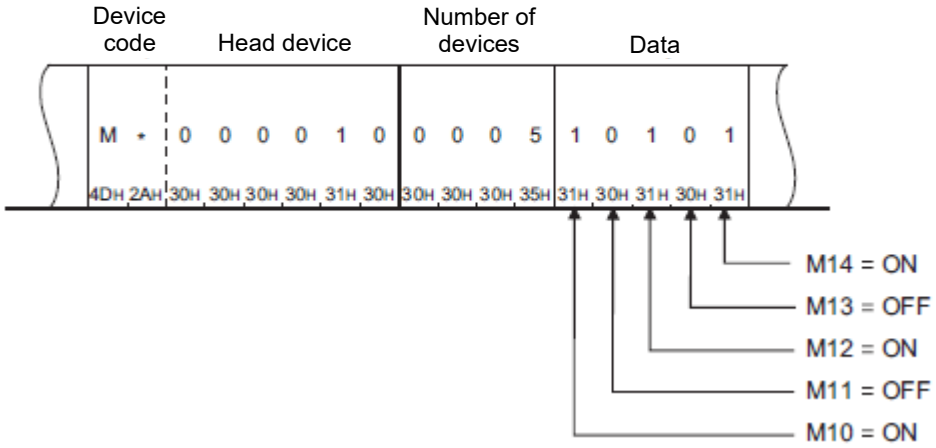
  The value read from the device is stored for reading. The value to be written to the device is stored for writing.
  The data arrangement will differ depending on the bit unit (subcommand: 00□1, 00□3) or word unit (subcommand: 00□0, 00□2).

  - In bit units (subcommand: 00□1, 00□3)

    When performing data communication in ASCII code, send data for the number of specified devices from the specified start device in the order from higher-order byte to lower-order byte. The ON state is denoted as "31H" (1), and the OFF state is denoted as "30H" (0). Use codes in upper case characters when specifying letters of the alphabet.

    Example

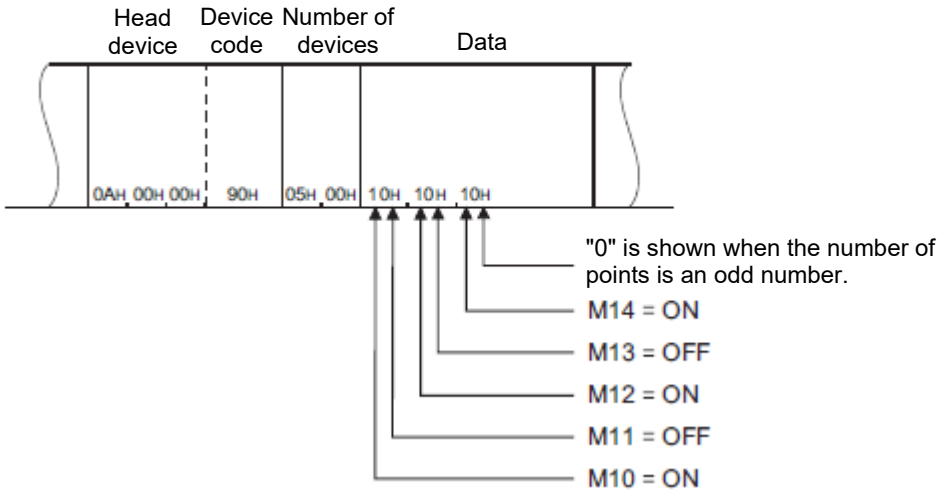
    ON/OFF state of five devices starting from M10



    When performing data communication in binary code, specify a single device with 4 bits, and send data for the number of specified devices from the specified start device in the order from higher-order byte to lower-order byte. The ON state is denoted as "1", and the OFF state is denoted as "0".

    Example

    ON/OFF state of five devices starting from M10



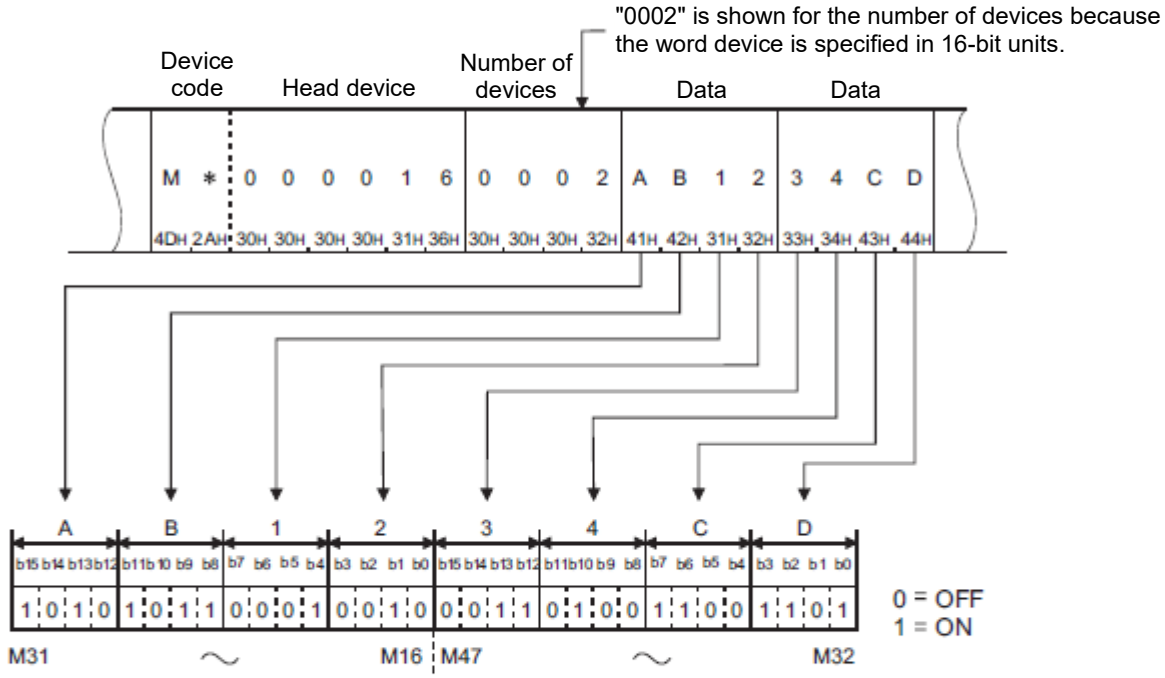
- In word units (subcommand: 00□0, 00□2)

  When performing data communication in ASCII code, send data with 1 word in 4-bit units in the order from higher-order byte to lower-order byte. Data is expressed in hexadecimal.

  Use codes in upper case characters when specifying letters of the alphabet.

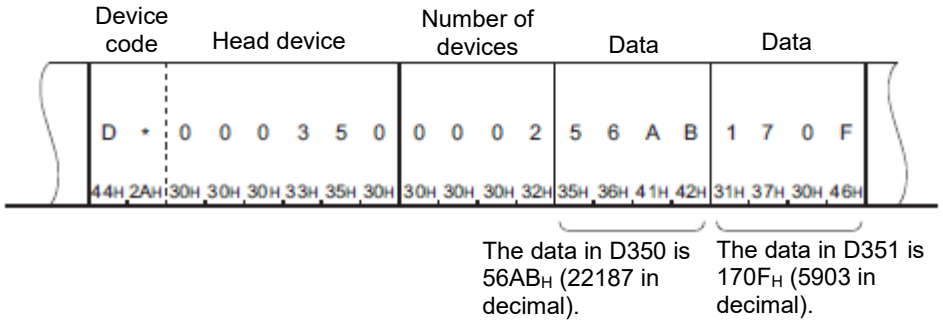
  Example

  ON/OFF state of 32 devices starting from M16



  Example

  Data stored in D350/D351



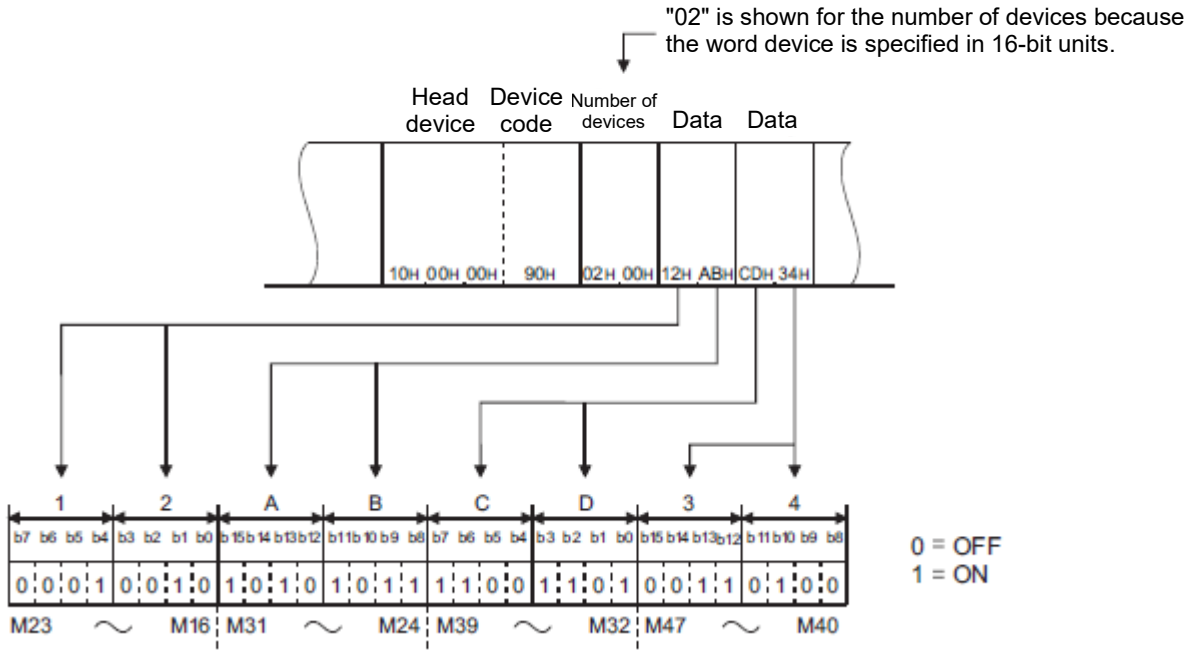
When word devices for reading data contain other than integers (real numbers, character strings), stored values are read as integer values.

- When D0 to D1 contains a real number (0.75), D0 = 0000H, and D1 = 3F40H.
- When D2 to D3 contains a character string ("12AB"), D2 = 3231H, and D3 = 4241H.

When bit devices are handled in word units when performing data communication in binary code, a single device is specified with a 1 bit as shown in the following example. Data is stored in the order from lower-order byte (bit 0 to bit 7) to higher-order byte (bit 8 to bit 15).

Example

ON/OFF state of 32 devices starting from M16



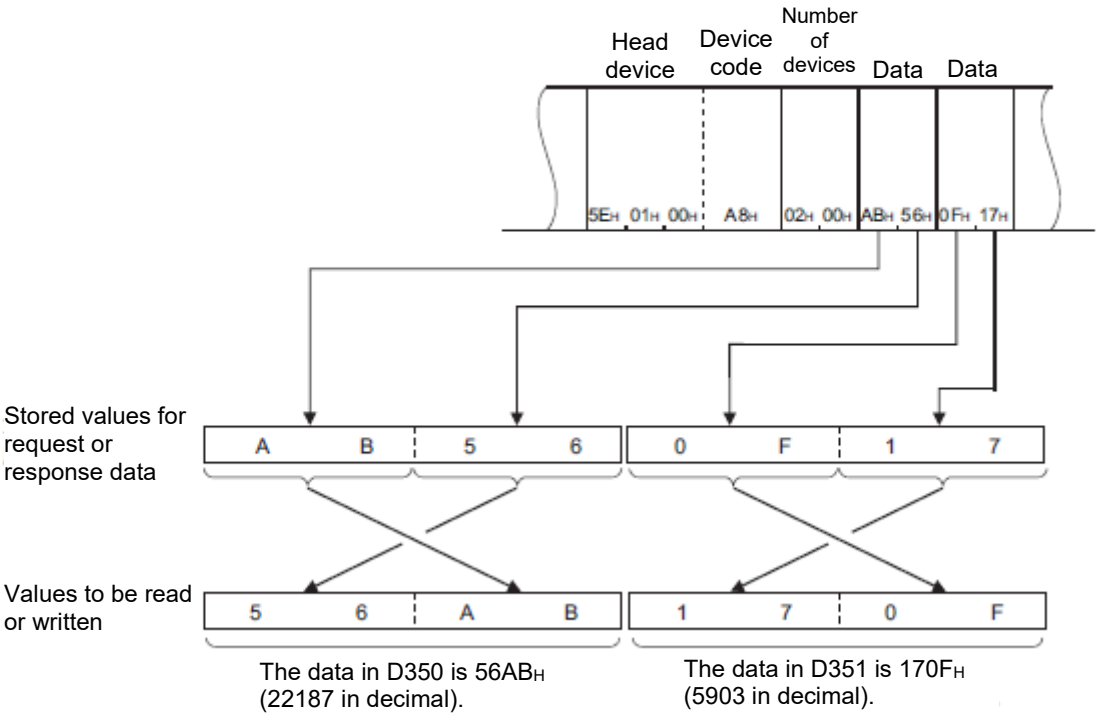
When word devices are used, 1 word is specified in 16 bits as follows. Data is stored in the order from lower-order byte (bit 0 to bit 7) to higher-order byte (bit 8 to bit 15).

When reading, do so after replacing values stored in the response data with higher/lower-order bytes at the user side.

When writing, store request data after replacing the values to be written with higher/lower-order bytes at the user side.

Example

Data stored in D350/D351



When word devices for reading data contain other than integers (real numbers, character strings), stored values are read as integer values.

- When D0 to D1 contains a real number (0.75), D0 = 0000H, and D1 = 3F40H.
- When D2 to D3 contains a character string ("12AB"), D2 = 3231H, and D3 = 4241H.

- Precautions

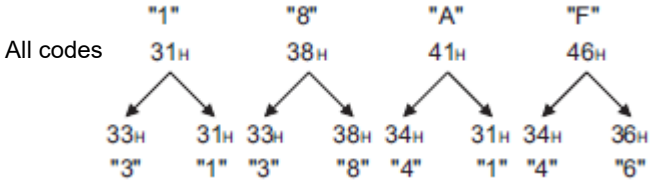
  When performing data communication with ASCII data, process as follows when passing character strings from external devices to the CPU module.

  The procedure for converting data received by SLMP-compatible devices from external devices to binary code data, and writing it to a specified device is described below.

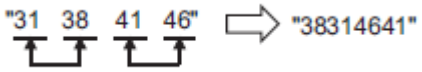
  1. Expand character strings sent from external devices to 2-byte code per one character.
  2. Rearrange the character strings expanded to 2-byte code per one character, and send them to the SLMP-compatible device.
  3. Write the data sent to the SLMP-compatible device to the specified device.

  The following is an example of a case where a character string ("18AF") received from an external device is converted to binary code data, and written to D0 to D1.

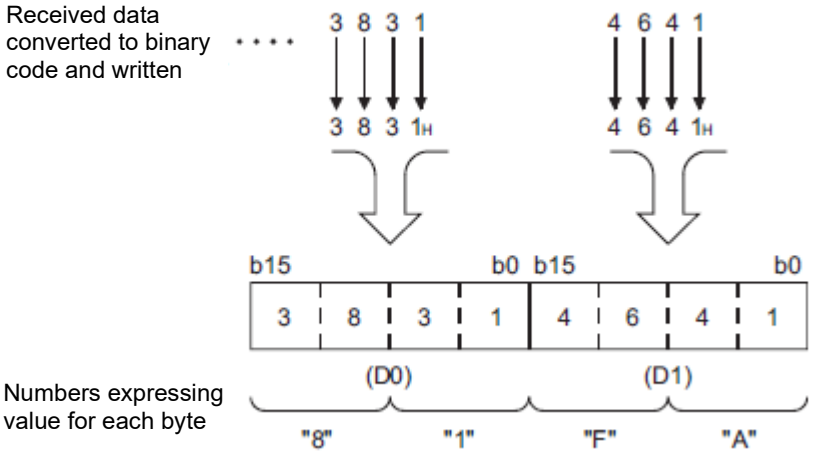
  1. Expand the character string ("18AF") sent from the external device to 2-byte code per one character.



  2. Rearrange the character strings expanded to 2-byte code per one character, and send them to the SLMP-compatible device.



  3. Write the "38314641" data sent to the SLMP-compatible device to D0 to D1.



- Number of devices for bit access

  This is the data required to specify the number of devices accessed in bit units.

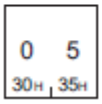
  - When performing data communication in ASCII code

    Convert the number of devices to 2 ASCII code digits (hexadecimal), and send them in the order from higher-order byte to lower-order byte. Use codes in upper case characters if specifying letters of the alphabet.

    Example

    Number of devices: 5 / 20

    5 devices

    20 devices

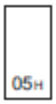
  - When performing data communication in binary code

    Convert the number of devices to hexadecimal and send.

    Example

    Number of devices: 5 / 20

    5 devices

    20 devices

3.5.7.2.2. Read (Command: 0401)

Read the data from devices.

■ Request data

ASCII

0 4 0 1 (30H 34H 30H 31H)	Subcommand	Device code	First device No.	Number of devices

Binary

	Sub-command	First device No.	Device code	Number of devices
01H 04H				

- Subcommand

Item	Subcommand *1	
	ASCII code	Binary code
When reading data in bit units	0 0 0 1 (30H 30H 30H 31H) or 0 0 8 1 (30H 30H 38H 31H)	(01H 00H) or (81H 00H)
	0 0 0 3 (30H 30H 30H 33H) or 0 0 8 3 (30H 30H 38H 33H)	(03H 00H) or (83H 00H)
When reading data in word units	0 0 0 0 (30H 30H 30H 30H) or 0 0 8 0 (30H 30H 38H 30H)	(00H 00H) or (80H 00H)
	0 0 0 2 (30H 30H 30H 32H) or 0 0 8 2 (30H 30H 38H 32H)	(02H 00H) or (82H 00H)

*1: Use subcommand 008□ if accessing a link direct device, module access device, or CPU buffer memory access device. When the subcommand is set to 008□, the message format will differ. (Reading, writing by specifying device extension)

- Device code

  Specify the type of device to be read.

- First device No.

  Specify the first number of the device to be read.

- Number of devices

  Specify the number of devices to be read.

Item	Number of devices	
	ASCII code	Binary code
When reading data in bit units	1 to 3584 devices	1 to 7168 devices
When reading data in word units	1 to 960 devices	

■ Response data

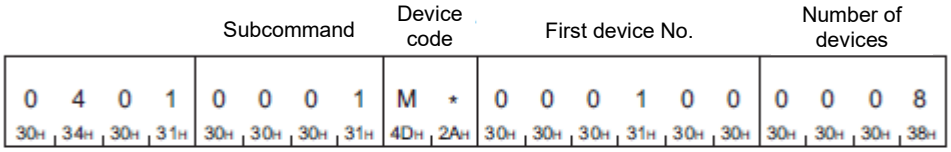
The value read from the device is stored in hexadecimal. The data order will differ depending on whether it is in ASCII code or binary code.

■ Communication example (when reading data in bit units)

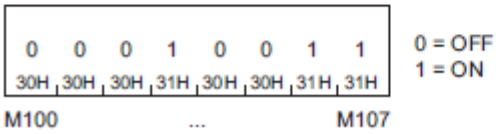
Read M100 to M107.

- When performing data communication in ASCII code

(Request data)

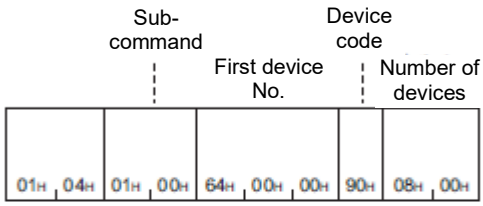


(Response data)

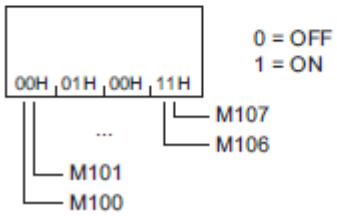


- When performing data communication in binary code

(Request data)



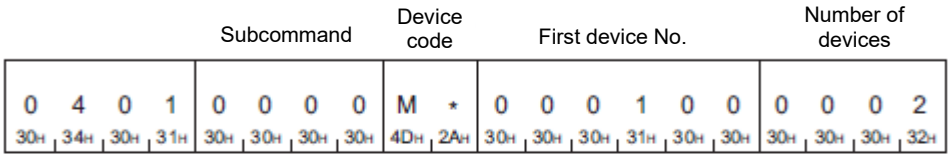
(Response data)



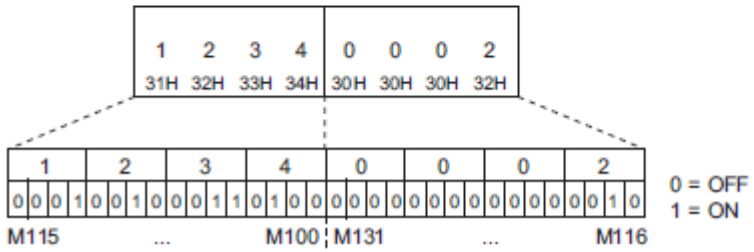
■ Communication example (when reading data in word units (bit device))

- Read M100 to M131 (data for two words).

(Request data)

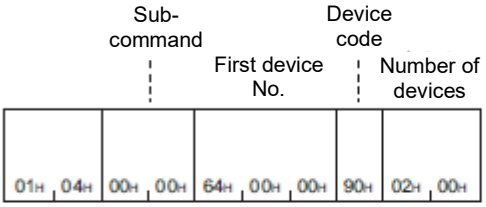


(Response data)

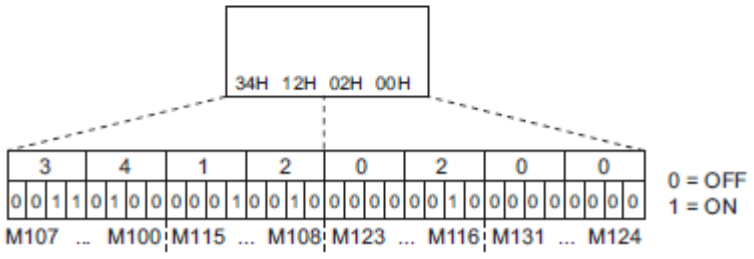


- When performing data communication in binary code

(Request data)



(Response data)



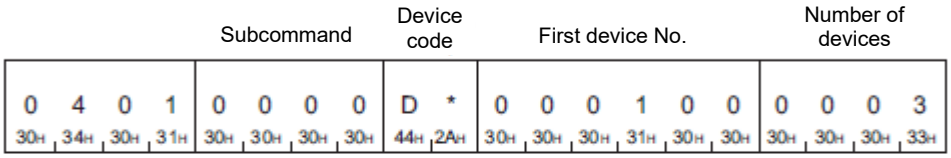
■ Communication example (when reading data in word units (word device))

Read values D100 to D102.

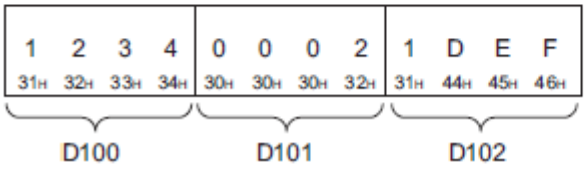
Here D100 = 4660 (1234H), D101 = 2 (2H), and D102 = 7663 (1DEFH).

- When performing data communication in ASCII code

(Request data)

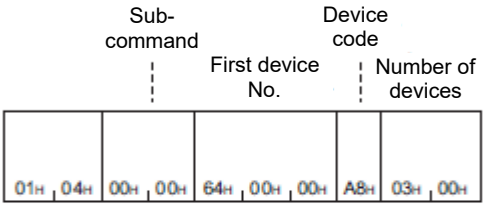


(Response data)



- When performing data communication in binary code

(Request data)



(Response data)

3.5.7.2.3. Write (Command: 1401)

Write the data to devices.

■ Request data

ASCII

1 4 0 1 (31H 34H 30H 31H)	Subcommand	Device code	First device No.	Number of devices	Write data

Binary

(01H 14H)	Sub-command	First device No.	Device code	Number of devices	Write data

- Subcommand

Item	Subcommand *1	
	ASCII code	Binary code
When writing data in bit units	0 0 0 1 (30H 30H 30H 31H) or 0 0 8 1 (30H 30H 38H 31H)	(01H 00H) or (81H 00H)
	0 0 0 3 (30H 30H 30H 33H) or 0 0 8 3 (30H 30H 38H 33H)	(03H 00H) or (83H 00H)
When writing values in word units	0 0 0 0 (30H 30H 30H 30H) or 0 0 8 0 (30H 30H 38H 30H)	(00H 00H) or (80H 00H)
	0 0 0 2 (30H 30H 30H 32H) or 0 0 8 2 (30H 30H 38H 32H)	(02H 00H) or (82H 00H)

*1: Use subcommand 008□ if accessing a link direct device, module access device, or CPU buffer memory access device. When the subcommand is set to 008□, the message format will differ. (Reading, writing by specifying device extension)

- Device code

  Specify the type of device to be written.

- First device No.

  Specify the first number of the device to be written.

- Number of devices

  Specify the number of devices to be written.

Item	Number of devices	
	ASCII code	Binary code
When writing data in bit units	1 to 3584 devices	1 to 7168 devices
When writing data in word units	1 to 960 devices	

- Write data

  Specify the value to be written to all the devices specified in "Number of devices" in the request data.

■ Request data

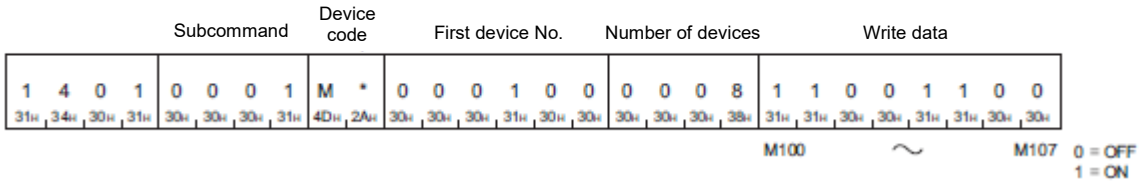
There is no Write command response data.

■ Communication example (when writing data in bit units)

Write values to M100 to M107.

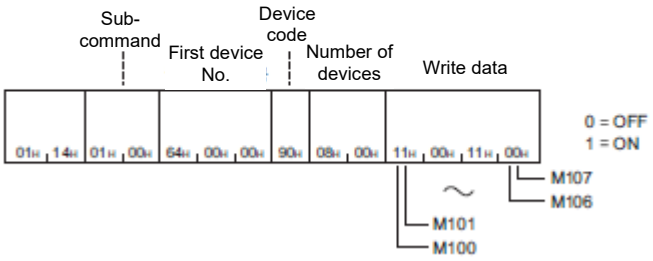
- When performing data communication in ASCII code

(Request data)



- When performing data communication in binary code

(Request data)

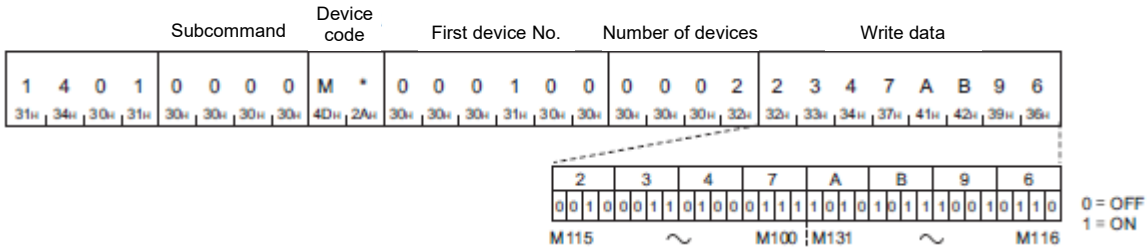


■ Communication example (when writing data in word units (bit device))

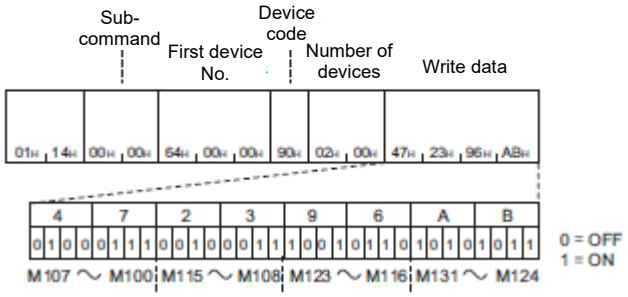
Write values to M100 to M131 (data for two words).

- When performing data communication in ASCII code

(Request data)



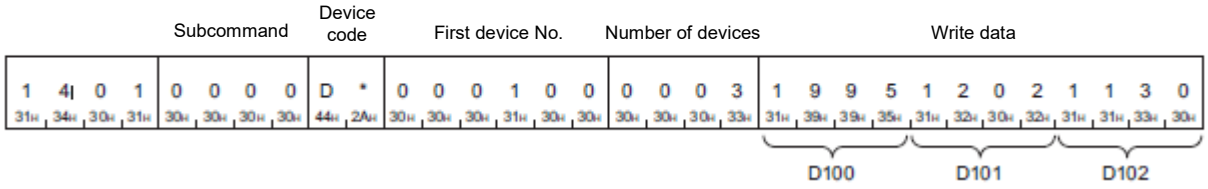
- When performing data communication in binary code
  (Request data)



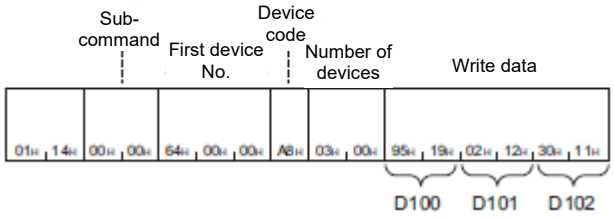
■ Communication example (when writing data in word units (word device))

Write 6549 (1995H) for D100, 4610 (1202H) for D101, and 4400 (1130H) for D102.

- When performing data communication in ASCII code
  (Request data)



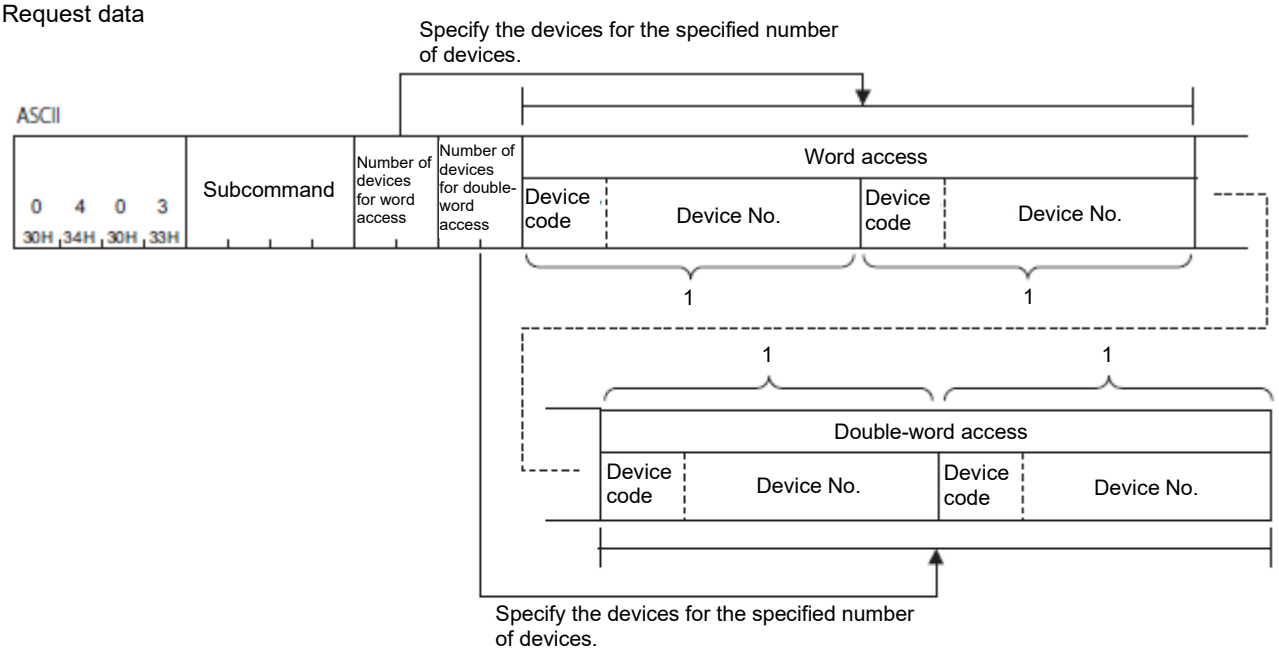
- When performing data communication in binary code
  (Request data)

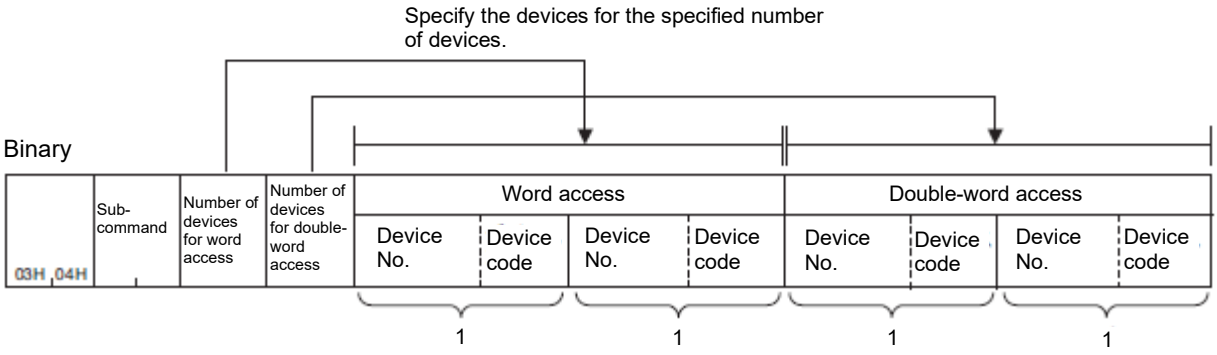


3.5.7.2.4. Read Random (Command: 0403)

The value is read in the devices with the specified numbers. The devices with non-consecutive numbers can be specified.

■ Request data





- Subcommand

Subcommand *1					
ASCII code				Binary code	
0 0 0 0 30H 30H 30H 30H	or	0 0 8 0 30H 30H 38H 30H		or	
0 0 0 2 30H 30H 30H 32H	or	0 0 8 2 30H 30H 38H 32H	02H 00H	or	82H 00H

*1: Use subcommand 008□ if accessing a link direct device, module access device, or CPU buffer memory access device. When the subcommand is set to 008□, the message format will differ. (Reading, writing by specifying device extension)

- Number of word access devices, number of double-word access devices

  Specify the number of devices to be read with 1 byte (binary code) or 2 bytes (2 digits) (ASCII code).

Subcommand	Item	Description
0002	Number of devices for word access	Specify the number of devices for 1 word access. The applicable units are 16-bit units for bit devices, and 1-word units for word devices.
	Number of devices for double-word access	Specify the number of devices for 2 word access. The applicable units are 32-bit units for bit devices, and 2-word units for word devices.
0000	Number of devices for word access	Specify the number of devices for 1 word access. The applicable units are 16-bit units for bit devices, and 1-word units for word devices.
	Number of devices for double-word access	Specify the number of devices for 2 word access. The applicable units are 32-bit units for bit devices, and 2-word units for word devices.

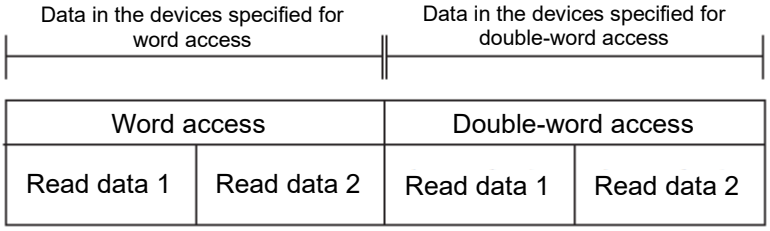
- Device code, device number

  Specify devices to be read in the order word access, double-word access.

Item	Description
Word access	Specify devices based on the number set in the request data for word access. It is not necessary to specify devices when "0" is set.
Double-word access	Specify devices based on the number set in the request data for double-word access. It is not necessary to specify devices when "0" is set.

■ Response data

Values for read devices are stored in hexadecimal. The data order will differ depending on whether it is in ASCII code or binary code.



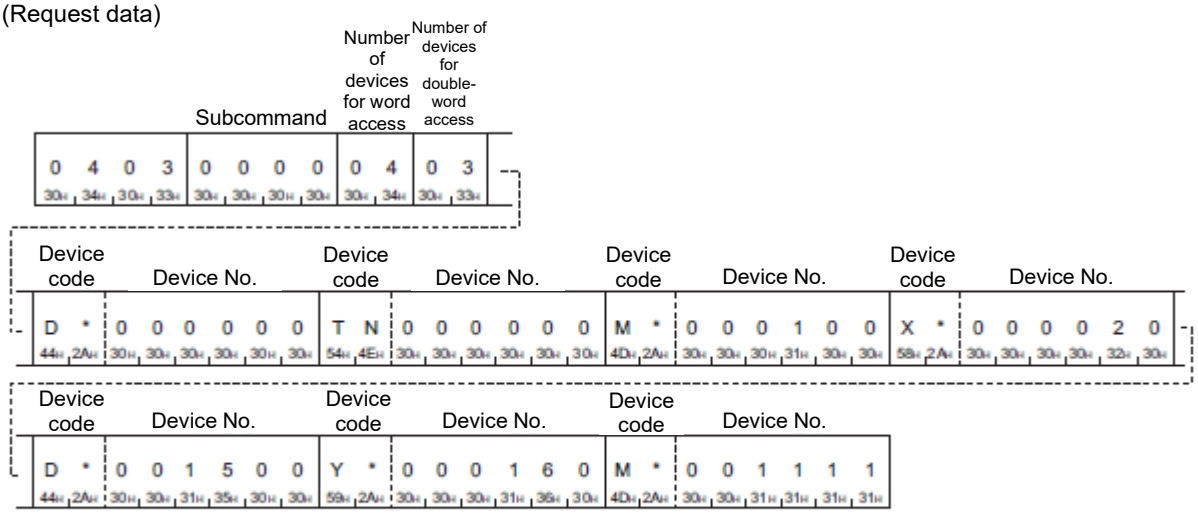
■ Communication example

With word access, read D0, D1, M100 to M115, and X20 to X2F, and with double-word access, read D1500 to D1501, Y160 to Y17F, and M1111 to M1142.

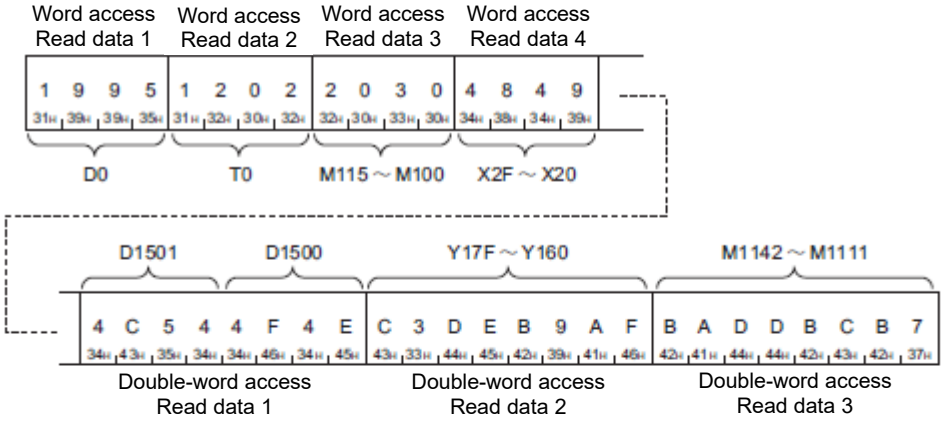
Here D0 = 6549 (1995H), D1 = 4610 (1202H), D1500 = 20302 (4F4EH), and D1501 = 19540 (4C54H).

- When performing data communication in ASCII code

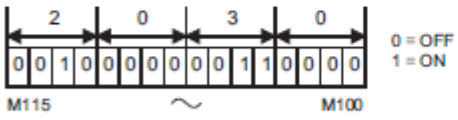
(Request data)



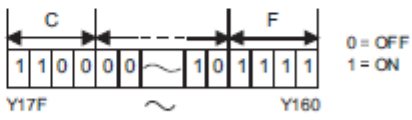
(Response data)



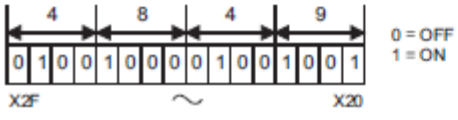
Word access read data 3



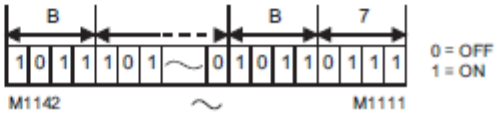
Double-word access read data 2



Word access read data 4

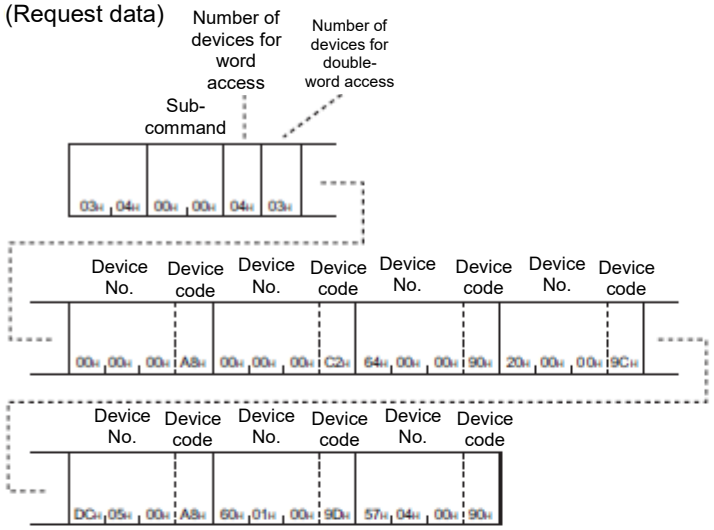


Double-word access read data 3

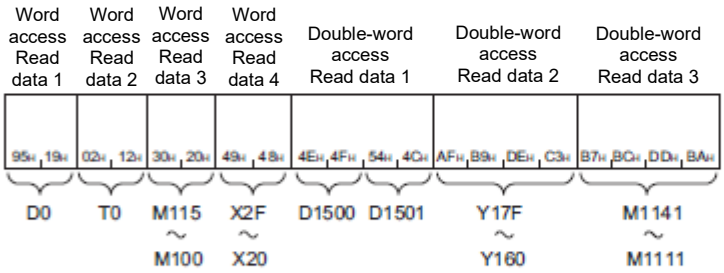


- When performing data communication in binary code

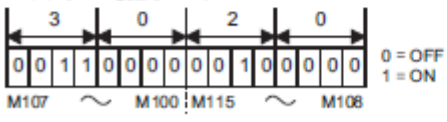
(Request data)



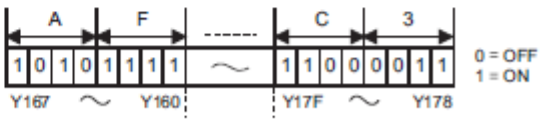
(Response data)



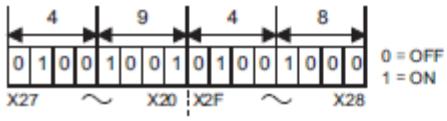
Word access read data 3



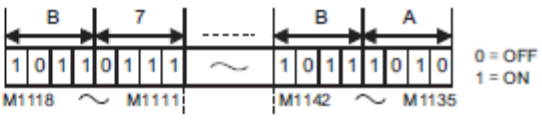
Double-word access read data 2



Word access read data 4



Double-word access read data 3

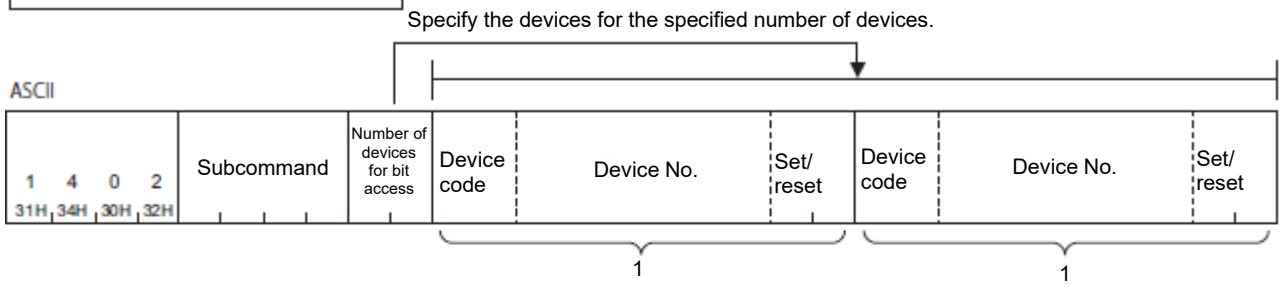


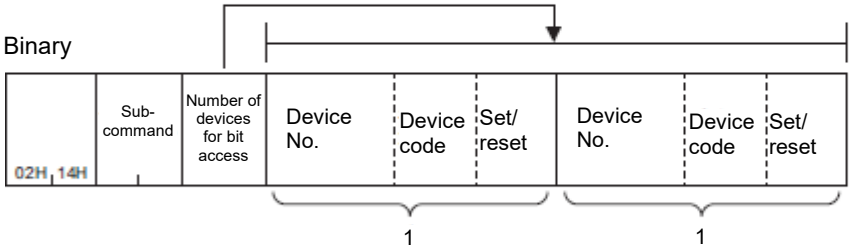
3.5.7.2.5. Write Random (Command: 1402)

The value is written in the devices with the specified numbers. The devices with non-consecutive numbers can be specified.

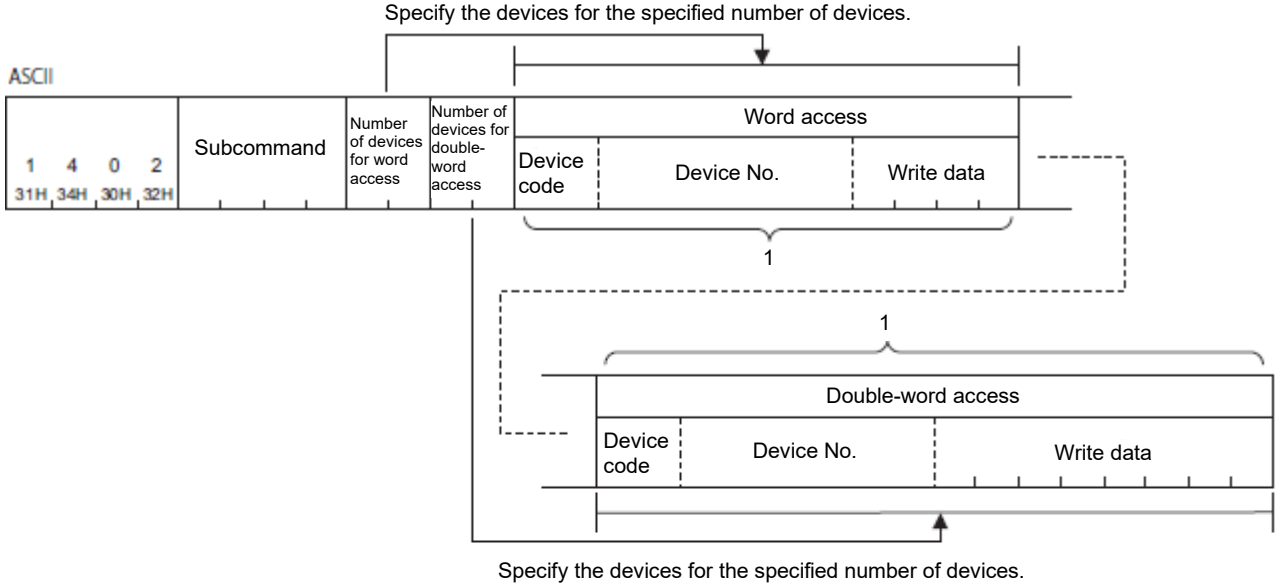
■ Request data

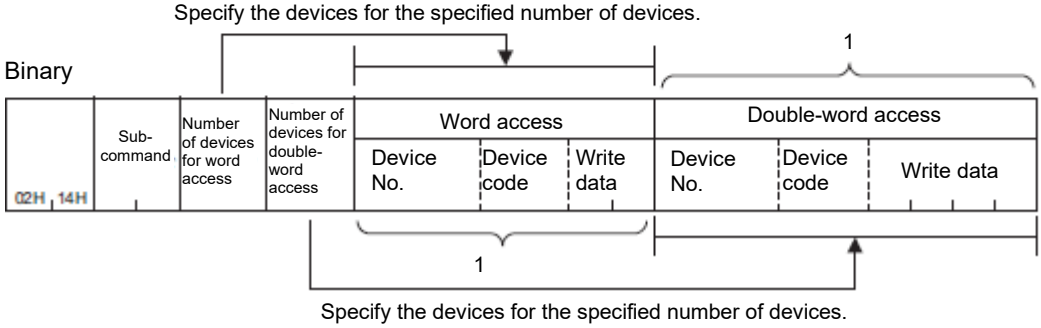
Writing data in bit units





Writing data in word units





- Subcommand

Item	Subcommand *1	
	ASCII code	Binary code
When writing data in bit units	0 0 0 1 (30H 30H 30H 31H) or 0 0 8 1 (30H 30H 38H 31H)	01H 00H or 81H 00H
	0 0 0 3 (30H 30H 30H 33H) or 0 0 8 3 (30H 30H 38H 33H)	03H 00H or 83H 00H
When writing data in word units	0 0 0 0 (30H 30H 30H 30H) or 0 0 8 0 (30H 30H 38H 30H)	00H 00H or 80H 00H
	0 0 0 2 (30H 30H 30H 32H) or 0 0 8 2 (30H 30H 38H 32H)	02H 00H or 82H 00H

*1: Use subcommand 008□ if accessing a link direct device, module access device, or CPU buffer memory access device. When the subcommand is set to 008□, the message format will differ. (Reading, writing by specifying device extension)

- Number of devices for bit access, Number of devices for word access, Number of devices for double-word access

Specify the number of target devices.

Subcommand	Item	Description
0003 0002	Number of devices for bit access	Specify the number of bit devices in 1-bit units.
	Number of devices for word access	Specify the number of devices for 1 word access. The applicable units are 16-bit units for bit devices, and 1-word units for word devices.
	Number of devices for double-word access	Specify the number of devices for 2 word access. The applicable units are 32-bit units for bit devices, and 2-word units for word devices.
0001 0000	Number of devices for bit access	Specify the number of bit devices in 1-bit units.
	Number of devices for word access	Specify the number of devices for 1 word access. The applicable units are 16-bit units for bit devices, and 1-word units for word devices.
	Number of devices for double-word access	Specify the number of devices for 2 word access. The applicable units are 32-bit units for bit devices, and 2-word units for word devices.

- Device code, Device No., Write data

  Specify devices to be written.

  When writing data in bit units, specify bit devices.

  Specify write data in hexadecimal.

Item	Description
Word access	Specify devices based on the number set in the request data for word access. It is not necessary to specify devices when "0" is set.
Double-word access	Specify devices based on the number set in the request data for double-word access. It is not necessary to specify devices when "0" is set.

- Set/reset

  Specify ON/OFF for bit devices.

Item	Subcommand	Data to be written		Remarks
		When turned ON	When turned OFF	
ASCII code	0003 0002	"0001"	"0000"	Send 4 digits in order from "0"
	0001 0000	"01"	"00"	Send 2 digits in order from "0"
Binary code	0003 0002	0100H	0000H	Either of the 2-byte numerical values on the left is sent.
	0001 0000	01H	00H	Either of the 1-byte numerical values on the left is sent.

■ Response data

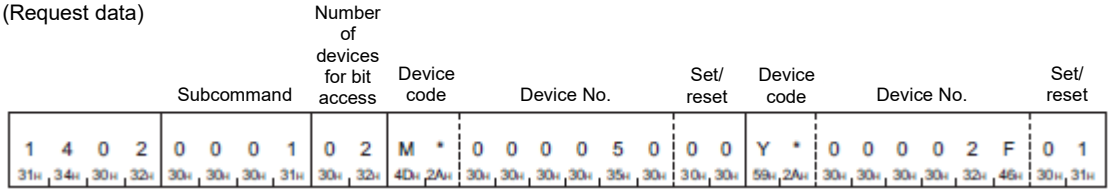
There is no Write Random command response data.

■ Communication example (when writing data in bit units)

Turn M50 OFF, and turn Y2F ON.

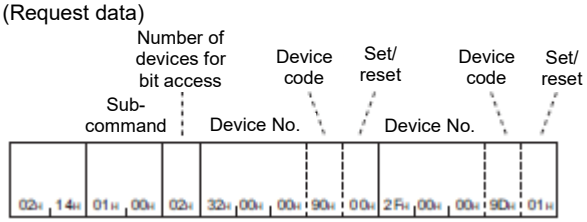
- When performing data communication in ASCII code

(Request data)



- When performing data communication in binary code

(Request data)



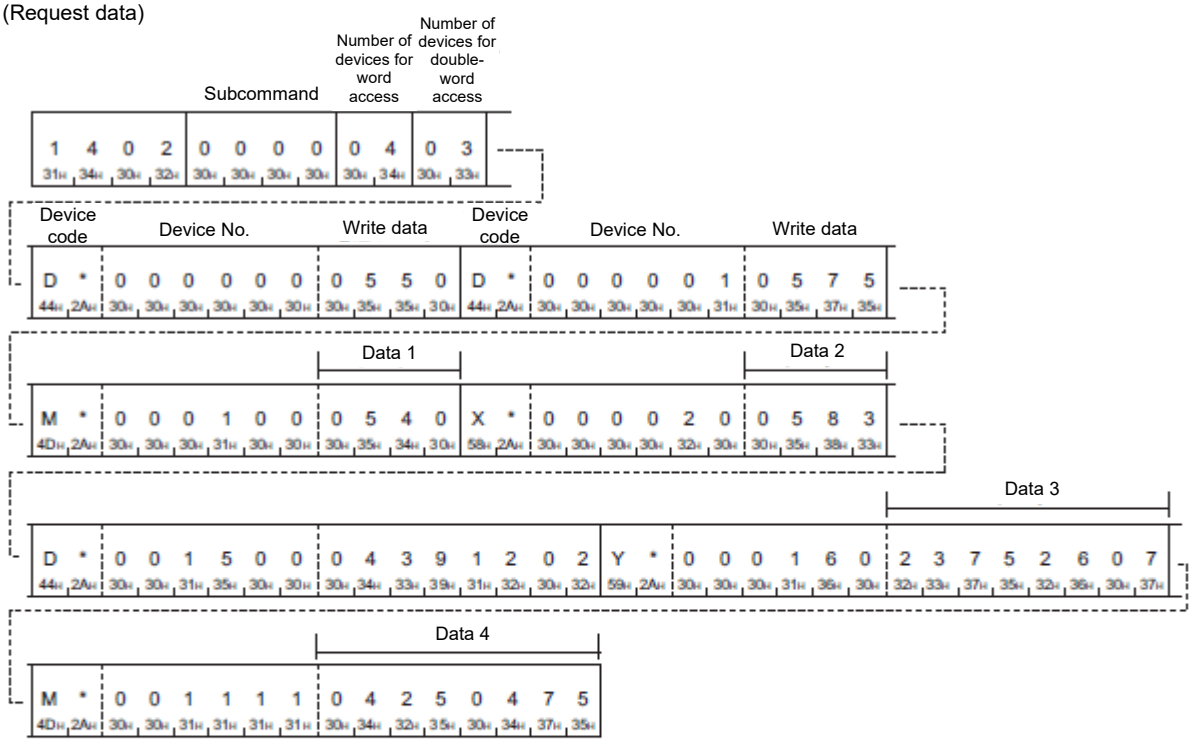
■ Communication example (when writing data in word units)

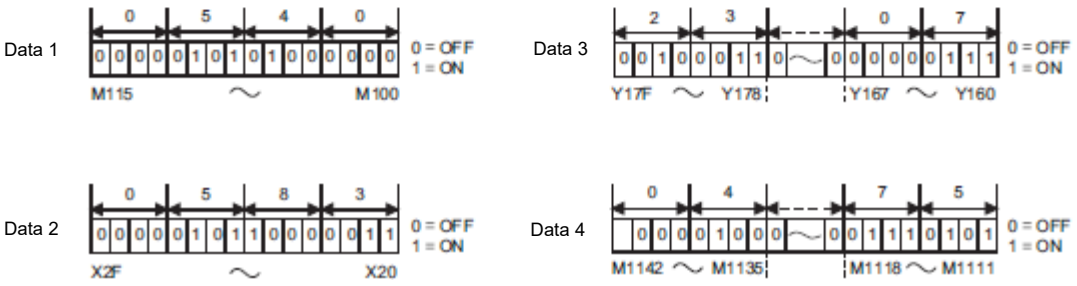
Write values to devices as follows.

Item	Device to be written
Word access	D0, D1, M100 to M115, X20 to X2F
Double-word access	D1500 to D1501, Y160 to Y17F, M1111 to M1142

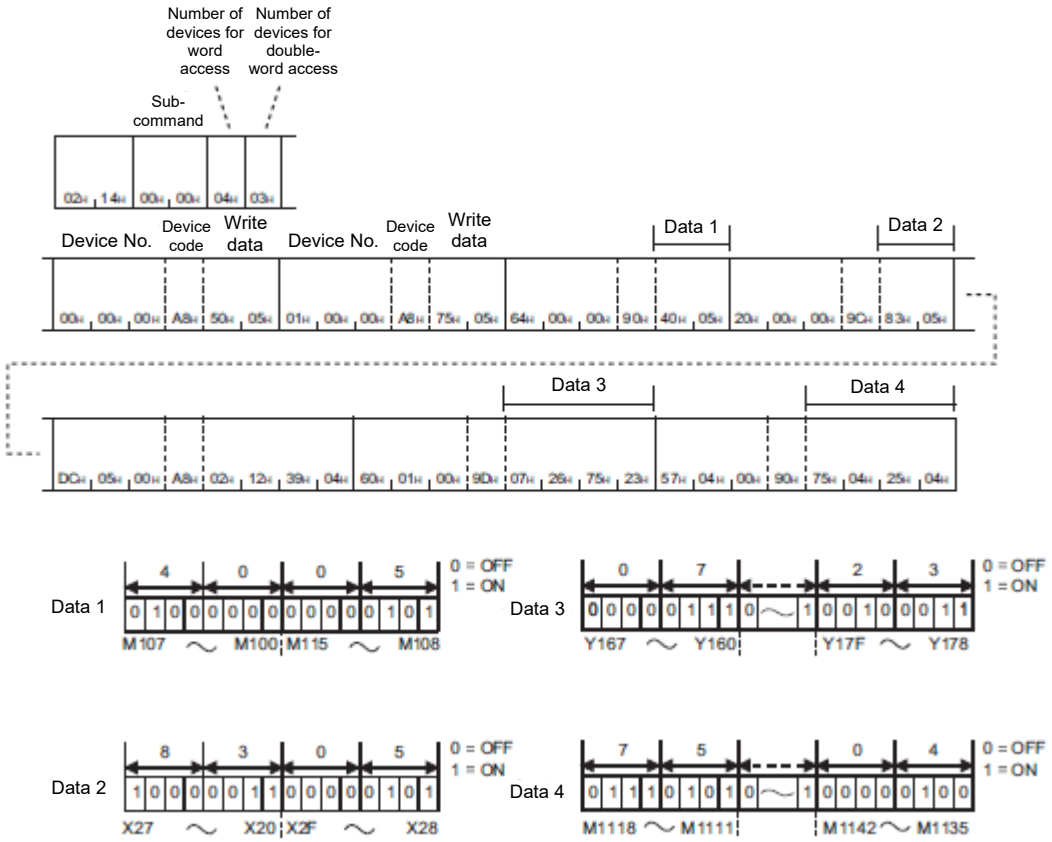
- When performing data communication in ASCII code

(Request data)





- When performing data communication in binary code
  (Request data)

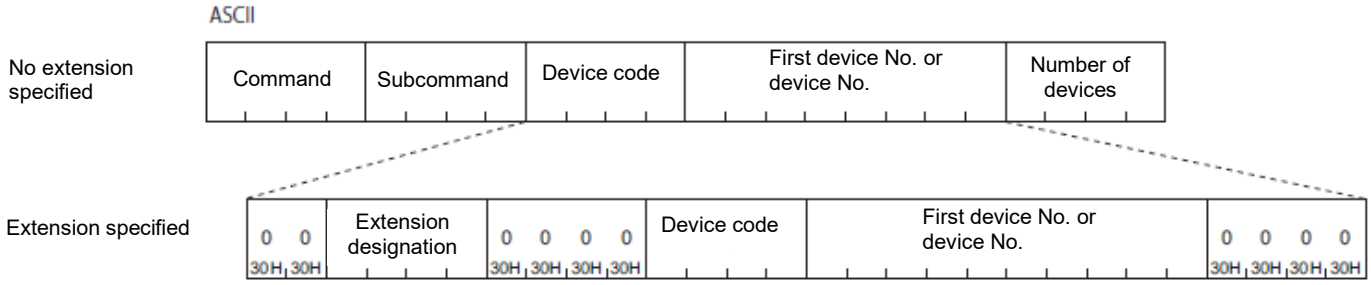


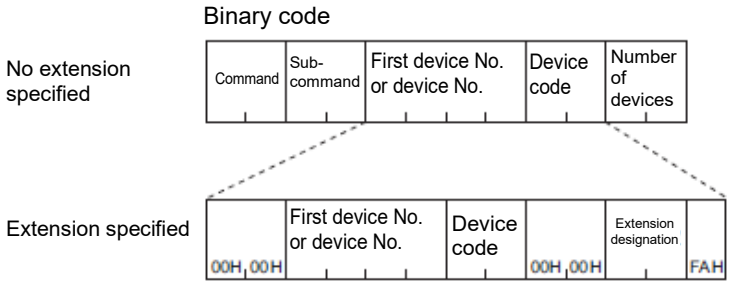
3.5.7.2.6. Accessing CPU Buffer Memory Access Devices

Access RCPU buffer memory.

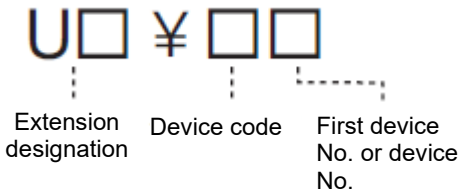
■ Request data

For Read (Command: 0401), refer to the following example. For other commands, with the exception of device codes, start device numbers, and device numbers, access based on the format for each command.





CPU module access device and request data compatibility is as follows.

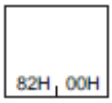


- Command

Access is possible with the following commands.

Item		Command
Category	Operation	
Device	Read	0401
	Write	1401
	Read Random	0403
	Write Random	1402

- Subcommand

ASCII code	Binary code
0 0 8 2 30H 30H 38H 32H	

- Extension designation

  Specify the CPU module start I/O number.

ASCII code	Binary code
Specify the start I/O number in hexadecimal (3 ASCII code digits). When the start I/O number is expressed with 4 digits, specify with the first 3 digits. U 3 E □ 55H 33H 45H	Specify the start I/O number in hexadecimal (2 bytes). When the start I/O number is expressed with 4 digits, specify with the first 3 digits.

  The start I/O numbers for the specified CPU modules are as follows.

CPU module CPU No.	Start I/O number
CPU No.1	03E0H
CPU No.2	03E1H
CPU No.3	03E2H
CPU No.4	03E3H

- Device code

  Specify the following device codes.

Device	Category	Device code		Device No. range	
		ASCII code *1	Binary code		
CPU buffer memory	Word	G***	00ABH	Specify within the range of device numbers held by the access destination unit.	Decimal
CPU buffer memory fixed cycle area		HG** *2	002EH		

*1: For ASCII code, specify device codes with 4 digits. For device codes with 3 digits or less, add an asterisk (*) (ASCII code: 2AH) or a space (ASCII code: 20H) after the device code.

*2 :When the CR800-Q controller is used, the HG devices cannot be used as SLMP-compatible devices.

- Start device or device number

  Specify the start device or device number in decimal.

  Specify the subcommand 0032/0082 device number (ASCII code) with 10 bytes (10 digits).

■ Response data

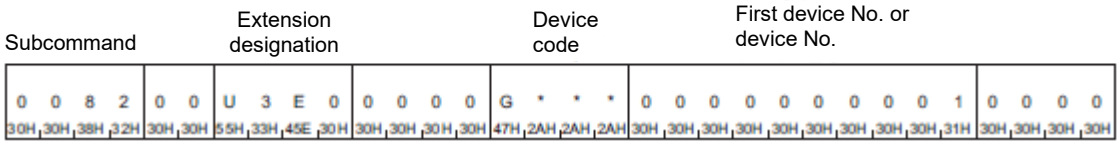
The same applies if no extension is specified.

■ Communication example

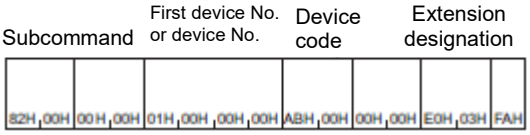
The start I/O number accesses the 03E0H CPU module buffer memory (address: 1).

Show the request data when performing communication with ASCII code.

- When performing data communication in ASCII code
  (Request data)



- When performing data communication in binary code
  (Request data)



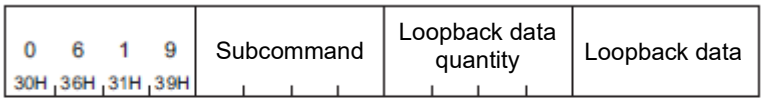
3.5.7.3. Self Test (Loopback Test) (Command: 0619)

Perform a test to determine whether communication between external devices and Ethernet-equipped modules is normal. By performing a loopback test, it is possible to confirm whether the connection with the external device is correct, and whether data communication is functioning properly.

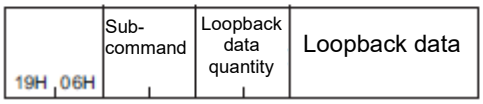
* Loopback tests can only be performed for Ethernet-equipped modules connected to external devices. Loopback tests cannot be used for other station modules connected via a network.

■ Request data

ASCII



Binary code



- Subcommand

Subcommand	
ASCII code	**Binary code**
0 0 0 0 30H 30H 30H 30H	00H 00H

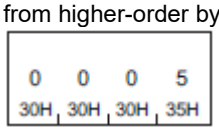
- Loopback data quantity

  Specify the "Loopback data" quantity in bytes. The range that can be specified is 1 to 960 bytes.

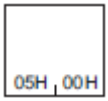
  Example

  When the loopback data quantity is 5 bytes

  When using ASCII, convert the number of bytes to 4 ASCII code digits (hexadecimal), and send them in the order from higher-order byte to lower-order byte.

  When using binary code, send the number of 2-byte characters indicating the number of bytes in the order from lower-order byte to higher-order byte.

- Loopback data

  Specify the data sent and received when performing a loopback test.

  When performing data communication in ASCII code, specify a 1-byte character string ("0" to "9", "A" to "F") for data with maximum of 960 characters, and send from the start.

  When performing data communication in binary code, convert the 1-byte character ("0" to "9", "A" to "F") code to a 1-byte numerical value, and send data with maximum of 960 bytes from the starting character code.

■ Request data

The same content as that in the "Loopback data quantity" and "Loopback data" specified in the request message is stored.

ASCII

Loopback data quantity	Loopback data

Binary code

Loopback data quantity	Loopback data

■ Communication example

Perform a loopback test with loopback data "ABCDE".

- When performing data communication in ASCII code
  (Request data)

	Subcommand	Loopback data quantity	Loopback data
0 6 1 9	0 0 0 0	0 0 0 5	A B C D E
30H 36H 31H 39H	30H 30H 30H 30H	30H 30H 30H 35H	41H 42H 43H 44H 45H

(Response data)

Loopback data quantity	Loopback data
0 0 0 5	A B C D E
30H 30H 30H 35H	41H 42H 43H 44H 45H

- When performing data communication in binary code
  (Request data)

Sub-command		Loopback data quantity	Loopback data
			A B C D E
19H 06H	00H 00H	05H 00H	41H 42H 43H 44H 45H

(Response data)

Loopback data quantity	Loopback data
	A B C D E
05H 00H	41H 42H 43H 44H 45H

3.5.8. End Code

The following is a list of stored end codes.

Code category	End code	Description	Processing details
Processing success	0000H	The request was successfully processed.	Indicates that the request was correctly processed.
Standard error	C059H	● The command or subcommand is specified incorrectly. ● A command other than the prescribed sequence was received.	Review the command and subcommand, and send again.
	C05CH	The request message has an error.	Review the request content, and send again.
	C061H	The request data length is inconsistent with the number of data.	Review the request data content or request data length, and send again.
	CEE1H	The request message size exceeds the allowable range.	Review the request content, and send again.
	CEE2H	The response message size exceeds the allowable range.	Review the request content, and send again.

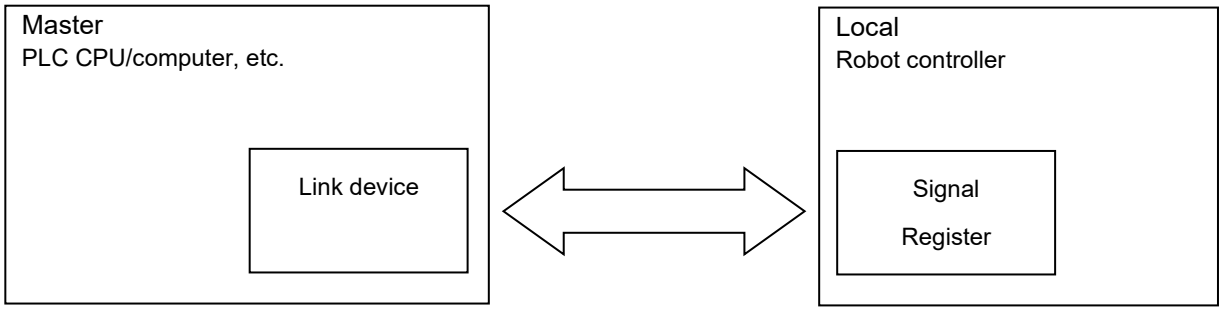
3.6. CC-Link IE Field Network Basic function

3.6.1. Overview

The CR800 series supports this function. It is not supported by the CR750/CR751 series.

CC-Link IE Field Network Basic is an FA network to which general-purpose Ethernet was applied.

The MELFA FR series supports CC-Link IE Field Network Basic local stations, and the signals and registers of robot controllers can be input and output via periodic communication (cyclic transmission) with a PLC, computer, or other master station.



PLC CPUs in the MELSEC iQ-R/iQ-F/Q/L series and robot controllers in the MELFA FR series have Ethernet built-in as standard, so they do not require dedicated options. This allows system construction with minimal configuration, thereby saving space and reducing the cost.

Because CC-Link IE Field Network Basic has application software that runs on a general-purpose Ethernet protocol stack, TCP/IP transmissions can intermingle. Therefore, the products that support CC-Link IE Field Network Basic and the products that support Ethernet can be connected by a single cable, which makes it easy to construct the system however you want.

3.6.2. Supported version

Controller type	Version	Remarks
CR800-R, CR800-D, CR860-R, CR860-D	A1d or later	CR75x-Q and CR75x-D are not supported
CR800-Q, CR860-Q	A2 or later	

Computer support SW	Version	Remarks
RT ToolBox3	1.10L or later	

3.6.3. Specifications

The communication specifications of CC-Link IE Field Network Basic are described below.

3.6.3.1. Communication specifications

The communication specifications of the robot are as follows.

Item		Description
Transmission speed		100Mbps
Communication method		UDP/IP
Port number		61450
IP address		192.168.0.20 (initial value, set with NETIP parameters)
Number of occupied stations		Up to four local stations
Connection cable		Standard Ethernet cable, category 5e or higher (STP cable)
Protocol version		2.00
Maximum number of link points	Remote input, RX (*1)	Number of occupied stations×64 points
	Remote output, RY (*2)	Number of occupied stations×64 points
	Remote register, RWr (*3)	Number of occupied stations×32 points
	Remote register, RWw (*4)	Number of occupied stations×32 points

(*1) Remote input, RX: Information input from local to master through bitwise operations.

(*2) Remote output, RY: Information output from master to local through bitwise operations.

(*3) Remote register, RWr: Information input from local to master through 16-bit (1 word) operations.

(*4) Remote register, RWw: Information output from master to local through 16-bit (1 word) operations.

CAUTION If the Modbus TCP function is enabled, the CC-Link IE Field Basic function is disabled.

3.6.4. Parameters

Specify settings with the following parameters.

Parameter	Parameter name	No. of arrays No. of characters	Description	Factory setting
CC-Link IE Field Network Basic function, switch enable/disable	CCLBENA	Integer 1	Enable the CC-Link IE Field Network Basic function. 0: Disable / 1: Enable	0 (disable)
CC-Link IE Field Network Basic function, setting at data link error	CCLBCLR	Integer 1	When the data link malfunctions, specify whether the input status of CC-Link IE Field Network Basic is cleared to OFF or 0 or is retained. 0: Clear input / 1: Retain input	0 (clear input)

3.6.5. Support of robot I/O signals and link devices

The support of robot I/O signals and link devices for RX/RY and RWr/RWw are indicated here.

As shown below, the link relays RX/RY and link registers RWr/RWw of a master station's link device interacts with the I/O signals (6000 to max. 6255) and I/O registers (6000 to max. 6127) of each robot. Even if the station number changes, the I/O signals of the robot are the same. Also, the number of stations occupied by a robot can be set from 1 to 4, designated by the setting for number of stations occupied by master stations.

Number of stations occupied by robot	Input Output	Bitwise device				1 word device			
		Points	Link relay RX/RY (*1)	I/O signal		Points	Link register RWr/RWw (*2)	I/O register	
				Start	End			Start	End
1	Input	64	RY0 to RY3F	6000	6063	32	RWw0 to RWw1F	6000	6031
	Output	64	RX0 to RX3F	6000	6063	32	RWr0 to RWr1F	6000	6031
2	Input	128	RY0 to RY7F	6000	6127	64	RWw0 to RWw3F	6000	6063
	Output	128	RX0 to RX7F	6000	6127	64	RWr0 to RWr3F	6000	6063
3	Input	192	RY0 to RYBF	6000	6191	96	RWw0 to RWw5F	6000	6095
	Output	192	RX0 to RXBF	6000	6191	96	RWr0 to RWr5F	6000	6095
4	Input	256	RY0 to RYFF	6000	6255	128	RWw0 to RWw7F	6000	6127
	Output	256	RX0 to RXFF	6000	6255	128	RWr0 to RWr7F	6000	6127

(*1) Remote input, RX: Information input from local to master through bitwise operations.
Remote output, RY: Information output from master to local through bitwise operations.

(*2) Remote register, RWr: Information input from local to master through 16-bit (1 word) operations.
Remote register, RWw: Information output from master to local through 16-bit (1 word) operations.

3.6.6. Setup procedure

The steps up to using the CC-Link IE Field Network Basic function are indicated here.

The system configuration used as an example in this description has MELSEC PLC R16CPU as the master station and FR series robot RV-4FR-D as the local station.

Network configuration → Chapter 3.6.6.1

Build the network and then set the necessary parameters.

↓

Network diagnostics → Chapter 3.6.6.2

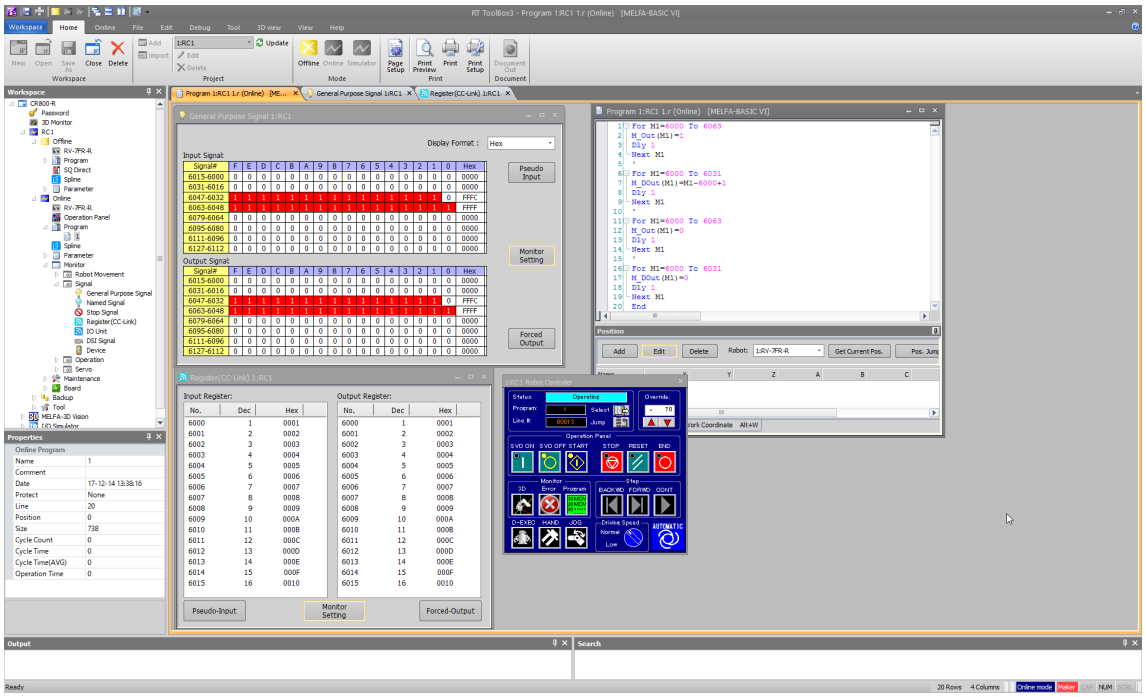
Run network diagnostics to confirm whether normal communication is possible with the state of the connection cables and the parameters that were set.

↓

Programming → Chapter 3.6.6.3

Write the program.

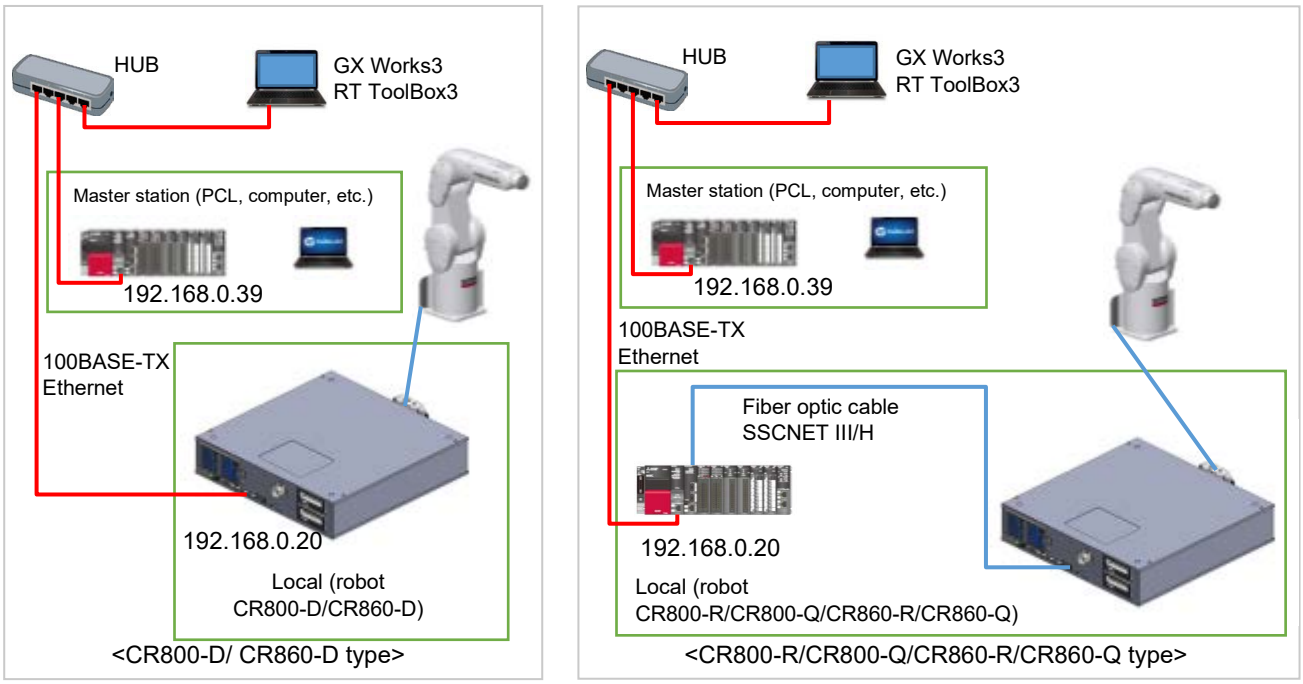
Confirm the operation by using the General Purpose Signal window and Register window on RT ToolBox3. Refer to the instruction manual of RT ToolBox3 for how to use signal monitoring, how to operate the robot program, and so on.



3.6.6.1. Network configuration

Build the network like in the following figure using 100BASE-TX Ethernet cables, and then set the necessary parameters.

In the following configurations, the master station is a PLC, and the local station is a robot.



(1) Master station

IP address of PLC R16CPU: 192.168.0.39 / Subnet mask: 255.255.255.0

(2) Local

IP address of robot controller: 192.168.0.20 / Subnet mask: 255.255.255.0

⚠CAUTION

- For the CR800-R/CR800-Q/CR860-R/CR860-Q type, use the Ethernet connector of the R16RTCPU/Q172DSRCPU module.
  The Ethernet connector of the CR800-R/CR800-Q/CR860-R/CR860-Q robot controller cannot be used.
- The PLC CPU acting as the master station must have a firmware version that supports the CC-Link IE Field Network Basic function. Refer to the website or manual of each device for details.

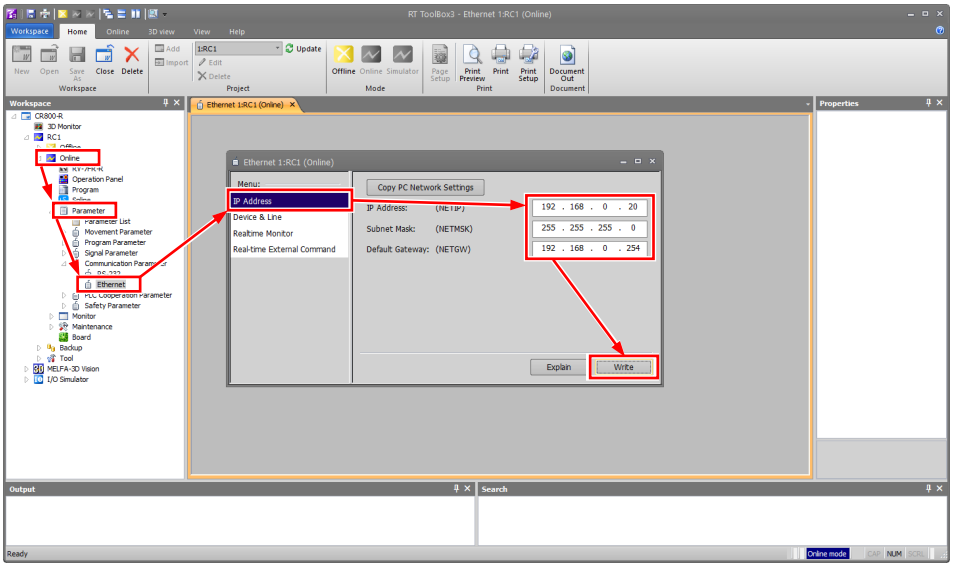
Download the profile (csp+ file) of the robot controllers from the website of the CC-Link Partner Association (Products).

https://www.cc-link.org/

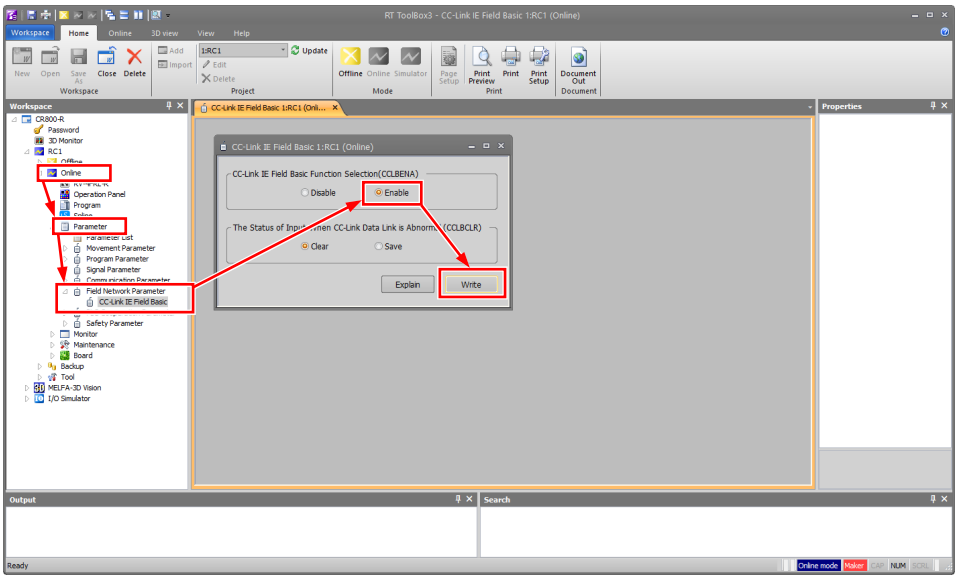
https://www.cc-link.org/en/products/index.html

■ Local station parameter settings

1. In RT ToolBox3, open "Online" → "Parameter" → "Ethernet", and set the IP address of the robot.
   Here, the initial value 192.168.0.20 is being used. If you do not change the initial value, it is not necessary to press Write.



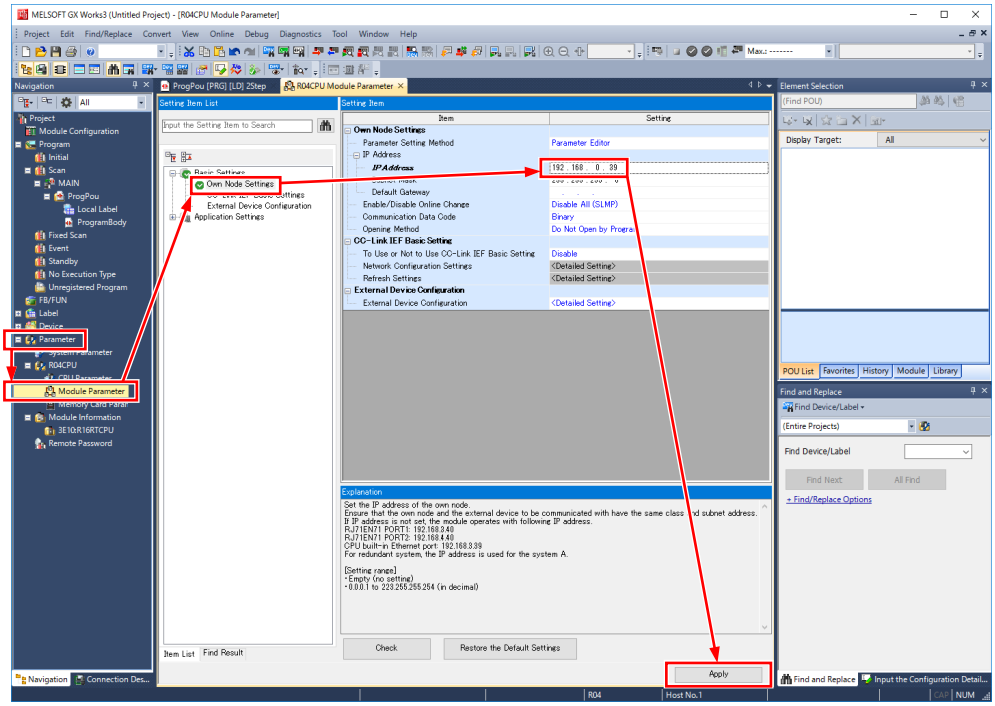
2. Next, open "Online" → "Parameter" → "Field Network Parameter" → "CC-Link IE Field Basic", and change the function selection to "Enable". Lastly, press "Write" and then reset the power of the robot controller.



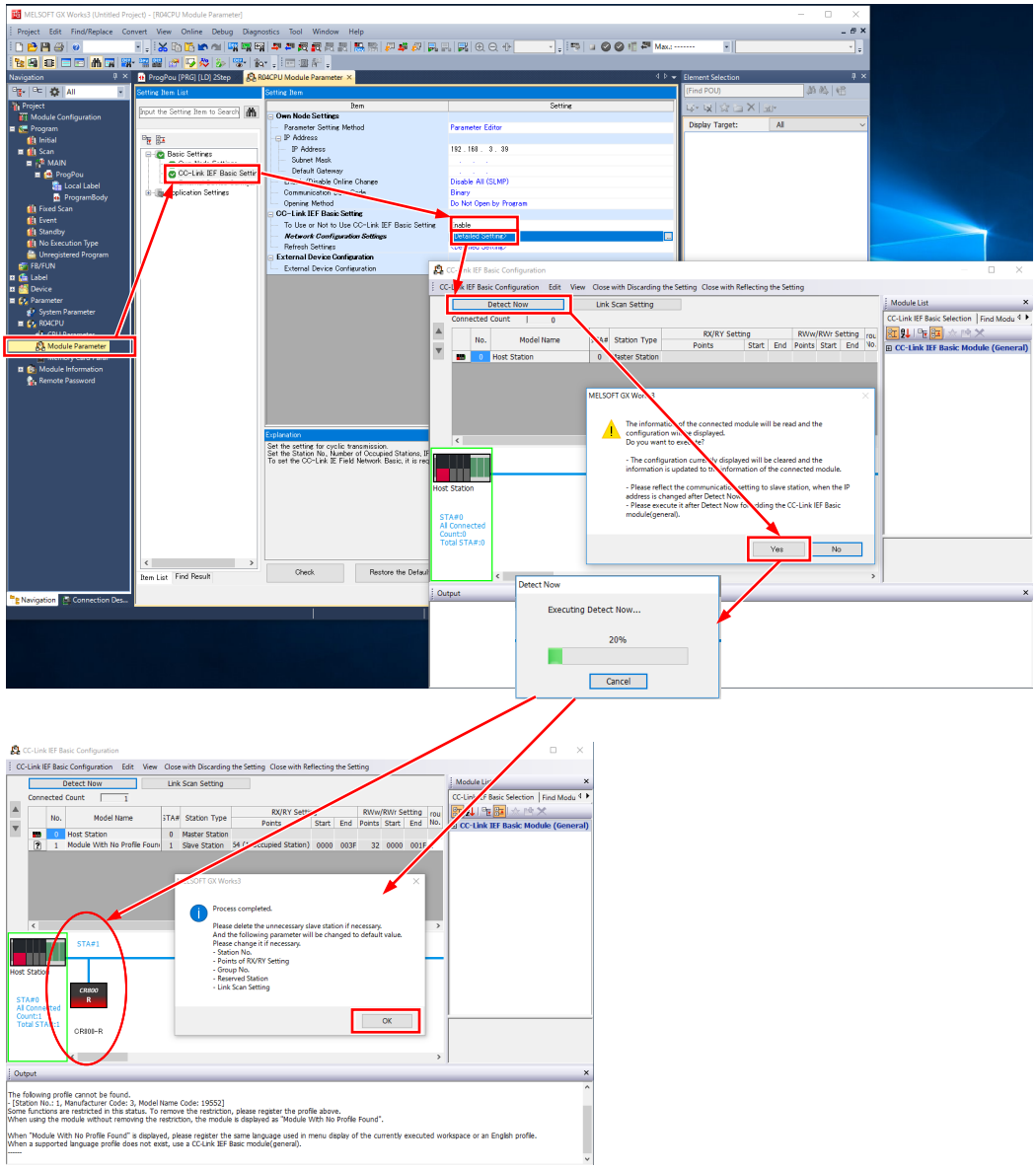
■ Master station parameter settings

Set the parameters as follows.

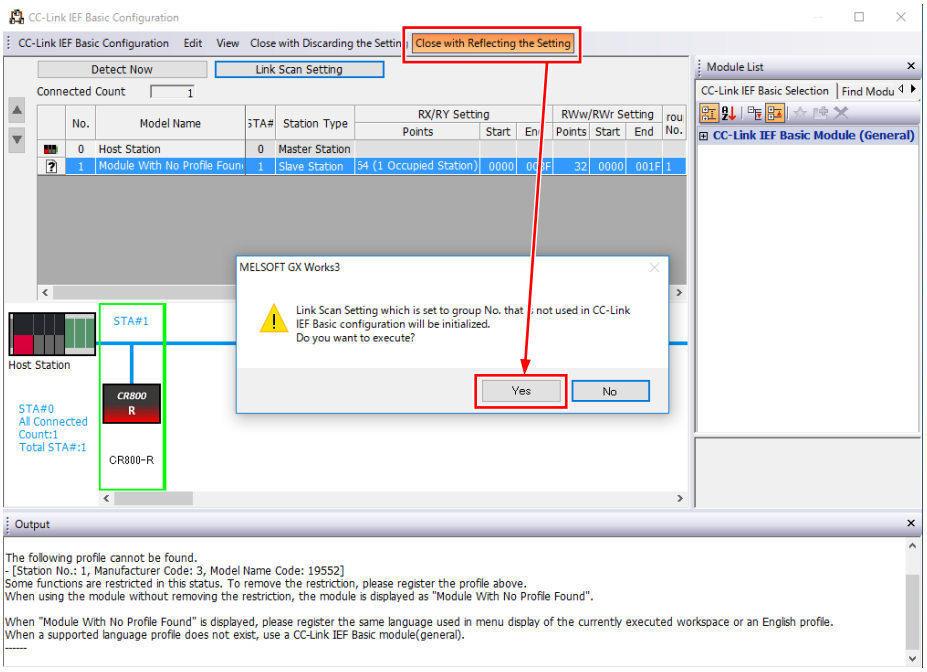
1. In GX Works3, open "Parameter" → "Module Parameter" → "Own Node Settings". Then set the IP address of PLC R16CPU under "IP Address", and press "Apply" to finalize the settings. Next, go to "Online" → "Write to PLC" to write the parameters and establish Ethernet communication. Finally, reset the power and restart.



2. In GX Works3, go to "CC-Link IEF Basic Setting" in "Module Parameter" and set "Enable" for whether to use or not to use the CC-Link IEF Basic Setting. Then open "<Detailed Setting>" beside the network configuration settings. Here select "Detect Now". When the automatic detection is complete, the detected local stations are displayed once automatic detection finishes., STA#1 for CR800-R is added.



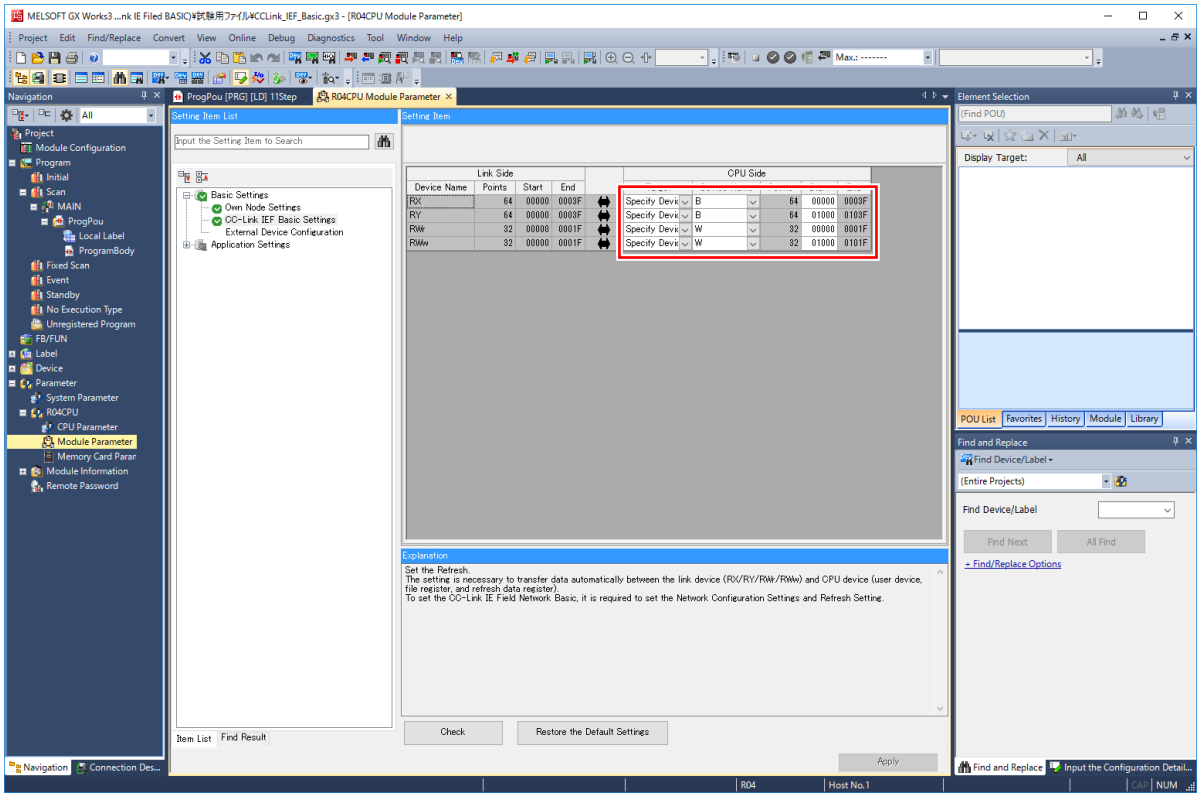
3. Press "Close with Reflecting the Setting" and then select "Yes" on the confirmation dialog box that is displayed.



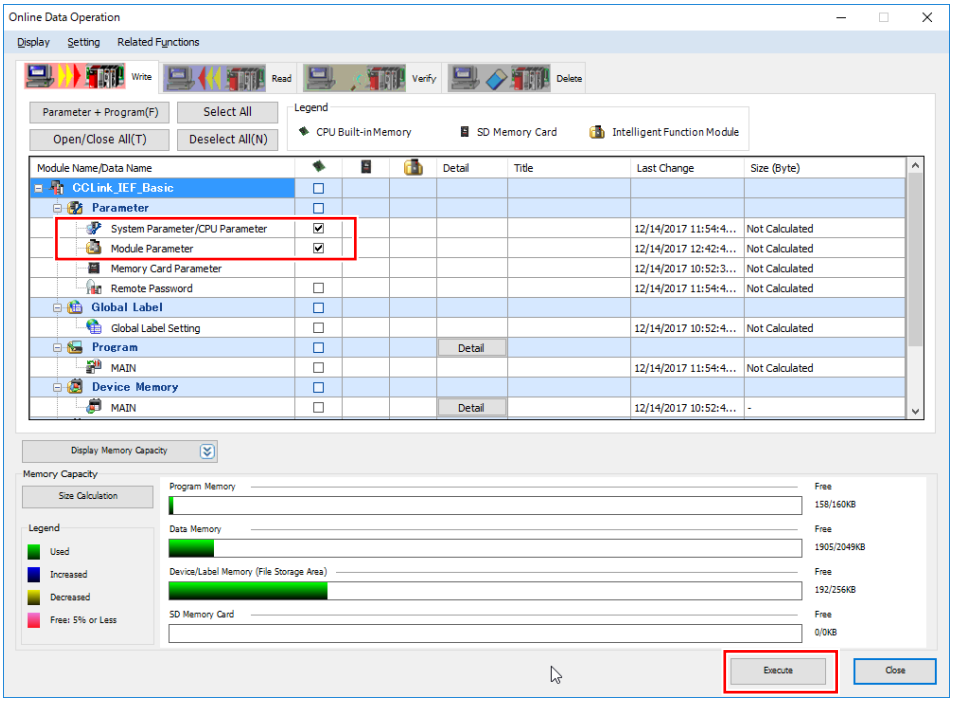
4. Refresh the settings.

Here the RX/RY/RWr/RWw devices on the link side are assigned to the desired devices on the CPU side.

In the following example RX0 to RX3F (64 points) is assigned to B0 to B3F; RY0 to RY3F (64 points) is assigned to B1000 to B103F; RWr0 to RWr1F (32 points) is assigned to W0 to W1F; and RWw0 to RWw1F (32 points) is assigned to W1000 to W101F.



5. Finally, go to the menu bar's "Online" → "Write to PLC", and press "Execute" to write the parameters to the PLC CPU. When the writing is complete, reset the power and restart.

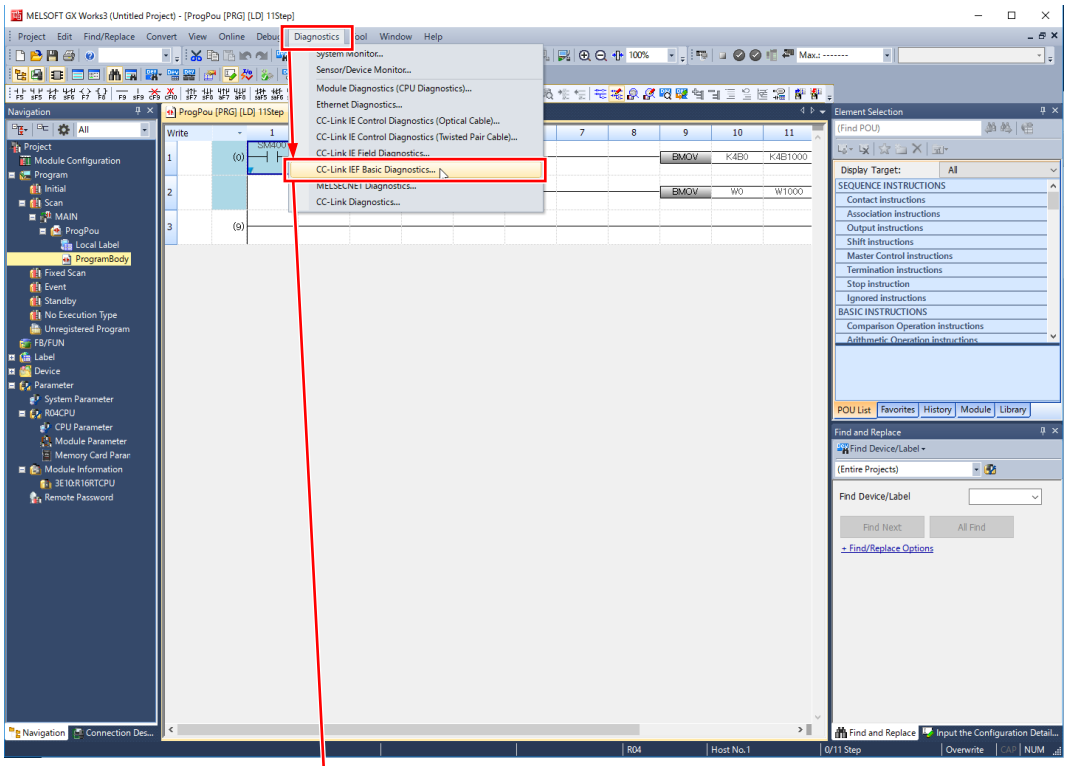


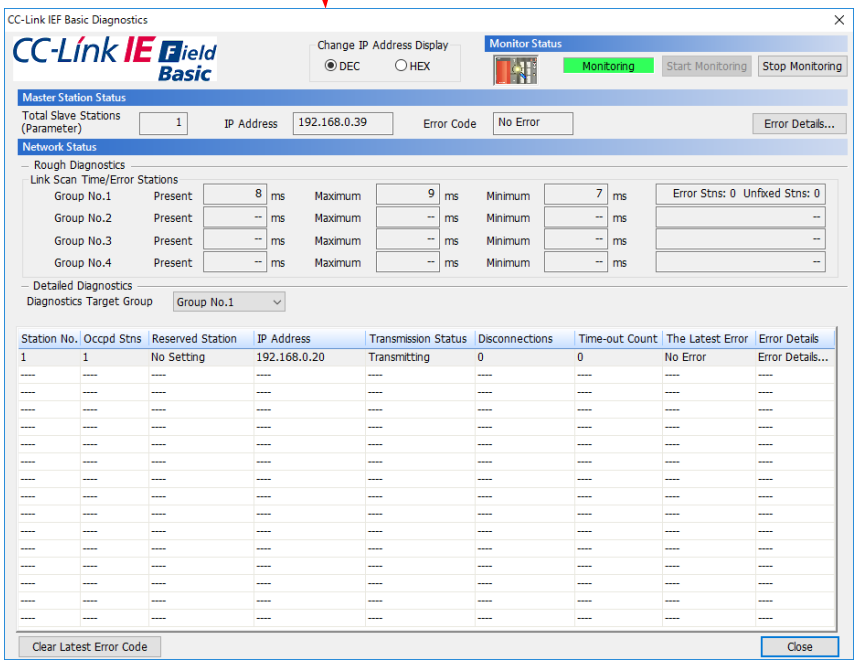
The settings are now complete. Next, run network diagnostics to confirm whether normal communications are possible.

3.6.6.2. Network diagnostics

By using CC-Link IEF Basic Diagnostics, confirm whether normal communication is possible with the state of the connection cables and the parameters that were set.

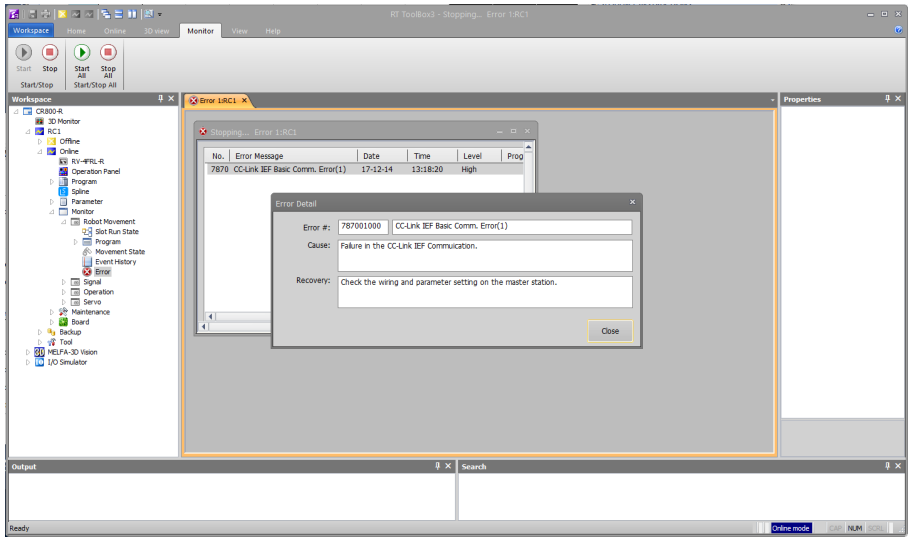
In GX Works3, select "Diagnostics" → "CC-Link IEF Basic Diagnostics" to open the diagnostics screen.



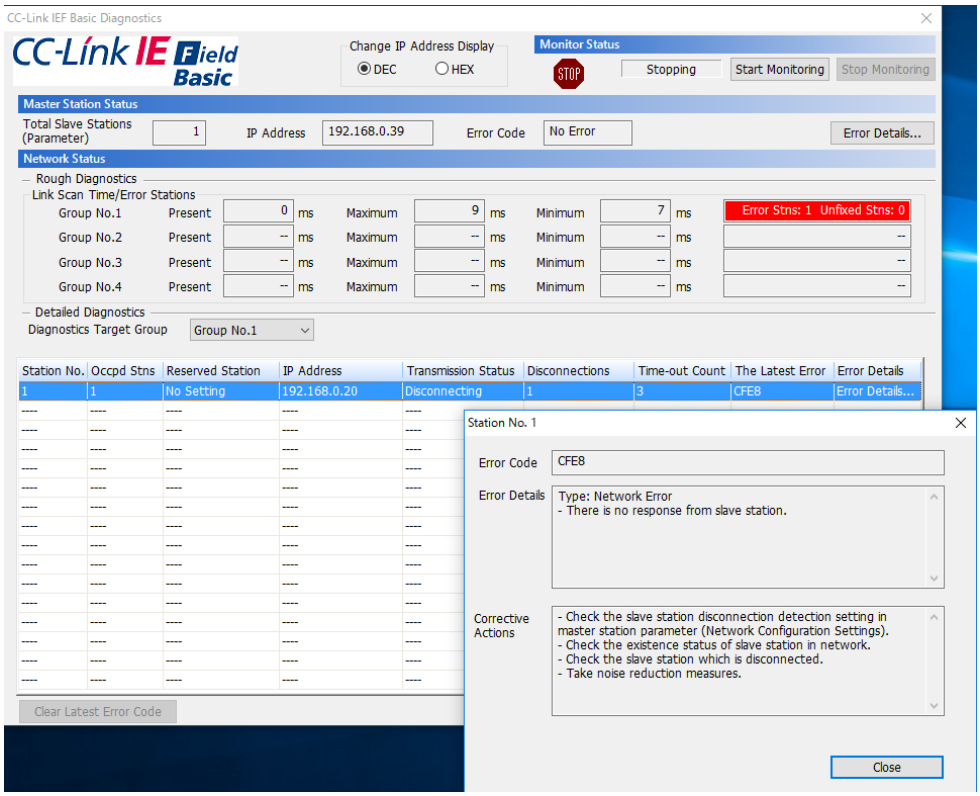


After the robot local station has established proper communication with the master station, if the master station goes down or the wiring becomes disconnected and communication with the master station is blocked, error 7870 is issued on the robot controller.

The error number of the robot controller and its details can be checked on the error monitor screen of RT ToolBox3.



For the PLC CPU master station, the station with the error can be confirmed in the network status section of the CC-Link IEF Basic Diagnostics screen in GX Works3.

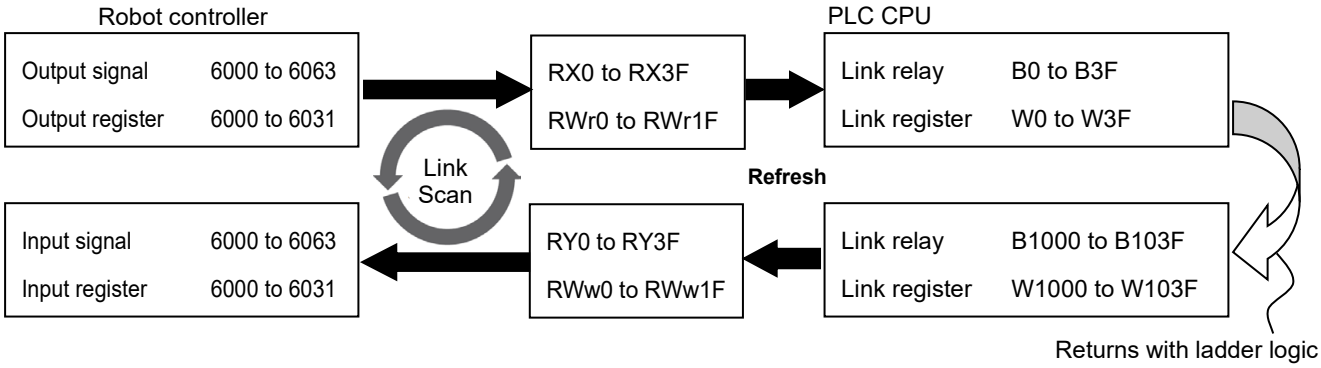


3.6.6.3. Programming

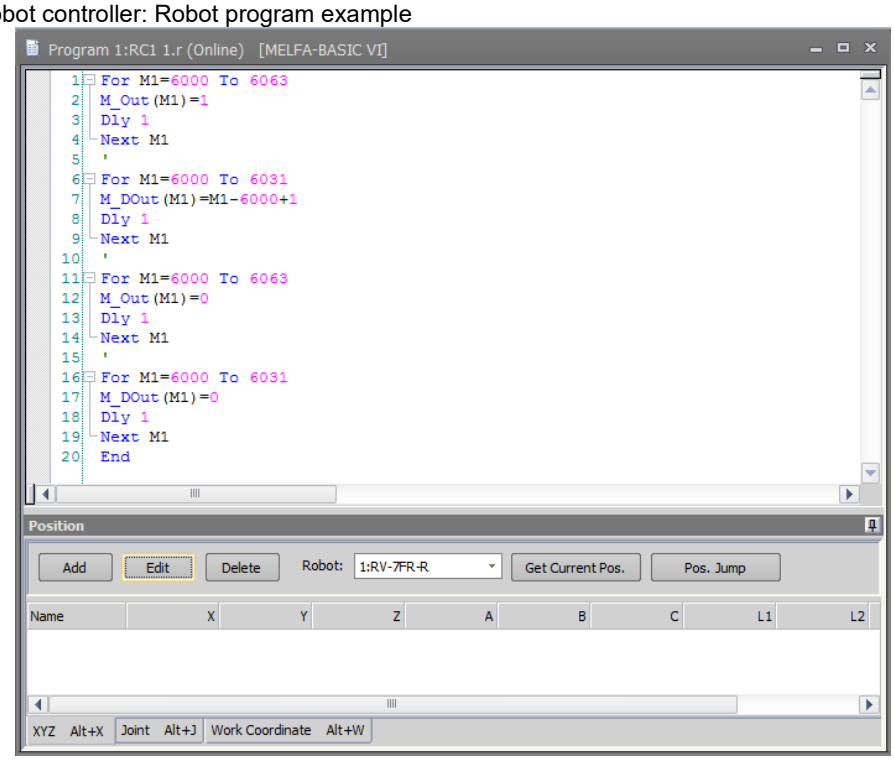
Write the program.

In the following example, the signal and register value output by the robot program of the robot controller is returned by the PLC CPU's ladder program and reflected in the robot's input signal and register.

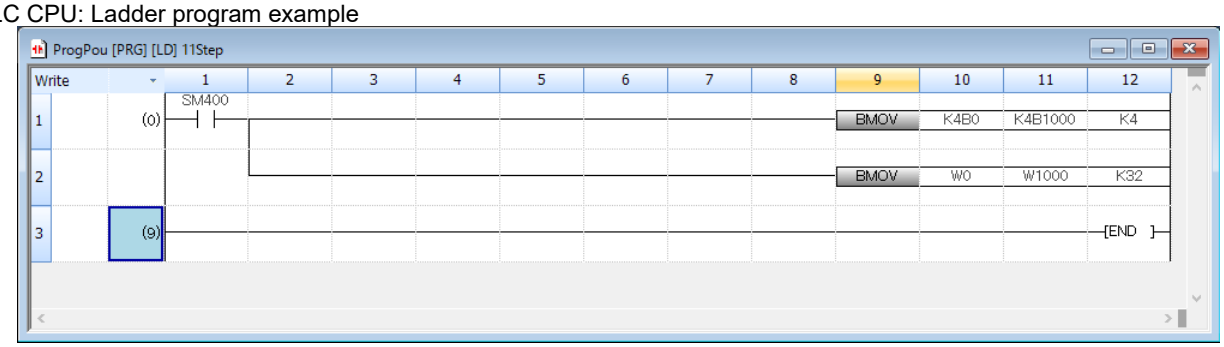
<Example>



(1) Robot controller: Robot program example



(2) PLC CPU: Ladder program example

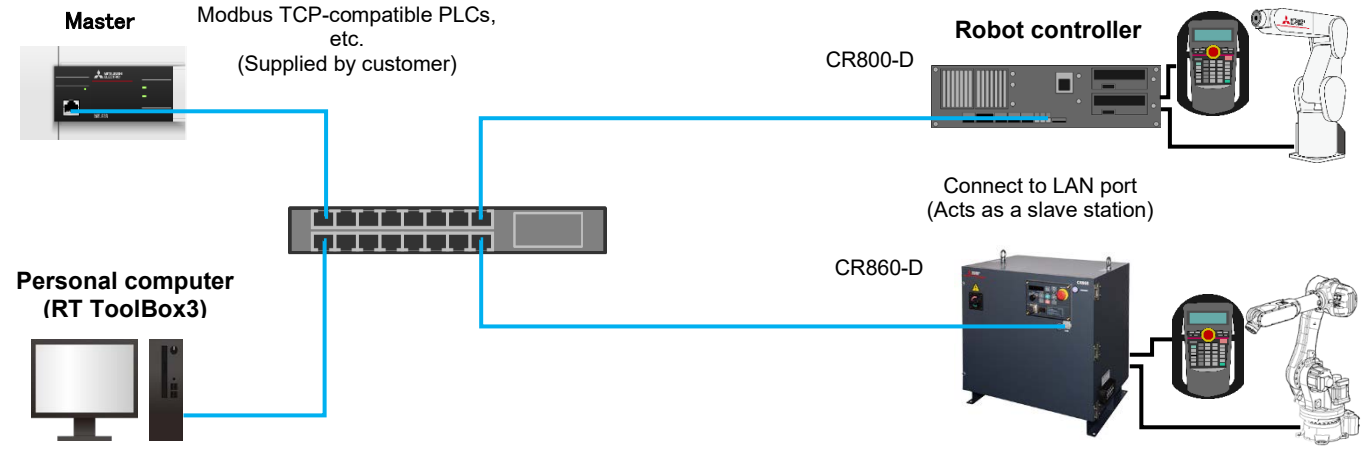


3.7. Modbus TCP communication function

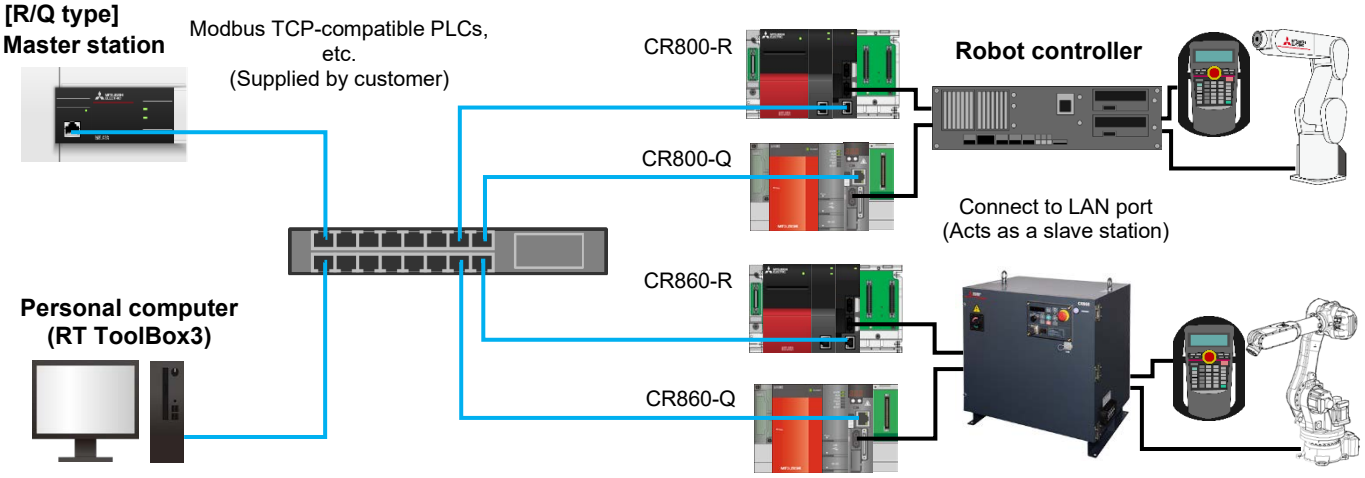
3.7.1. Overview

The CR800 series supports this function. It is not supported by the CR750/CR751 series.
Modbus TCP is an Ethernet-based communication protocol for industrial automation technology.
The MELFA FR series supports Modbus TCP slave stations and allows input and output of signals and registers of robot controllers via communication with master stations such as PLCs and personal computers (standard MODBUS functions).

[D type]



[R/Q type]
Master station



3.7.2. Supported version

Controller type	Version	Remarks
CR800-R, CR800-D, CR860-R, CR860-D	E4 or later	CR75x-Q and CR75x-D are not supported.
CR800-Q, CR860-Q	E4 or later	

Computer support SW	Version	Remarks
RT ToolBox3	E4 or later	

3.7.3. Specifications

The Modbus TCP specifications are as follows.

Item		Specifications	Remarks
Compatible controllers		CR800 series only	CR75x-Q and CR75x-D are not supported.
Master/slave method		Slave method only	
Number of units that can be communicated with		1	Indicates the maximum number of master stations that can be communicated with.
RTU/ASCII mode		Only RTU mode (binary)	
UDP/TCP		UDP and TCP	Can be selected with parameters.
Communication speed		Depends on network speed (Generally 100Mbps or 1Gbps)	
Topology		A typical Ethernet topology such as star, line, or tree	
Use with SLMP		Not possible	If the Modbus TCP function is enabled, the SLMP function is disabled.
Use with CC-Link		Not possible	The card cannot be installed because an error occurs upon installation due to duplicated access range of the input and outputs.
Use with CC-Link IE Field network		Not possible	
Use with CC-Link IE TSN		Not possible	
Use with EtherCAT		Not possible	
Use with CC-Link IE Field Network Basic		Not possible	If the Modbus TCP function is enabled, the CC-Link IE Field Network Basic function is disabled.
Robot controller I/O		I/O signal numbers: 6000 to 8047 (2048 total) I/O register numbers: 6000 to 6511 (512 total)	The access range is the same as that of CC-Link I/O.
Standard MODBUS functions		The following eight functions are supported. Read coil (FC: 01H) Read input (FC: 02H) Read holding register (FC: 03H) Read input register (FC: 04H) Write one coil (FC: 05H) Write one register (FC: 06H) Write multiple coils (FC: 0FH) Write multiple registers (FC: 10H)	In pseudo input mode, writing via Modbus TCP is not possible, but reading is.
RT ToolBox3	Read option information	Yes	

* The following restrictions apply when using the iQ Care MELFA Support remote service.

MELFA cloud connector cannot be used when the Modbus TCP function is enabled.

Disable the Modbus TCP function with parameter MBTCPENA when using MELFA cloud connector.

3.7.4. Parameters

Specify settings with the following parameters.

Parameter name	No. of arrays No. of characters	Description	Factory setting
NETIP	Character string 1	Set the controller IP address.	192.168.0.20
NETMSK	Character string 1	Set the subnet mask of the controller.	255.255.255.0
NETGW	Character string 1	Set the IP address of the controller gateway.	192.168.0.254
MBTCPENA	Integer 1	Enable the Modbus TCP function. 0: Disable 1: Enable	0
MBTCPPRT	Integer 1	Set the port number to be used for Modbus TCP communication. (502 or 1024 to 65535) However, do not use the numbers listed in the [Prohibited port list].	502
MBTCPCP	Integer 1	Set the Modbus TCP communication protocol. 0: TCP 1: UDP	0

[Prohibited port list]

Port No.	Protocol
5000	SLMP
5001 (*1)	GOT
5006	GOT
5007	GOT
5009	Logging function
10000	MXT
10001-10009 (*2)	Data link
11000	T/B
12000	Real time monitor
43815	Maintenance tool function
45237	SLMP

(*1) If you change the number in the GOTPORT parameter, that number is included.

(*2) If you change the number in the CPRCE** (** = 11 to 19) parameter, that number is included.

3.7.5. Standard MODBUS functions

This section describes the standard MODBUS functions supported by the robot controller.

3.7.5.1. List of standard MODBUS functions

The following is a list of the MODBUS standard functions supported by the robot controller.

Function Code (FC)	Function name	Operation
01H	Read coil	Reads the ON/OFF status of the robot controller input signal.
02H	Read input	Reads the ON/OFF status of the robot controller output signal.
03H	Read holding register	Reads the values of the robot controller input register.
04H	Read input register	Reads the values of the robot controller output register.
05H	Write one coil	Writes the ON/OFF value to one robot controller input signal.
06H	Write one register	Writes the value to one robot controller input register.
0FH	Write multiple coils	Writes the ON/OFF value to multiple robot controller input signals.
10H	Write multiple registers	Writes values to multiple robot controller input registers.

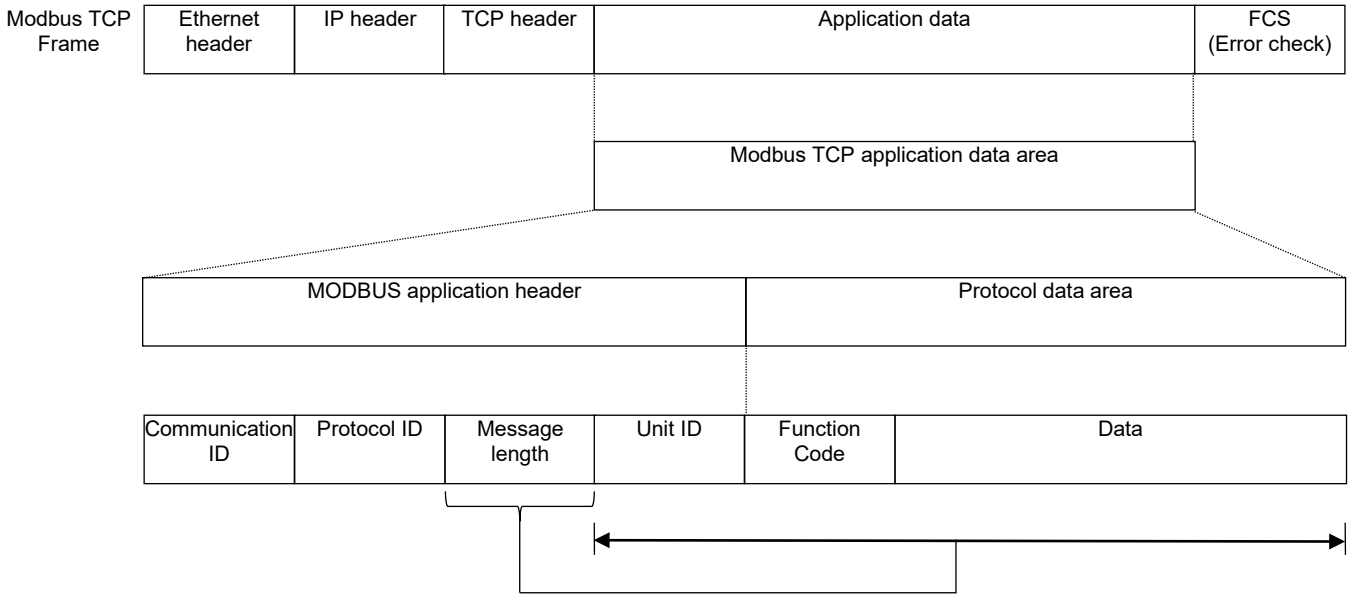
3.7.5.2. Relationship between robot inputs/outputs and MODBUS devices

The following table shows the relationship between robot input/output numbers (signals and registers) and MODBUS device numbers.

Type	Input/ output	Points	Robot			MODBUS device		
			Device	No.		Device	No.	
				Start	End		Start	End
Bit	Input	2048	Input signal	6000	8047	Coil	0	2047
	Output	2048	Output signal	6000	8047	Input	0	2047
Word	Input	512	Input register	6000	6511	Holding register	0	511
	Output	512	Output register	6000	6511	Input register	0	511

3.7.5.3. Frame specifications

The Modbus TCP frame specifications are as follows.



Area name		Area size	Description
MODBUS Application Header	Communication ID	2 bytes	This is used by the master to match response messages from the slave.
	Protocol ID	2 bytes	Indicates the protocol of the protocol data area. Stores "0" when using Modbus TCP.
	Message length	2 bytes	The message size is stored in bytes. The message length after this area is stored.
	Unit ID	1 byte	This is used to specify a slave connected to another line, such as the MODBUS Serial protocol.
Protocol Data area	Function code	1 byte	Specifies the processing to be performed by the master on the slave.
	Data	1 to 252 bytes	■ When the master sends the slave a request message: Stores the requested processing details. ■ When the slave sends the master a response message: Stores the processing result.

3.7.5.4. Protocol data area format by function

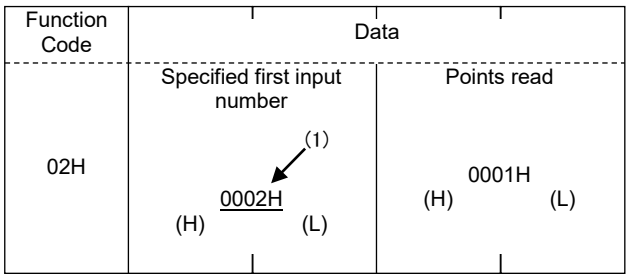
This section describes the format of the protocol data area for standard MODBUS functions.

[Specifying robot controller I/O numbers in a message]

When specifying robot controller I/O numbers in a message, specify "I/O number - 6000".

You can specify I/O numbers from 0 to 2047 (2048 points in total) and register numbers from 0 to 511 (512 points in total).

Example) When reading the status of output signal number 6002 of the robot controller with Read input (function code: 02H)



(1) When reading the status of output signal number 6002, specify 2 (0002H) as the first input number.

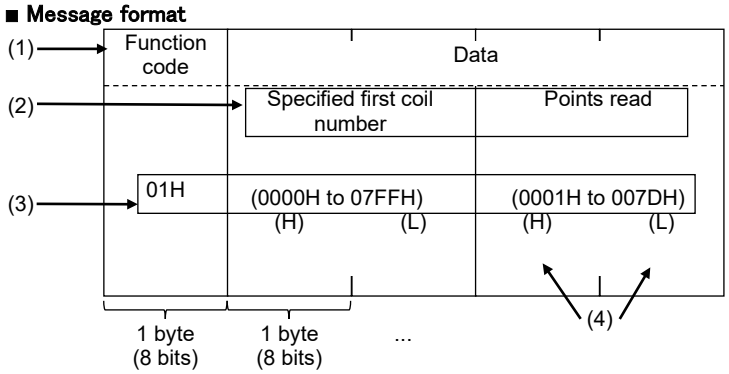
The device number stored in the response message is

"Actually read/written robot controller I/O number - 6000 ".

[How to interpret request and response formats]

This section shows how to interpret the request and response message formats of the standard MODBUS functions.

■ **Message format**



(1) Area name

(2) Frame information

(3) Request message format: Setting range

Response message format: Value stored in response message

(4) When one piece of data is two bytes, the upper byte (8 bits) is (H) and the lower byte (8 bits) is (L).

■ About the message format

The format of the response message issued by the slave to the master differs depending on whether the slave processing completes normally or with an error.

Whether the processing of standard MODBUS functions completes normally or with an error is indicated.

[Error response code]

If processing of the slave (robot controller) completes with an error, an error response code is sent to the master.

Refer to the following section for further information on error response codes.

☞ 3.7.5.5 Error response code

3.7.5.4.1. Read coil (FC: 01H)

[Operation] Reads the ON/OFF status of one or more robot controller input signals.

[Number of points that can be accessed in one message] 1 to 2000 points

[Request message format (master → slave)]

Function code	Data	
	Specified first coil number	Points read
01H	(0000H to 07FFH) (H) (L)	(0001H to 07D0H) (H) (L)

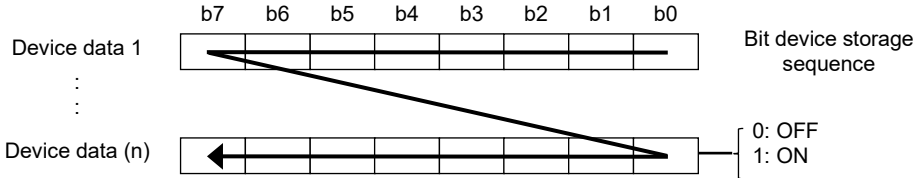
[Response message format (slave → master)]

■ Completed normally

Function code	Data			
	Number of bytes (n) read	Device data 1	...	Device data (n)
01H				

Number of bytes (n) read

• Area for device data 1 to n



• The status of the read coils are stored in the order of low to high bits.
• If the number of read points is not a multiple of eight, the remaining bits equal zero.

■ Completed with error

Function code	Data
81H	Error response code

3.7.5.4.2. Read input (FC: 02H)

[Operation] Reads the ON/OFF status of one or more robot controller output signals.

[Number of points that can be accessed in one message] 1 to 2000 points

[Request message format (master → slave)]

Function code	Data	
	Specified first input number	Points read
02H	(0000H to 07FFH) (H) (L)	(0001H to 07D0H) (H) (L)

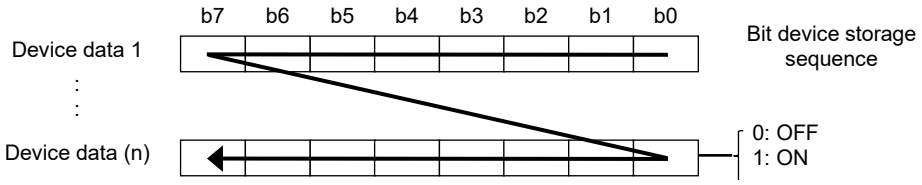
[Response message format (slave → master)]

■ Completed normally

Function code	Data			
	Number of bytes (n) read	Device data 1	...	Device data (n)
02H				

Number of bytes (n) read

• Area for device data 1 to n



• The status of the read inputs are stored in the order of low to high bits.
• If the number of read points is not a multiple of eight, the remaining bits equal zero.

■ Completed with error

Function code	Data
82H	Error response code

3.7.5.4.3. Read holding register (FC: 03H)

[Operation] Reads one or more robot controller input register values.

[Number of points that can be accessed in one message] 1 to 125 points

[Request message format (master → slave)]

Function code	Data	
	Specified first holding register number	Points read
03H	(0000H to 01FFH) (H) (L)	(0001H to 007DH) (H) (L)

[Response message format (slave → master)]

■ Completed normally

Function code	Data			
	Number of read bytes = n × 2	Device data 1	···	Device data (n)
03H		(H) (L)		(H) (L)

Number of read bytes = n × 2

• For example, if n = 4, the number of read bytes is 4 × 2 = 8 bytes.

■ Completed with error

Function code	Data
	Error response code
83H	

3.7.5.4.4. Read input register (FC: 04H)

[Operation] Reads one or more robot controller output register values.

[Number of points that can be accessed in one message] 1 to 125 points

[Request message format (master → slave)]

Function code	Data	
	Specified first input register number	Points read
04H	(0000H to 01FFH) (H) (L)	(0001H to 007DH) (H) (L)

[Response message format (slave → master)]

■ Completed normally

Function code	Data			
	Number of read bytes = n × 2	Device data 1	···	Device data (n)
04H		(H) (L)		(H) (L)

Number of read bytes = n × 2

• For example, if n = 4, the number of read bytes is 4 × 2 = 8 bytes.

■ Completed with error

Function code	Data
84H	Error response code

3.7.5.4.5. Write one coil (FC: 05H)

[Operation] Writes the ON/OFF value to one robot controller input signal.

[Number of points that can be accessed in one message] 1 point

[Request message format (master → slave)]

Function code	Data	
	Specified coil number	Specified ON/OFF status
05H	(0000H to 07FFH) (H) (L)	[FF00H: ON 0000H: OFF] (H) (L)

[Response message format (slave → master)]

■ Completed normally

The slave replies with the request message received from the master as it is.

■ Completed with error

Function code	Data
85H	Error response code

3.7.5.4.6. Write one register (FC: 06H)

[Operation] Writes values to one robot controller input register.

[Number of points that can be accessed in one message] 1 point

[Request message format (master → slave)]

Function code	Data	
	Specified holding register number	Write data
06H	(0000H to 01FFH) (H) (L)	(0000H to FFFFH) (H) (L)

[Response message format (slave → master)]

■ Completed normally

The slave replies with the request message received from the master as it is.

■ Completed with error

Function code	Data
86H	Error response code

3.7.5.4.7. Write multiple coils (FC: 0FH)

[Operation] Writes the ON/OFF value to multiple robot controller input signals.

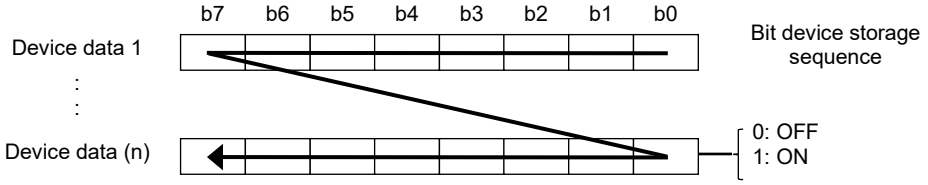
[Number of points that can be accessed in one message] 1 to 1968 points

[Request message format (master → slave)]

Function code	Data					
	Specified first coil number	Write points (n)	Number of bytes (n)	Device data 1	···	Device data (n)
0FH	(0000H to 007FFH) (H) (L)	(0001H to 07B0H) (H) (L)	(01H to F6H)			

Number of bytes (n)

• Area for device data 1 to n



• The values stored in device data 1 to n (ON/OFF) are written to the coil in the order of the lower to upper bits of the device data.

◇◆◇ Tips ◇◆◇

The number of points specified for write points and the number of bits specified for number of bytes must match.
For example, if the number of write points is set to 16, the number of bytes should be 2 bytes (16 bits).

[Response message format (slave → master)]

■ Completed normally

Function code	Data	
	First coil number	Write points
0FH	(H) (L)	(H) (L)

• First coil number: The same value as the first coil number in the request message is stored.
• Write points: The same value as the number of write points in the request message is stored.

■ Completed with error

Function code	Data
8FH	Error response code

3.7.5.4.8. Write multiple registers (FC: 10H)

[Operation] Writes values to multiple robot controller input registers.

[Number of points that can be accessed in one message] 1 to 123 points

[Request message format (master → slave)]

Function code	Data											
	Specified first holding register number		Write points (n)		Number of bytes = n × 2	Device data 1		...	Device data (n)	
10H	(0000H to 01FFH) (H)	(L)	(0001H to 007BH) (H)	(L)	(01H to F6H)	(H)	(L)		(H)	(L)

Number of bytes = n × 2

◇◆◇ Tips ◇◆◇

The number of points specified for write points and the number of bits specified for number of bytes must match. For example, if the number of write points is set to 2, the number of bytes should be 4 bytes (32 bits).

[Response message format (slave → master)]

■ Completed normally

Function code	Data			
	First holding register number		Write points	
10H	(H)	(L)	(H)	(L)

• First holding register number: The same value as the first holding register number in the request message is stored.
• Write points: The same value as the number of write points in the request message is stored.

■ Completed with error

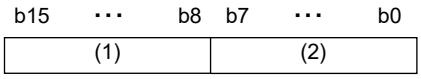
Function code	Data
90H	Error response code

3.7.5.5. Error response code

An error response code is an error code common to the MODBUS protocol that is stored in the response message when a slave responds abnormally to a request message from the master.

If the master receives an error response code from the slave, check the contents of the error and take action.

The response message format when processing ends with an error is as follows.



(1) Error response function code

(2) Error response code

3.7.5.5.1. Error response function code list

This list shows the error response function codes stored in the upper byte of the response message format.

Error response function code	Function name	Details
81H	Read coil	Failed to read coil
82H	Read input	Failed to read input
83H	Read holding register	Failed to read holding register
84H	Read input register	Failed to read input register
85H	Write one coil	Failed to write coil.
86H	Write one register	Failed to write register
8FH	Write multiple coils	Failed to write multiple coils
90H	Write multiple registers	Failed to write multiple holding registers

3.7.5.5.2. Error response code list

This list shows the error response codes stored in the lower byte of the response message format.

Error response code	Error name	Error details and cause	Action
01H	Function code error	The robot controller received an unsupported function code.	Review the request message on the master side.
02H	Device address error	There is an error in the specified MODBUS device address.	Check the MODBUS device type and size supported by the robot controller, and review the request message on the master side.
03H	Data error	There is an error in the protocol data area of the request message.	Review the request message on the master side. • Check the number of points that can be accessed in one message. • Specify ON/OFF to write one coil. • Match the specified number of write points and the number of bytes.
04H	Processing failed	Processing failed because an error occurred with the robot controller when processing the request message.	Review the request message on the master side. If pseudo-input mode is enabled on the slave (robot controller), disable it, or remove the CC-Link card if one is installed.

3.7.6. Setup procedure

The setup procedure is shown below.

The following section shows an example of connecting a robot controller and a Mitsubishi Electric PLC (MELSEC iQ-R series, RJ71EN71) with an Ethernet cable on a one-to-one basis and checking the I/O signals.

For more information on Mitsubishi Electric PLCs, refer to the manual included with the PLC.

3.7.6.1. Wiring and connection

(1) Connect the Ethernet cable to the LAN port on the robot controller.

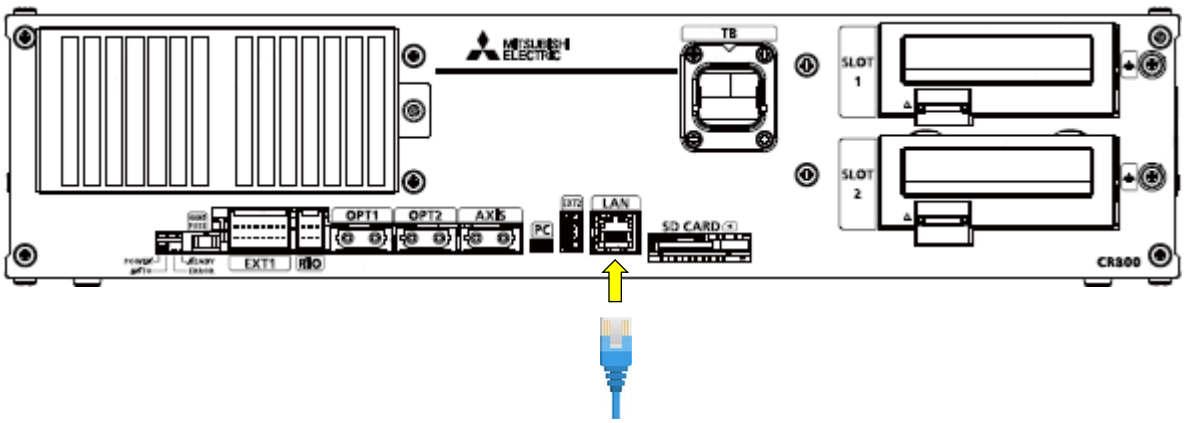
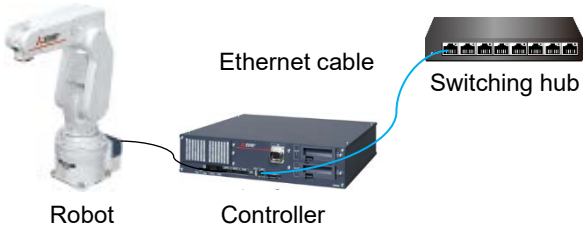


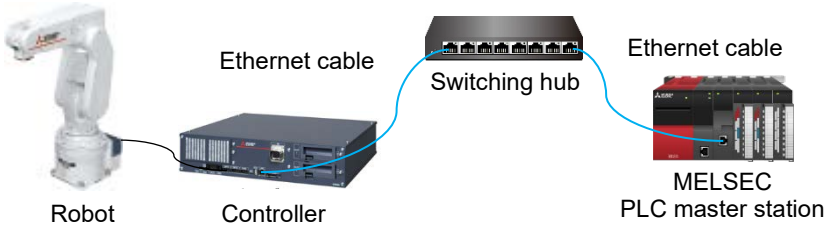
Fig. 3-1 Ethernet cable connection (CR800-D controller)

(2) Connect another Ethernet cable to the switching hub.

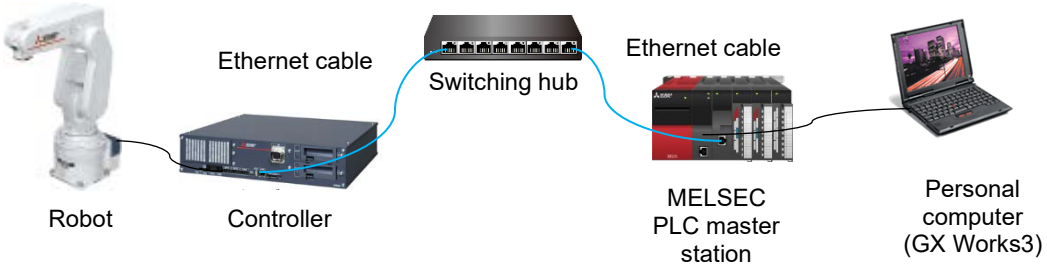


(3) Connect a straight Ethernet cable to P1 (for Ethernet) on the RJ71EN71.
For star type connection, connect a straight Ethernet cable to one of the two ports.

(4) Connect another Ethernet cable to the switching hub.



(5) Connect the PLC to a personal computer with GX Works3 (Mitsubishi Electric engineering software) installed using a USB cable.

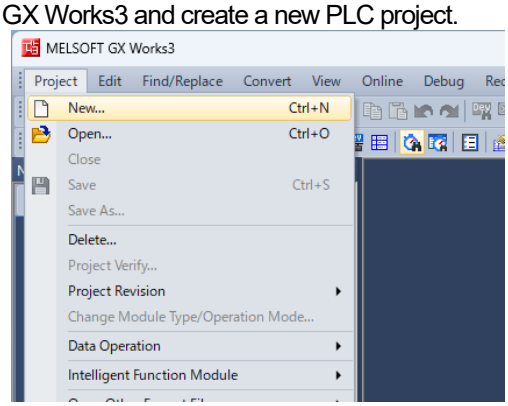


3.7.6.2. Parameter settings

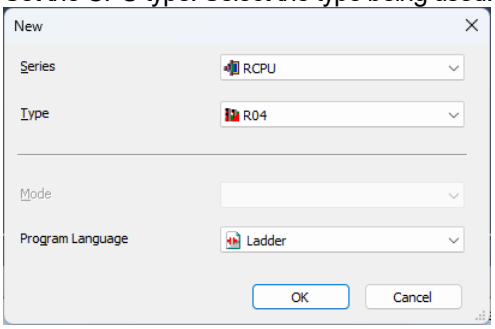
Set the parameters on the master side. If using a MELSEC iQ-R series programmable controller as the master, use GX Works3.

For further information on GX Works3, refer to the separate "GX Works3 Operating Manual".

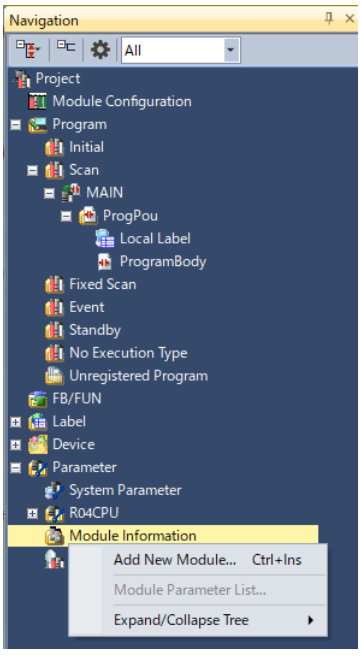
(1) Start GX Works3 and create a new PLC project.



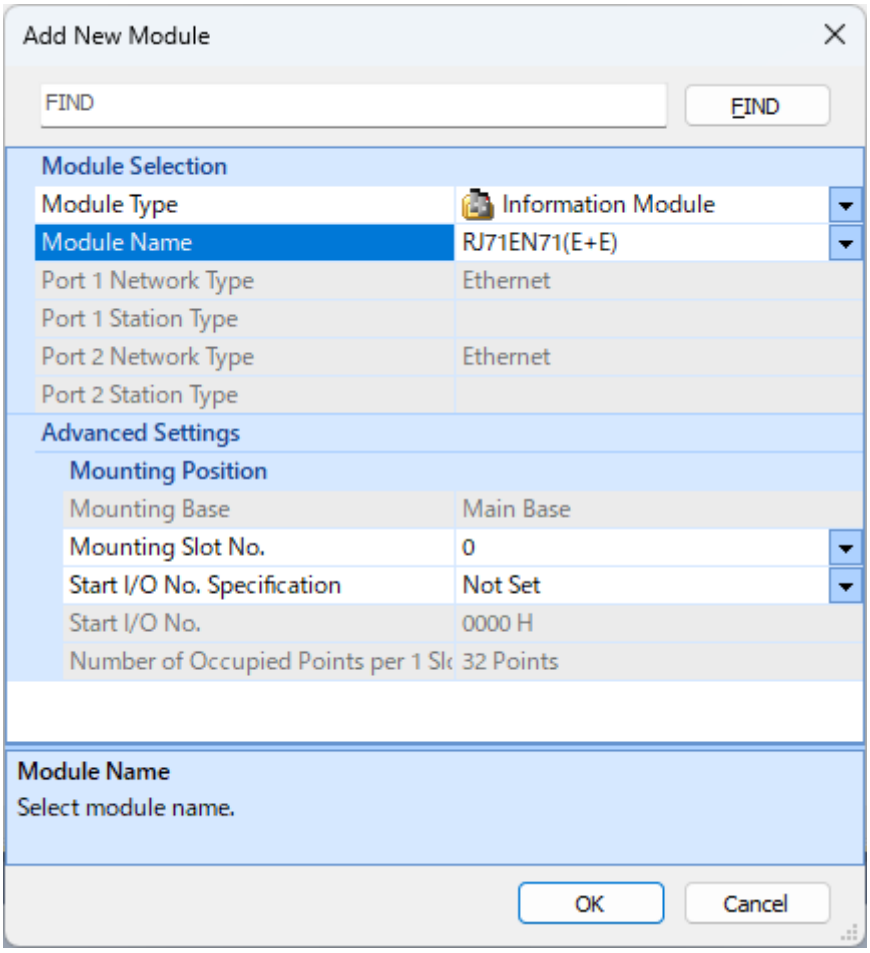
(2) Set the CPU type. Select the type being used.



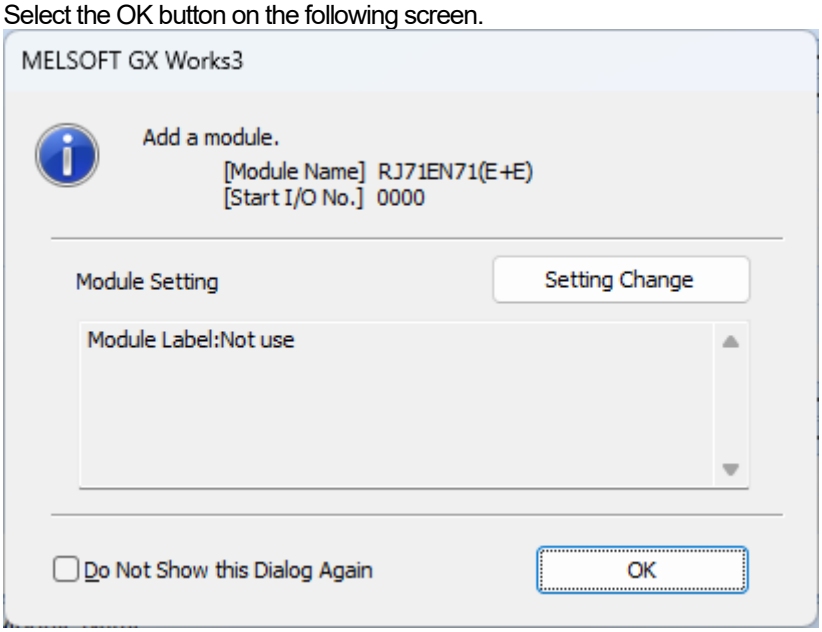
(3) Right-click Module Information then select Add New Module.



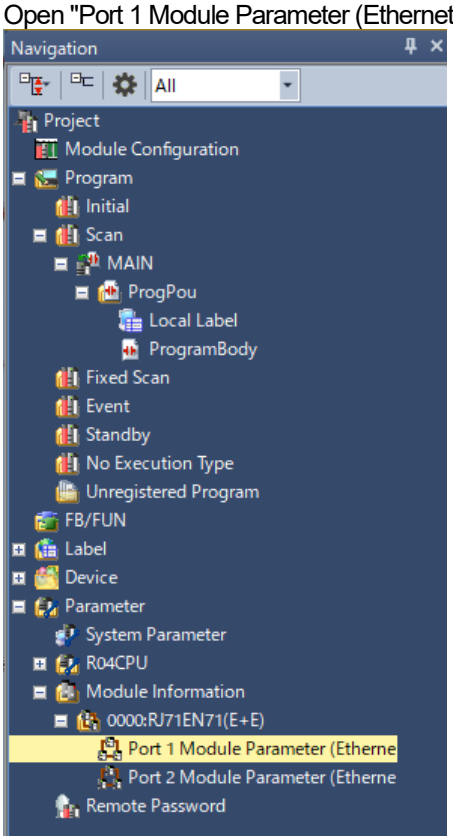
(4) After setting the module information for the master station in Add New Module, select the OK button.
- Module Type: Information Module
- Module Name: RJ71EN71(E+E)



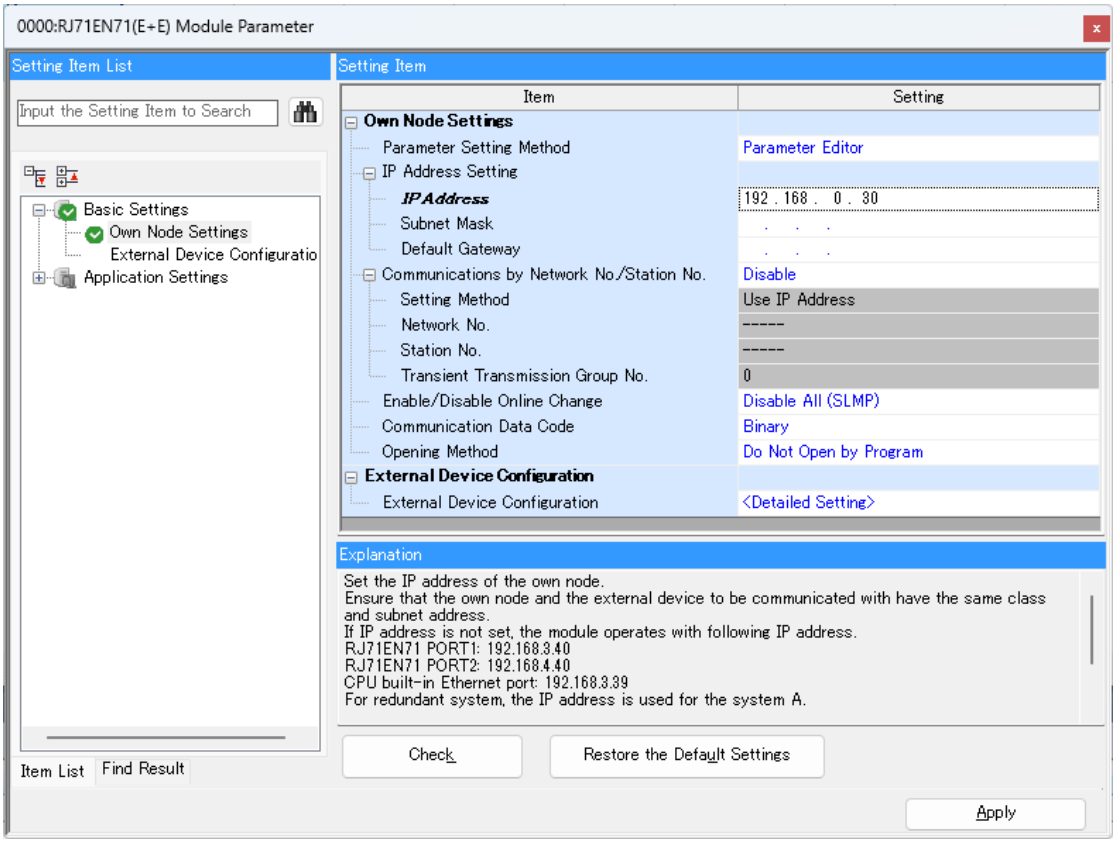
(5) Select the OK button on the following screen.



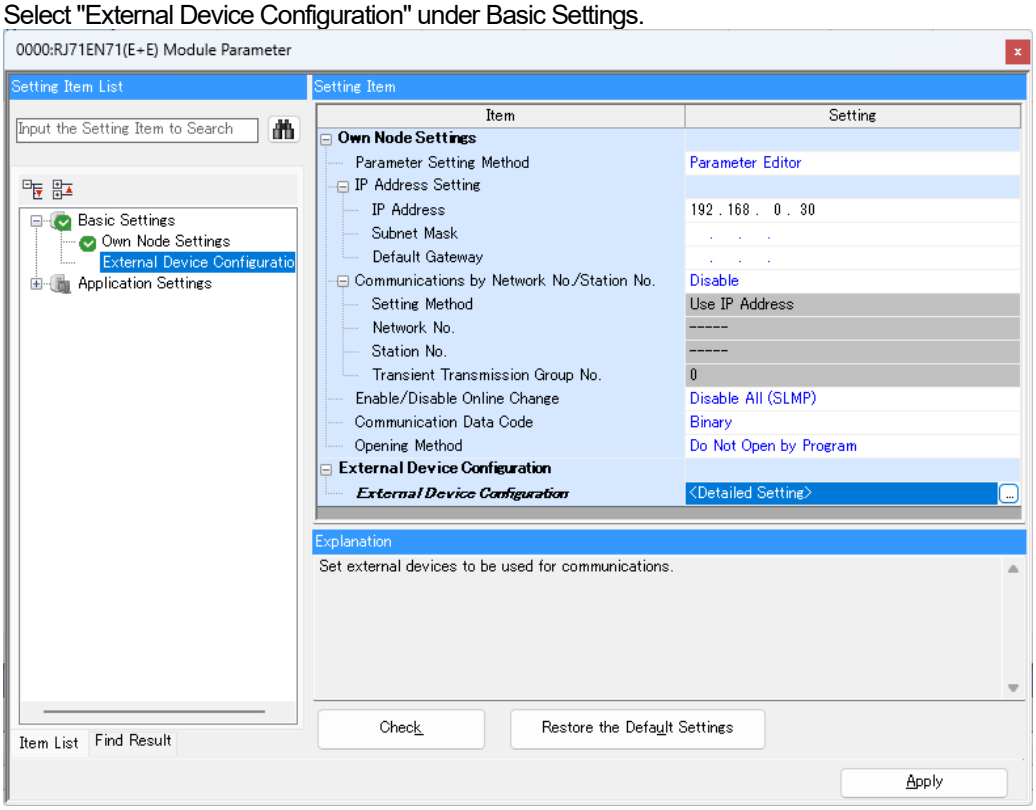
(6) Open "Port 1 Module Parameter (Ethernet)" under Module Information.



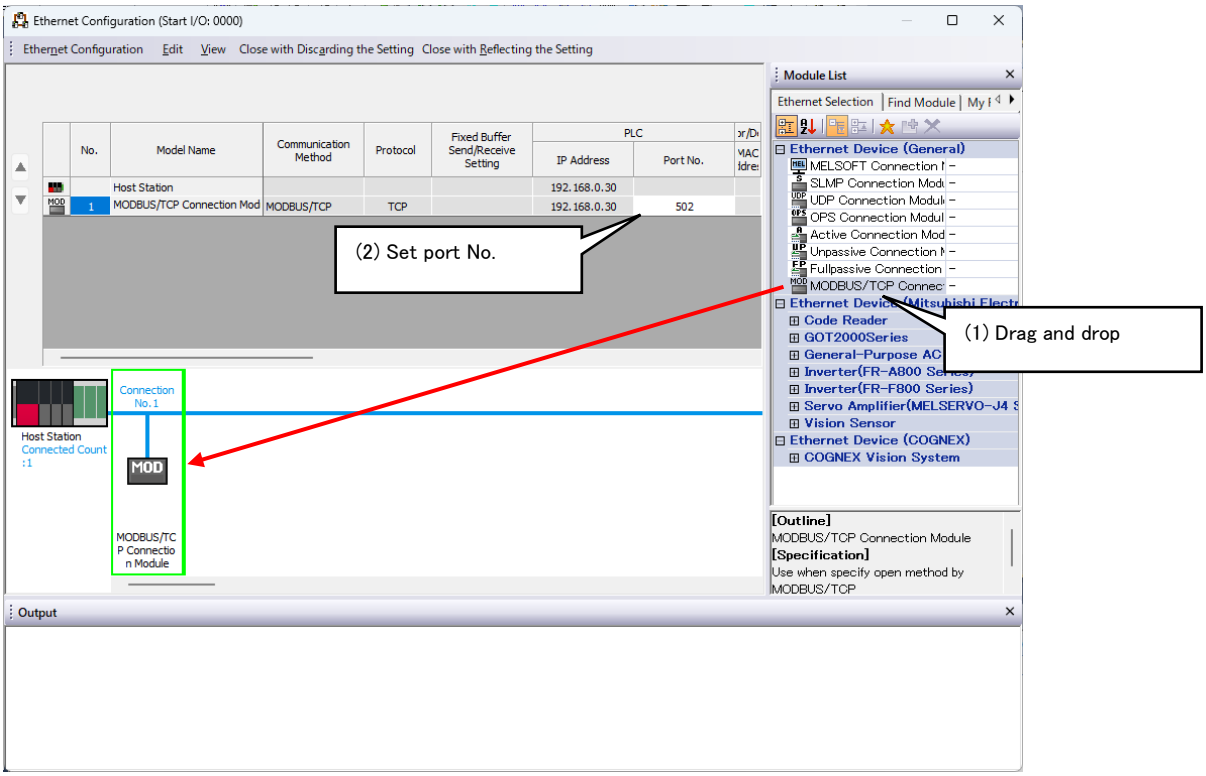
(7) Set "IP Address Setting" under Basic Settings.
(Example)
• IP Address: 192.168.0.30



(8) Select "External Device Configuration" under Basic Settings.

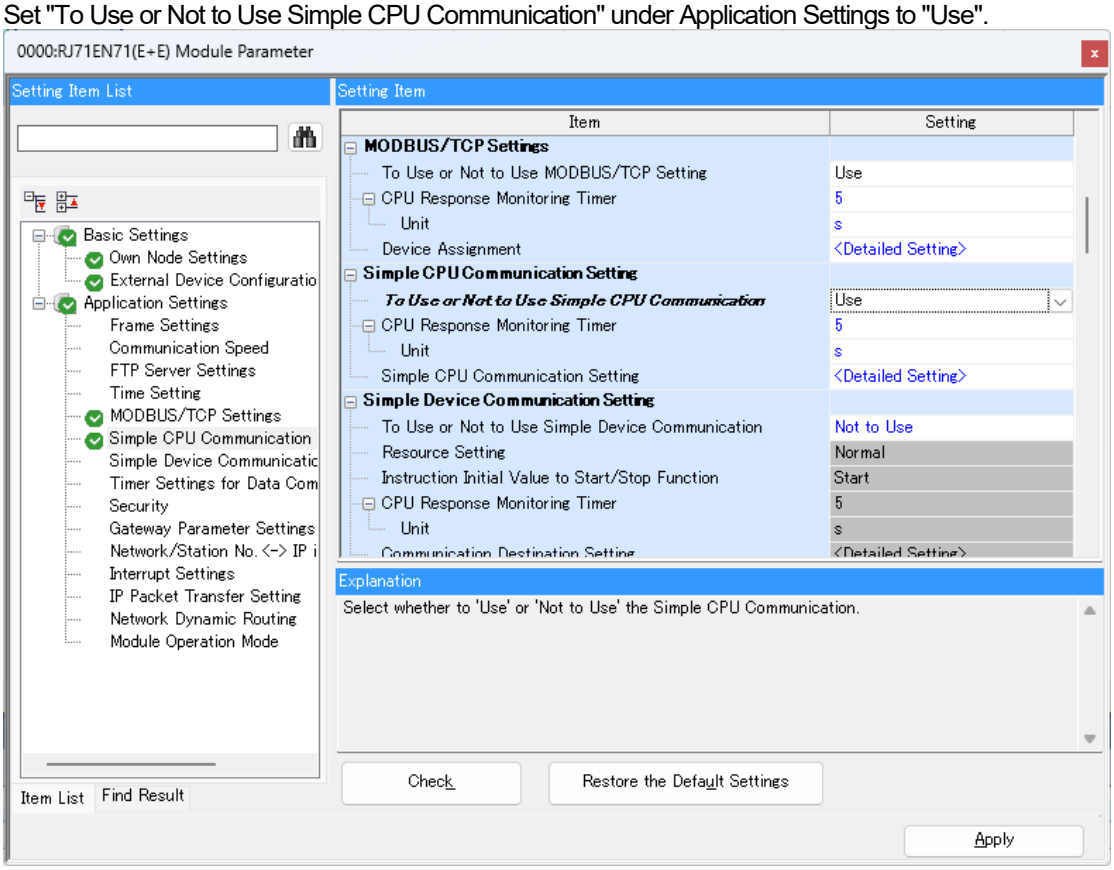


(9) Drag and drop the MODBUS/TCP Connection Module from the following module list, and configure it as follows.
(Example)
・ Port No.: 502

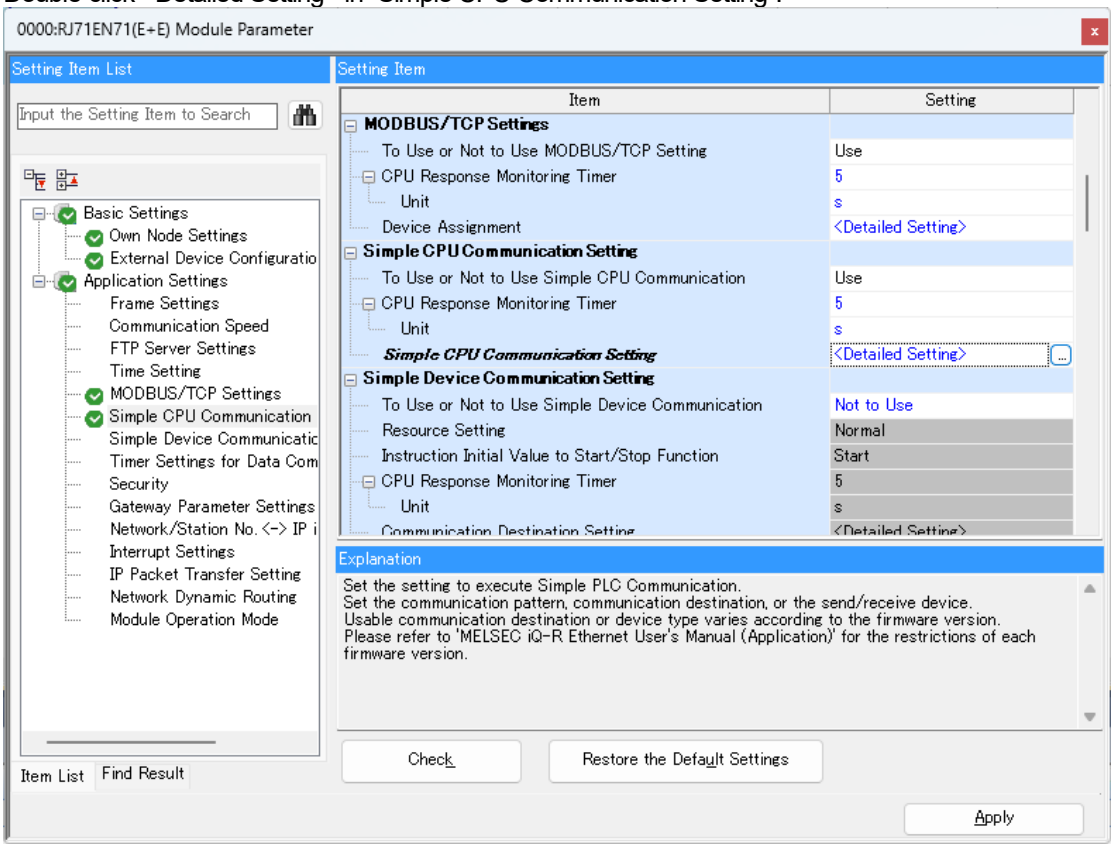


(10) Select "Close with Reflecting the Setting" on the above screen to close the screen.

(11) Set "To Use or Not to Use Simple CPU Communication" under Application Settings to "Use".



(12) Double-click <Detailed Setting> in "Simple CPU Communication Setting".



(13) Add a communication pattern.

[Pattern 1]: When the number of points is small and one message can be read/written at a time

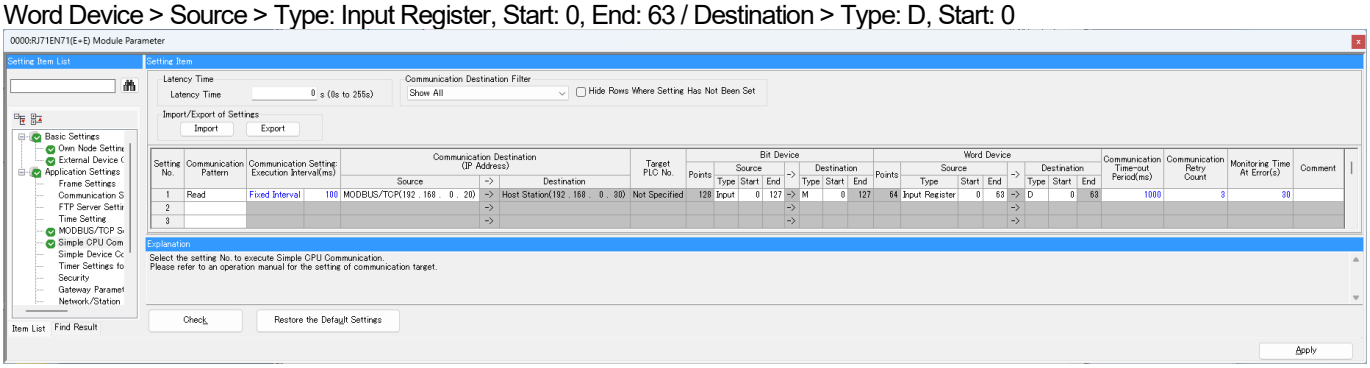
[Read]

(Example)

Communication Pattern: Read / Communication Destination (IP Address) > Source: MODBUS/TCP (192.168.0.20) /
Host station port number: Any (Example: 20000), Option: 0

Bit Device > Source > Type: Input, End: 127 / Destination > Type: M, Start: 0 /

Word Device > Source > Type: Input Register, Start: 0, End: 63 / Destination > Type: D, Start: 0



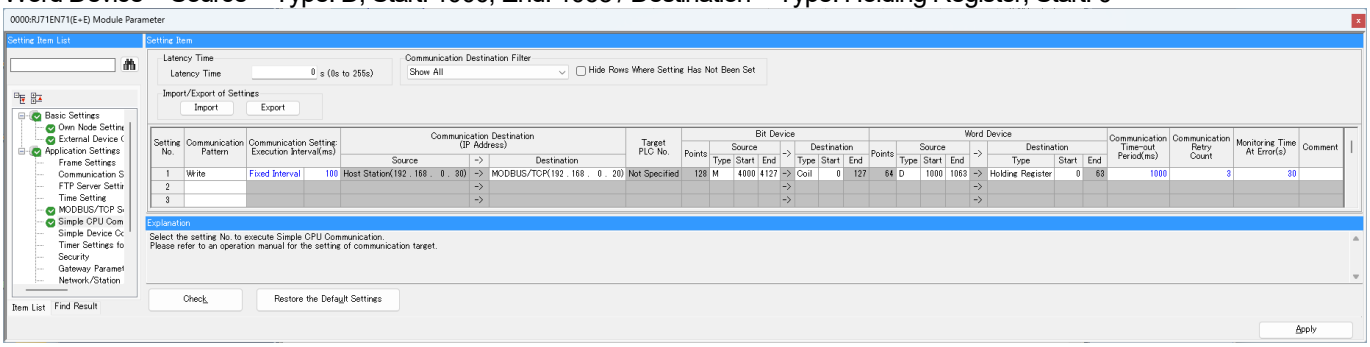
[Write]

(Example)

Communication Pattern: Write / Communication Destination (IP Address) > Destination: MODBUS/TCP (192.168.0.20) /
Host station port number: Any (Example: 20000), Option: 0

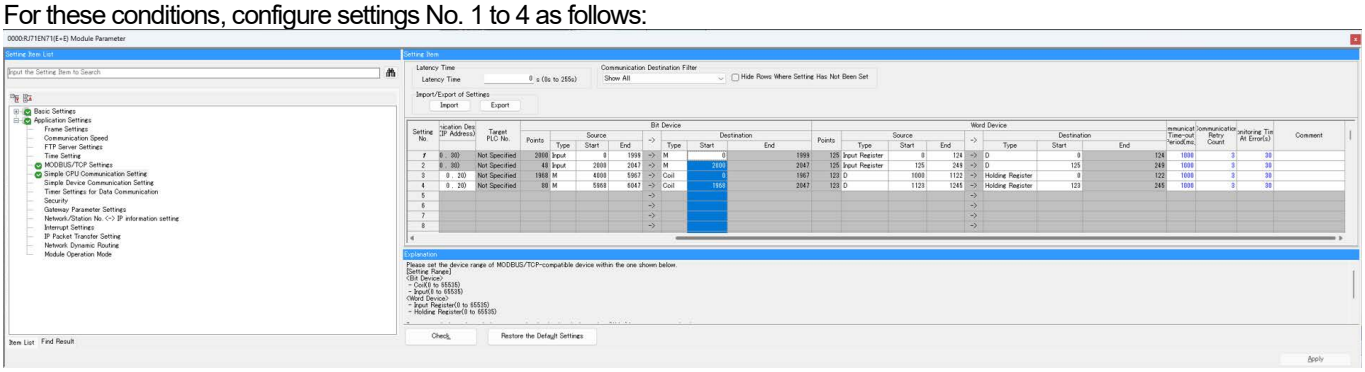
Bit Device > Source > Type: M, Start: 4000, End: 4127 / Destination > Type: Coil, Start: 0 /

Word Device > Source > Type: D, Start: 1000, End: 1063 / Destination > Type: Holding Register, Start: 0



[Pattern 2]: When a value such as the maximum number of points exceeds [Number of points that can be accessed in one message]

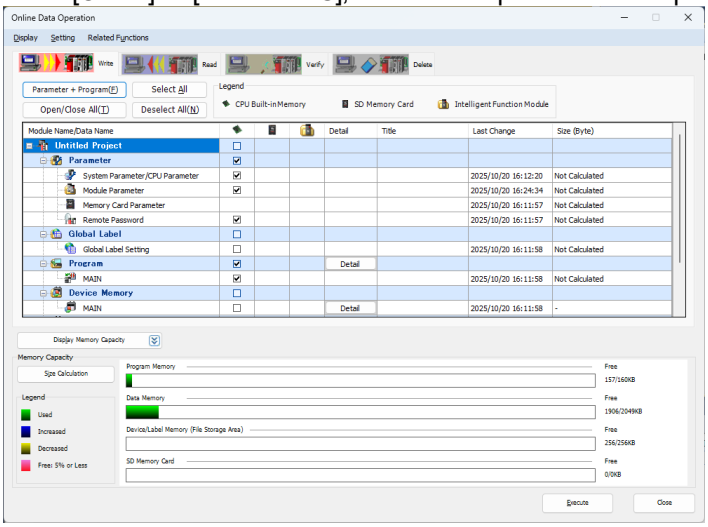
To acquire 2048 points of robot output signals, divide the input into 2000 points and 48 points, because [Number of points that can be accessed in one message] for Read input (02H) is 2000.
To acquire 512 points of robot output registers, do not attempt to acquire 512 points. Because [Number of points that can be accessed in one message] for Read input register (04H) is 125, execute the maximum value of 125 points twice to input 250 points of output registers.
To write values to 2048 points of robot input signals, divide the data into 1968 points and 80 points, because [Number of points that can be accessed in one message] for Write multiple coils (06H) is 1968.
To acquire 512 points of robot input registers, do not attempt to acquire 512 points. Because [Number of points that can be accessed in one message] for Write multiple registers (06H) is 123, execute the maximum value of 123 points twice to write the data to 246 points of input registers.
For these conditions, configure settings No. 1 to 4 as follows:



CAUTION

"Communication setting"
The execution interval (ms) is 100 by default. When setting a different value, refer to the actual execution interval.
To check the actual execution interval for simple CPU communication, refer to the manual of the master station.

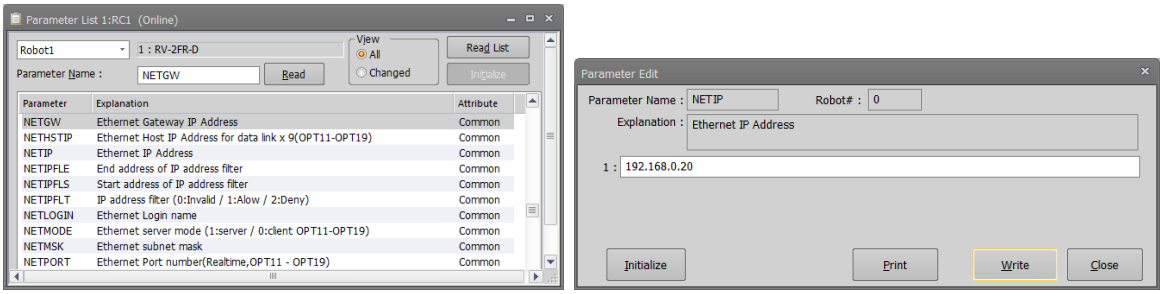
(14) Write the parameter and program to the PLC.
Set the connection destination of the PLC and personal computer to USB connection or another connection method then select [Online] → [Write to PLC], and write the parameters and program to the PLC.

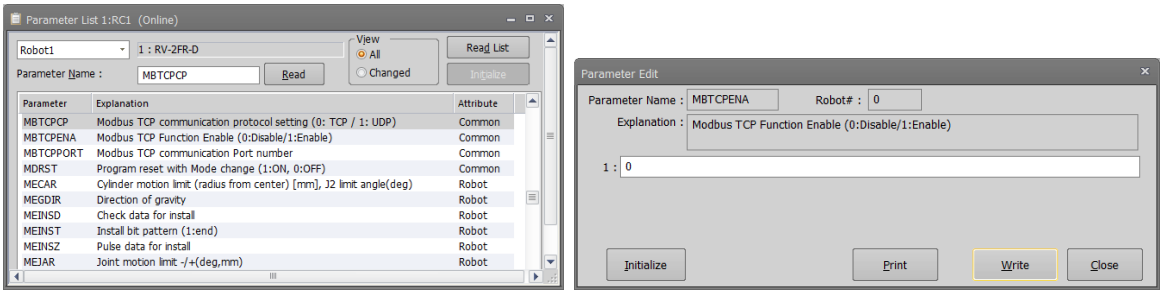


(15) Check the values of the robot controller parameters.
Power on the robot controller and check the following values of the parameters using RT ToolBox3.

(Example)

• NETIP	: 192.168.0.20	(Ethernet IP address)
• NETMSK	: 255.255.255.0	(Ethernet subnet mask)
• NETGW	: 192.168.0.254	(Ethernet gateway IP address)
• MBTCPENA	: 1: Enable	(Modbus TCP Function Enable)
• MBTCPPRT	: 502	(Modbus TCP communication port number)
• MBTCPCP	: 0: TCP	(Modbus TCP communication protocol setting)



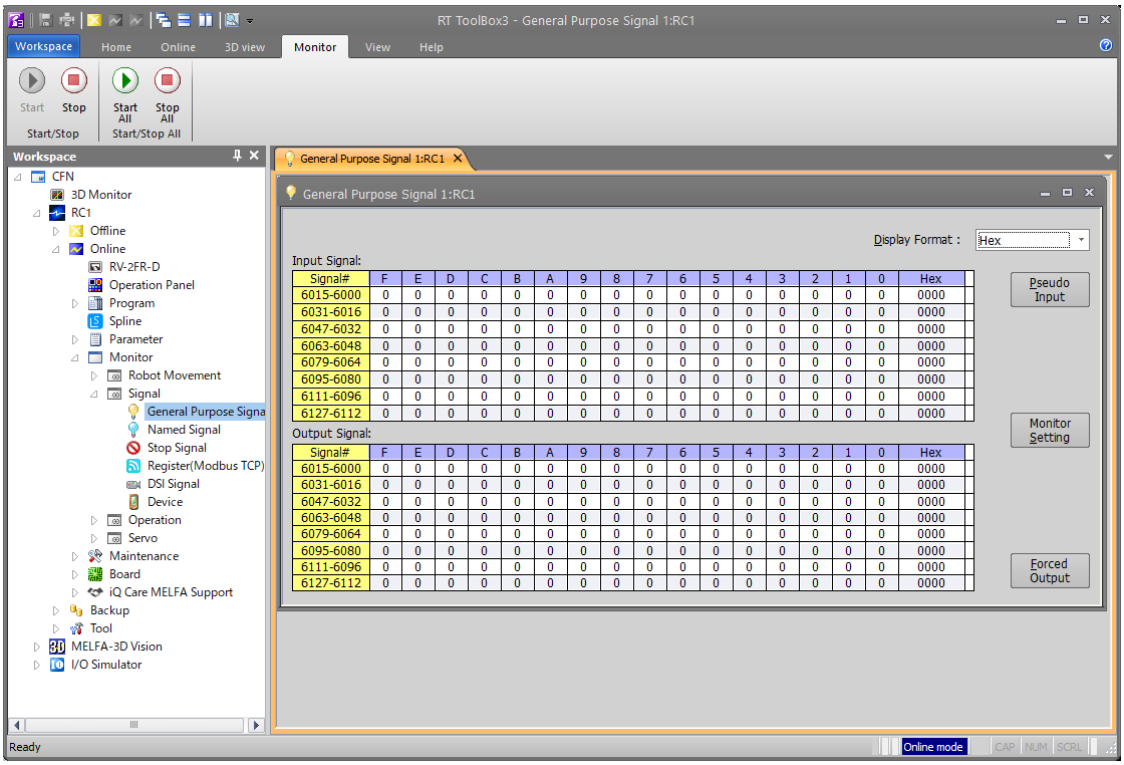


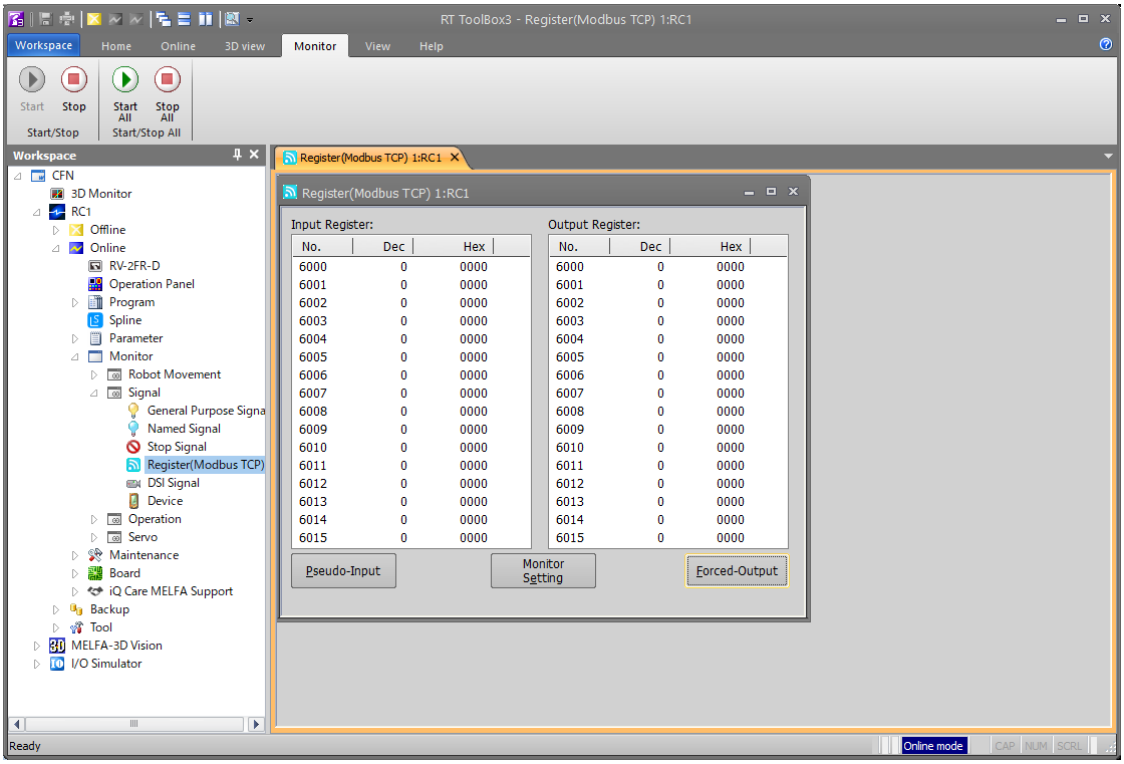
The port number must be the same as the port number set for the external device configuration settings on the PLC side in Step (9).
The values described in the parameter settings on the robot side above are setting examples. If the values match the external device configuration settings on the PLC side, the values can be changed.

3.7.6.3. Checking I/O signals

Check the exchange of I/O signals using RT ToolBox3 and the GX Works3 monitor screen.

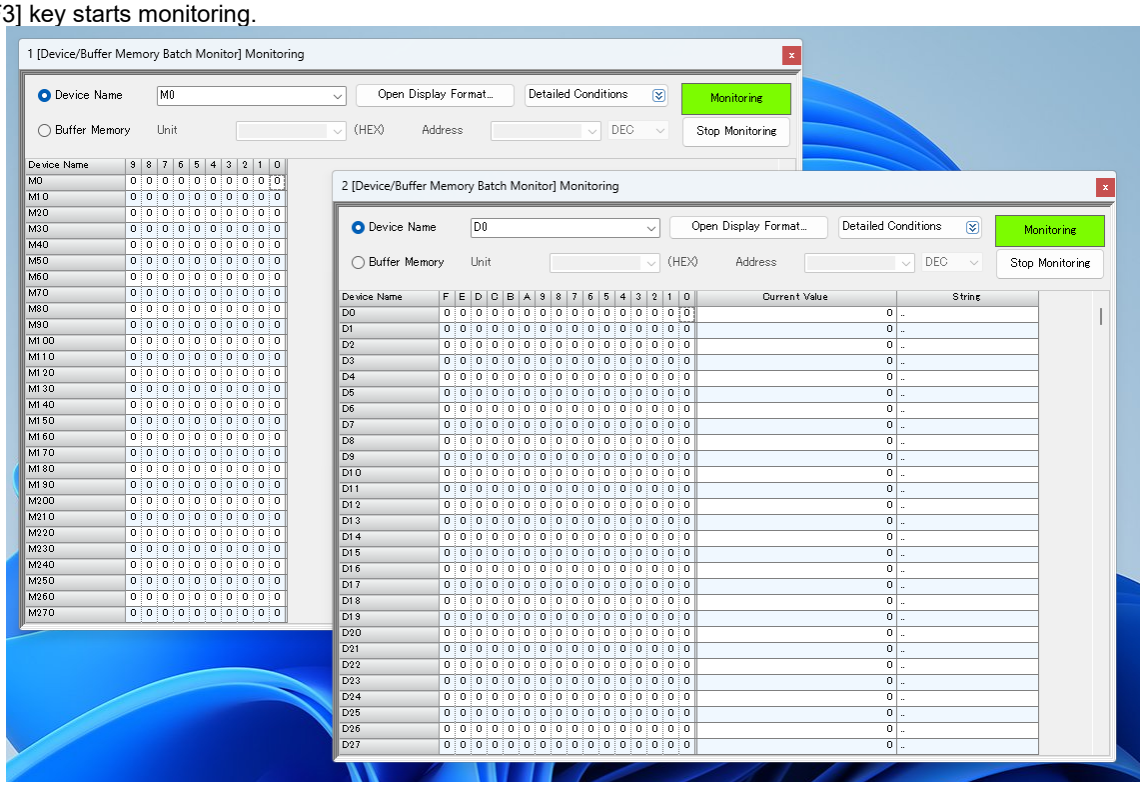
(1) Start the "General Purpose Signal" monitor and "Register" monitor in RT ToolBox3.





(2) Start "Device/Buffer Memory Batch Monitor" in GX Works3.

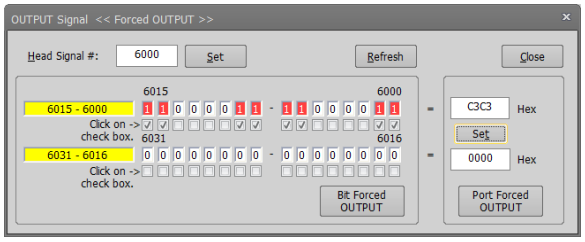
Select [Online] → [Monitor] → [Device/Buffer Memory Batch Monitor] to open the window and specify the beginning (M0/M4000/D0/D1000) of the device name to be monitored. Multiple monitors can be started at the same time and pressing the [F3] key starts monitoring.

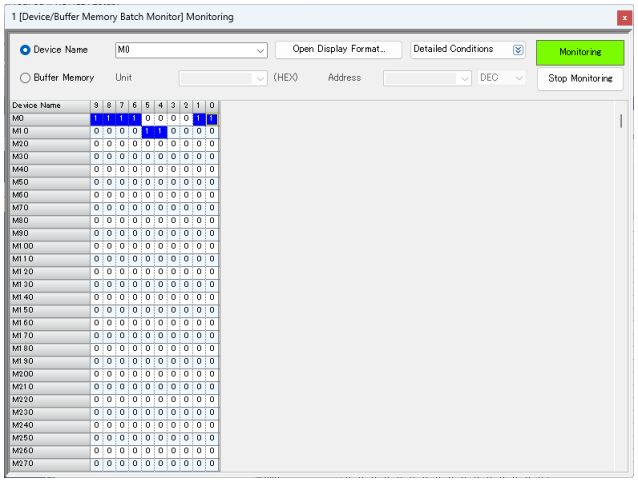


(3) Check the signals

[Read]

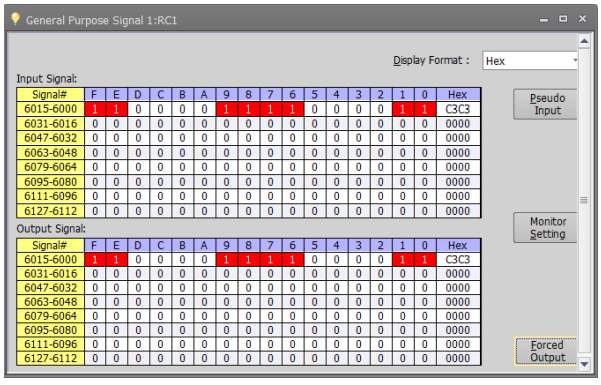
Check that the ON/OFF status of the read devices M0 to M127 in "Device/Buffer Memory Batch Monitor" change in the same way by pressing the Bit Forced OUTPUT button on the "General Purpose Signal" monitor to change the ON/OFF status of output signals 6000 to 6127.

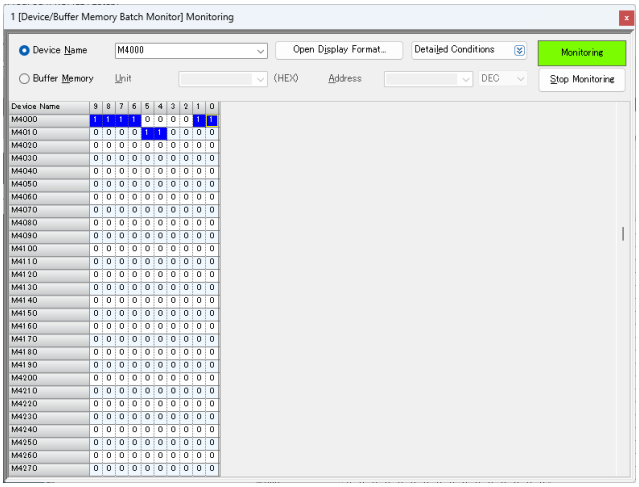




[Write]

Check that the ON/OFF status of the written input signals 6000 to 6127 in "General Purpose Signal" monitor change in the same way by changing the ON/OFF status of devices M4000 to M4127 in "Device/Buffer Memory Batch Monitor".

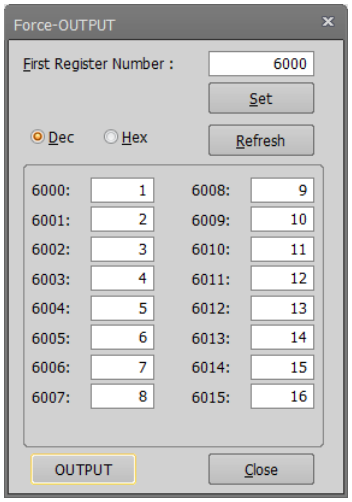


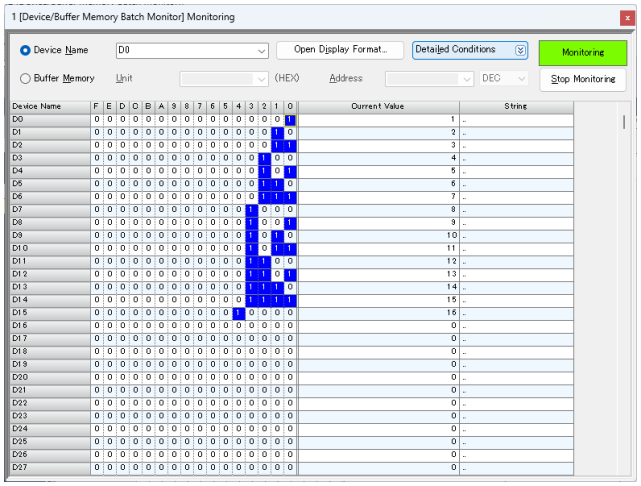


(4) Check the register.

[Read]

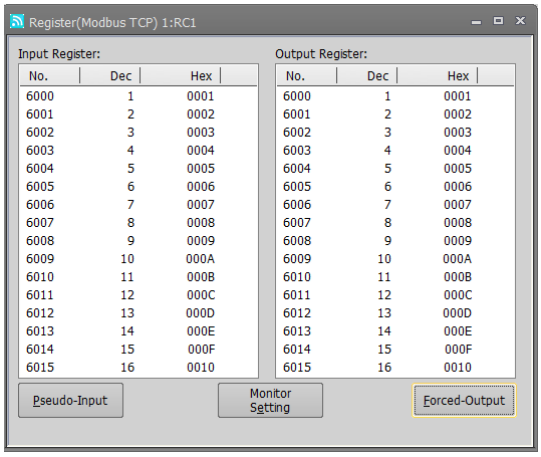
Check that the values of the read devices D0 to D63 in "Device/Buffer Memory Batch Monitor" change in the same way by pressing the Forced Output button on the Register monitor to change the output register numbers 6000 to 6063.

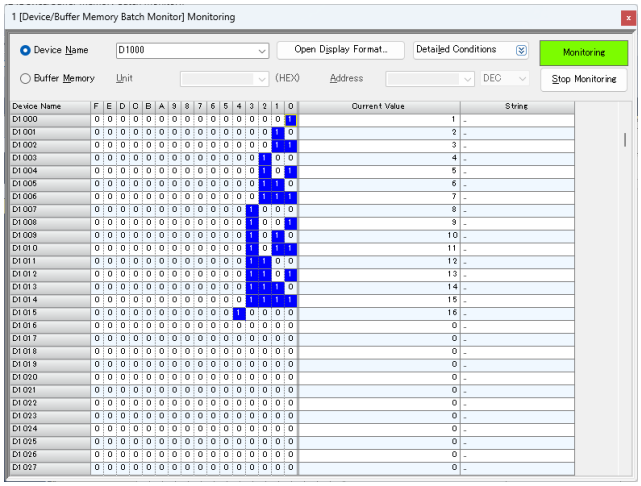




[Write]

Check that the values of the written input register numbers 6000 to 6063 in the "Register (CC-Link)" monitor change in the same way by changing the values of D1000 to D1063 in the "Device/Buffer Memory Batch Monitor".





<<MEMO>>

4. Appendix

4.1. Error list

The errors which occur only when the Ethernet function is used are listed as follows.

Error No.	Detail number	Error causes and remedies
7810	01000 ～ 21000	■Ethernet ***** parameter ERR Cause）Illegal parameter (*****)　（The parameter name is input in*****.） Measures）Correct parameter *****
7820	00000	■MXT/MXScommand timeout Cause）Time over MXTTOUT parameter. Measures）Check parameter MXTTOUT.
7830	00000	■Ethernet card is not installed, or command disable Cause）Ethernet card is not installed, or command disable. Measures）Install Ethenet card.
7840	01000	■MXT/MXS Illegal position data Cause）Illegal command position data (NAN/NUMBER). Measures）Check transmitted command position data.
7840	02000	■MXT/MXS Illegal data type Cause）Different data type. Measures）Check MXT/MXS command and transmitted data.
7850	00000	■Cannot read MXT positional data. Cause）The format of MXT positional data file is illegal. Measures）Please confirm the format of a positional data file.
7861	01000	■SLMP SLMPPORT parameter error Cause）Overlap with server port number of NETPORT. Measures）Please set not to overlap to another port number.

Error No.	Detail number	Error causes and remedies
7861	02000	■SLMP SLMPPORT parameter error Cause）Overlap with element of NETPORT(1) or MONPORT(1/2). Measures）Please set not to overlap to another port number.
7870	00000	■CC-Link IEF Basic Comm. Error Cause）Failure in the CC-Link IEF Commuication. Measures）Check the wiring and parameter setting on the master station.
7891	01000	■Modbus MBTCPPRT parameter error Cause）Overlap with server port number of NETPORT. Measures）Please set not to overlap to another port number.
7891	02000	■Modbus MBTCPPRT parameter error Cause）Overlap with element of NETPORT(1) or MONPORT(1/2). Measures）Please set not to overlap to another port number.
7892	00000	■Field cards are installed Cause）Fieldbus card cannot be installed when Modbus TCP is enabled. Measures）Remove the fieldbus card.

For the other errors except these, refer to the errors list of the instruction manual of the controller.

4.2. Sample program

This is the sample program of the Ethernet function.

4.2.1. Sample program of data link

The sample program to do the data link with Microsoft Visual Studio Express Visual Basic (hereafter written as VB) is herein described.

The program creation is briefly introduced with the following procedure.

For details of VB operation and application producing method, refer to the instruction manual of this software.

(1) Preparation of Winsock control

(2) Production of form screen

(3) Program (Form1.frm)

There is the program following 2 passages. Use either according to the customer's system.

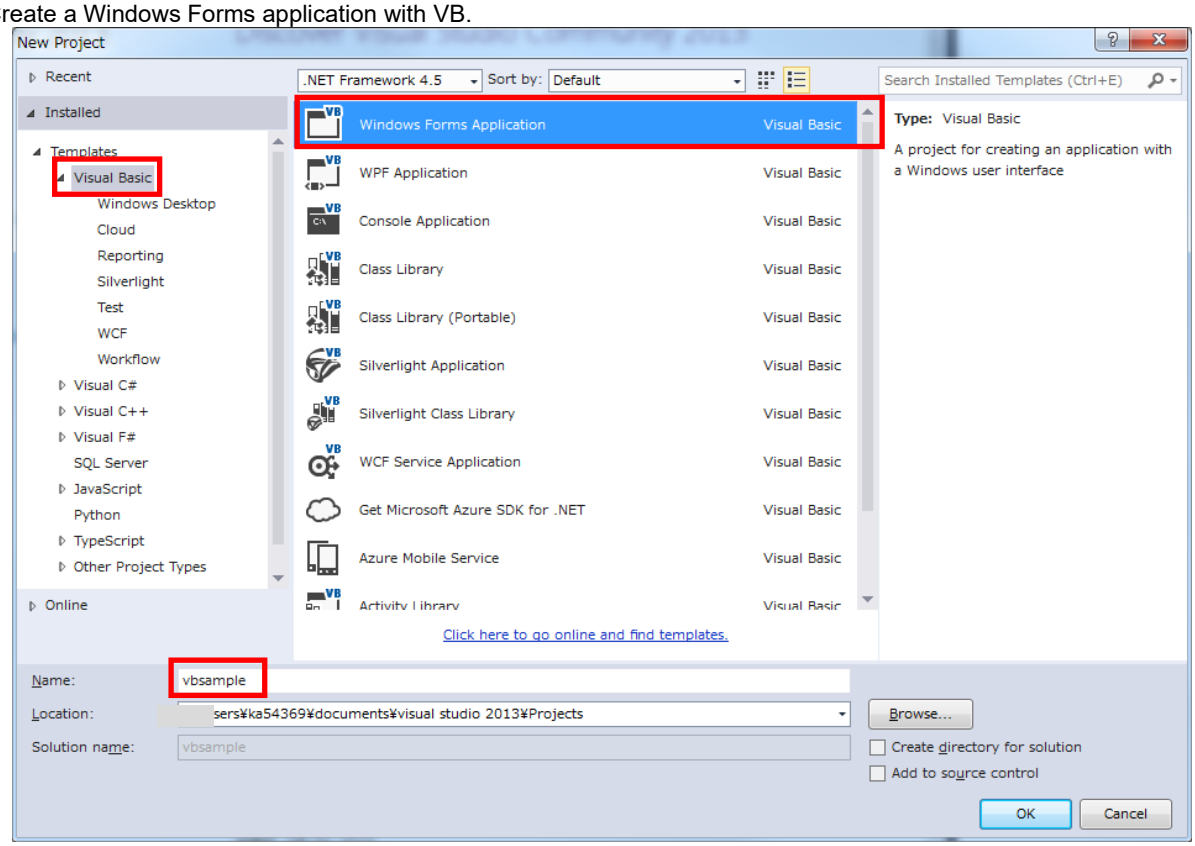
1) Program for the clients (when using the personal computer as the client and using the controller as the server).

2) Program for the server (when using the personal computer as the server and using the controller as the client).

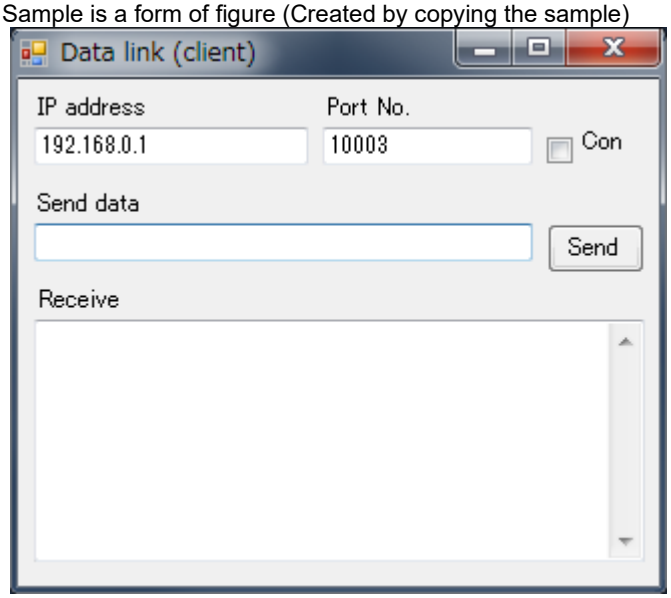
* About the work of 1) 2), the client and the server are the same.

(1) Preparation of project

Create a Windows Forms application with VB.



(2) Sample is a form of figure (Created by copying the sample)



Copy files to vbsample folder.

• Form1.Designer.vb

• Form1.vb

Be careful not to confuse the client and the server.

Each text files saved from pdf manual.

■ Form1.Designer.vb (Form for the client)

```
<Global.Microsoft.VisualBasic.CompilerServices.DesignerGenerated()> _
Partial Class Form1
    Inherits System.Windows.Forms.Form

    'Form overrides dispose to clean up the component list.
    <System.Diagnostics.DebuggerNonUserCode()> _
    Protected Overrides Sub Dispose(ByVal disposing As Boolean)
        Try
            If disposing AndAlso components IsNot Nothing Then
                components.Dispose()
            End If
        Finally
            MyBase.Dispose(disposing)
        End Try
    End Sub

    'Required by the Windows Form Designer
    Private components As System.ComponentModel.IContainer

    'NOTE: The following procedure is required by the Windows Form Designer
    'It can be modified using the Windows Form Designer.
    'Do not modify it using the code editor.
    <System.Diagnostics.DebuggerStepThrough()> _
    Private Sub InitializeComponent()
        Me.components = New System.ComponentModel.Container
        Me.Button1 = New System.Windows.Forms.Button
        Me.Check1 = New System.Windows.Forms.CheckBox
        Me.Text4 = New System.Windows.Forms.TextBox
        Me.Text3 = New System.Windows.Forms.TextBox
        Me.Text2 = New System.Windows.Forms.TextBox
```

```
Me.Text1 = New System.Windows.Forms.TextBox
Me.Label4 = New System.Windows.Forms.Label
Me.Label3 = New System.Windows.Forms.Label
Me.Label2 = New System.Windows.Forms.Label
Me.Label1 = New System.Windows.Forms.Label
Me.Timer1 = New System.Windows.Forms.Timer(Me.components)
Me.SuspendLayout()
'
'Button1
'
Me.Button1.BackColor = System.Drawing.SystemColors.Control
Me.Button1.Cursor = System.Windows.Forms.Cursors.Default
Me.Button1.ForeColor = System.Drawing.SystemColors.ControlText
Me.Button1.Location = New System.Drawing.Point(264, 72)
Me.Button1.Name = "Button1"
Me.Button1.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Button1.Size = New System.Drawing.Size(49, 25)
Me.Button1.TabIndex = 16
Me.Button1.Text = "Send"
Me.Button1.UseVisualStyleBackColor = False
'
'Check1
'
Me.Check1.BackColor = System.Drawing.SystemColors.Control
Me.Check1.Cursor = System.Windows.Forms.Cursors.Default
Me.Check1.ForeColor = System.Drawing.SystemColors.ControlText
Me.Check1.Location = New System.Drawing.Point(264, 24)
Me.Check1.Name = "Check1"
Me.Check1.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Check1.Size = New System.Drawing.Size(49, 25)
Me.Check1.TabIndex = 14
Me.Check1.Text = "Connection"
Me.Check1.UseVisualStyleBackColor = False
'
'Text4
'
Me.Text4.AcceptsReturn = True
Me.Text4.AcceptsTab = True
Me.Text4.BackColor = System.Drawing.SystemColors.Window
Me.Text4.Cursor = System.Windows.Forms.Cursors.IBeam
Me.Text4.ForeColor = System.Drawing.SystemColors.WindowText
Me.Text4.Location = New System.Drawing.Point(8, 120)
Me.Text4.MaxLength = 0
Me.Text4.Multiline = True
Me.Text4.Name = "Text4"
Me.Text4.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Text4.ScrollBars = System.Windows.Forms.ScrollBars.Vertical
Me.Text4.Size = New System.Drawing.Size(305, 121)
Me.Text4.TabIndex = 17
'
'Text3
'
Me.Text3.AcceptsReturn = True
Me.Text3.BackColor = System.Drawing.SystemColors.Window
Me.Text3.Cursor = System.Windows.Forms.Cursors.IBeam
Me.Text3.ForeColor = System.Drawing.SystemColors.WindowText
Me.Text3.Location = New System.Drawing.Point(8, 72)
Me.Text3.MaxLength = 0
Me.Text3.Name = "Text3"
Me.Text3.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Text3.Size = New System.Drawing.Size(249, 19)
```

```
        Me.Text3.TabIndex = 15
        '
        'Text2
        '
        Me.Text2.AcceptsReturn = True
        Me.Text2.BackColor = System.Drawing.SystemColors.Window
        Me.Text2.Cursor = System.Windows.Forms.Cursors.IBeam
        Me.Text2.ForeColor = System.Drawing.SystemColors.WindowText
        Me.Text2.Location = New System.Drawing.Point(152, 24)
        Me.Text2.MaxLength = 0
        Me.Text2.Name = "Text2"
        Me.Text2.RightToLeft = System.Windows.Forms.RightToLeft.No
        Me.Text2.Size = New System.Drawing.Size(105, 19)
        Me.Text2.TabIndex = 13
        Me.Text2.Text = "10003"
        '
        'Text1
        '
        Me.Text1.AcceptsReturn = True
        Me.Text1.BackColor = System.Drawing.SystemColors.Window
        Me.Text1.Cursor = System.Windows.Forms.Cursors.IBeam
        Me.Text1.ForeColor = System.Drawing.SystemColors.WindowText
        Me.Text1.Location = New System.Drawing.Point(8, 24)
        Me.Text1.MaxLength = 0
        Me.Text1.Name = "Text1"
        Me.Text1.RightToLeft = System.Windows.Forms.RightToLeft.No
        Me.Text1.Size = New System.Drawing.Size(137, 19)
        Me.Text1.TabIndex = 12
        Me.Text1.Text = "192.168.0.1"
        '
        'Label4
        '
        Me.Label4.BackColor = System.Drawing.SystemColors.Control
        Me.Label4.Cursor = System.Windows.Forms.Cursors.Default
        Me.Label4.ForeColor = System.Drawing.SystemColors.ControlText
        Me.Label4.Location = New System.Drawing.Point(8, 104)
        Me.Label4.Name = "Label4"
        Me.Label4.RightToLeft = System.Windows.Forms.RightToLeft.No
        Me.Label4.Size = New System.Drawing.Size(65, 13)
        Me.Label4.TabIndex = 19
        Me.Label4.Text = "Receive data"
        '
        'Label3
        '
        Me.Label3.BackColor = System.Drawing.SystemColors.Control
        Me.Label3.Cursor = System.Windows.Forms.Cursors.Default
        Me.Label3.ForeColor = System.Drawing.SystemColors.ControlText
        Me.Label3.Location = New System.Drawing.Point(8, 56)
        Me.Label3.Name = "Label3"
        Me.Label3.RightToLeft = System.Windows.Forms.RightToLeft.No
        Me.Label3.Size = New System.Drawing.Size(65, 13)
        Me.Label3.TabIndex = 18
        Me.Label3.Text = "Send data"
        '
        'Label2
        '
        Me.Label2.BackColor = System.Drawing.SystemColors.Control
        Me.Label2.Cursor = System.Windows.Forms.Cursors.Default
        Me.Label2.ForeColor = System.Drawing.SystemColors.ControlText
        Me.Label2.Location = New System.Drawing.Point(152, 8)
        Me.Label2.Name = "Label2"
```

```
        Me.Label2.RightToLeft = System.Windows.Forms.RightToLeft.No
        Me.Label2.Size = New System.Drawing.Size(65, 13)
        Me.Label2.TabIndex = 11
        Me.Label2.Text = "Port No."
        '
        'Label1
        '
        Me.Label1.BackColor = System.Drawing.SystemColors.Control
        Me.Label1.Cursor = System.Windows.Forms.Cursors.Default
        Me.Label1.ForeColor = System.Drawing.SystemColors.ControlText
        Me.Label1.Location = New System.Drawing.Point(8, 8)
        Me.Label1.Name = "Label1"
        Me.Label1.RightToLeft = System.Windows.Forms.RightToLeft.No
        Me.Label1.Size = New System.Drawing.Size(73, 17)
        Me.Label1.TabIndex = 10
        Me.Label1.Text = "IP address"
        '
        'Timer1
        '
        Me.Timer1.Interval = 50
        '
        'Form1
        '
        Me.AutoScaleDimensions = New System.Drawing.SizeF(6.0!, 12.0!)
        Me.AutoScaleMode = System.Windows.Forms.AutoScaleMode.Font
        Me.ClientSize = New System.Drawing.Size(320, 253)
        Me.Controls.Add(Me.Button1)
        Me.Controls.Add(Me.Check1)
        Me.Controls.Add(Me.Text4)
        Me.Controls.Add(Me.Text3)
        Me.Controls.Add(Me.Text2)
        Me.Controls.Add(Me.Text1)
        Me.Controls.Add(Me.Label4)
        Me.Controls.Add(Me.Label3)
        Me.Controls.Add(Me.Label2)
        Me.Controls.Add(Me.Label1)
        Me.Name = "Form1"
        Me.Text = "Data link (client)"
        Me.ResumeLayout(False)
        Me.PerformLayout()

    End Sub
    Public WithEvents Button1 As System.Windows.Forms.Button
    Public WithEvents Check1 As System.Windows.Forms.CheckBox
    Public WithEvents Text4 As System.Windows.Forms.TextBox
    Public WithEvents Text3 As System.Windows.Forms.TextBox
    Public WithEvents Text2 As System.Windows.Forms.TextBox
    Public WithEvents Text1 As System.Windows.Forms.TextBox
    Public WithEvents Label4 As System.Windows.Forms.Label
    Public WithEvents Label3 As System.Windows.Forms.Label
    Public WithEvents Label2 As System.Windows.Forms.Label
    Public WithEvents Label1 As System.Windows.Forms.Label
    Friend WithEvents Timer1 As System.Windows.Forms.Timer

End Class
```

■ Form1.vb (Program for the client)

```
Imports System
Imports System.Net.Sockets

Public Class Form1

    Private Client As TcpClient

    Private Sub Check1_CheckStateChanged(ByVal sender As System.Object, ByVal e As System.EventArgs)
    Handles Check1.CheckStateChanged
        ' Process for Connect or Disconnect
        Try
            If Check1.CheckState = CheckState.Checked Then
                Client = New TcpClient()
                Client.Connect(Text1.Text, Convert.ToInt32(Text2.Text)) 'Connect
                Button1.Enabled = Client.Connected
                Timer1.Enabled = Client.Connected
            Else
                Timer1.Enabled = False
                Button1.Enabled = False
                Client.GetStream().Close()      'Disconnect
                Client.Close()
            End If
        Catch ex As Exception
            Check1.Checked = False
            MessageBox.Show(ex.Message, Me.Text, MessageBoxButtons.OK, MessageBoxIcon.Error,
            MessageBoxDefaultButton.Button1)
        End Try
    End Sub

    Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
        'Send process
        Try
            Dim SendBuf As Byte() = System.Text.Encoding.Default.GetBytes(Text3.Text)
            Dim Stream As NetworkStream = Client.GetStream()
            Stream.Write(SendBuf, 0, SendBuf.Length)
        Catch ex As Exception
            Client = Nothing
            Timer1.Enabled = False
            Button1.Enabled = False
            Check1.Checked = False
            MessageBox.Show(ex.Message, Me.Text, MessageBoxButtons.OK, MessageBoxIcon.Error,
            MessageBoxDefaultButton.Button1)
        End Try
    End Sub

    Private Sub Timer1_Tick(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Timer1.Tick
        'Receive process
        Try
            Dim Stream As NetworkStream = Client.GetStream()
            If Stream.DataAvailable Then
                Dim bytes(1000) As Byte
                Dim strReceivedData As String = ""
                Dim datalength = Stream.Read(bytes, 0, bytes.Length)
                strReceivedData = System.Text.Encoding.Default.GetString(bytes).Substring(0, datalength)
                Text4.AppendText(strReceivedData)
                Text4.AppendText(System.Environment.NewLine)
            End If
        Catch ex As Exception
```

```
            Client = Nothing
            Timer1.Enabled = False
            Button1.Enabled = False
            Check1.Checked = False
            '
            MessageBox.Show(ex.Message, Me.Text, MessageBoxButtons.OK, MessageBoxIcon.Error,
            MessageBoxDefaultButton.Button1)
        End Try
    End Sub
End Class
```

■ Form1.Designer.vb (Form for the server)

```
<Global.Microsoft.VisualBasic.CompilerServices.DesignerGenerated()> _
Partial Class Form1
    Inherits System.Windows.Forms.Form

    'Form overrides dispose to clean up the component list.
    <System.Diagnostics.DebuggerNonUserCode()> _
    Protected Overrides Sub Dispose(ByVal disposing As Boolean)
        Try
            If disposing AndAlso components IsNot Nothing Then
                components.Dispose()
            End If
        Finally
            MyBase.Dispose(disposing)
        End Try
    End Sub

    'Required by the Windows Form Designer
    Private components As System.ComponentModel.IContainer

        'NOTE: The following procedure is required by the Windows Form Designer
        'It can be modified using the Windows Form Designer.
        'Do not modify it using the code editor.
        <System.Diagnostics.DebuggerStepThrough()> _
        Private Sub InitializeComponent()
            Me.components = New System.ComponentModel.Container
            Me.Button1 = New System.Windows.Forms.Button
            Me.Check1 = New System.Windows.Forms.CheckBox
            Me.Text4 = New System.Windows.Forms.TextBox
            Me.Text3 = New System.Windows.Forms.TextBox
            Me.Text2 = New System.Windows.Forms.TextBox
            Me.Text1 = New System.Windows.Forms.TextBox
            Me.Label4 = New System.Windows.Forms.Label
            Me.Timer1 = New System.Windows.Forms.Timer(Me.components)
            Me.Label3 = New System.Windows.Forms.Label
            Me.Label2 = New System.Windows.Forms.Label
            Me.Label1 = New System.Windows.Forms.Label
            Me.SuspendLayout()
            '
            'Button1
            '
            Me.Button1.BackColor = System.Drawing.SystemColors.Control
            Me.Button1.Cursor = System.Windows.Forms.Cursors.Default
            Me.Button1.ForeColor = System.Drawing.SystemColors.ControlText
            Me.Button1.Location = New System.Drawing.Point(264, 72)
            Me.Button1.Name = "Button1"
            Me.Button1.RightToLeft = System.Windows.Forms.RightToLeft.No
            Me.Button1.Size = New System.Drawing.Size(49, 25)
```

```
Me.Button1.TabIndex = 26
Me.Button1.Text = "Send"
Me.Button1.UseVisualStyleBackColor = False
'
'Check1
'
Me.Check1.BackColor = System.Drawing.SystemColors.Control
Me.Check1.Cursor = System.Windows.Forms.Cursors.Default
Me.Check1.ForeColor = System.Drawing.SystemColors.ControlText
Me.Check1.Location = New System.Drawing.Point(264, 24)
Me.Check1.Name = "Check1"
Me.Check1.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Check1.Size = New System.Drawing.Size(49, 25)
Me.Check1.TabIndex = 24
Me.Check1.Text = "Connection"
Me.Check1.UseVisualStyleBackColor = False
'
'Text4
'
Me.Text4.AcceptsReturn = True
Me.Text4.BackColor = System.Drawing.SystemColors.Window
Me.Text4.Cursor = System.Windows.Forms.Cursors.IBeam
Me.Text4.ForeColor = System.Drawing.SystemColors.WindowText
Me.Text4.Location = New System.Drawing.Point(8, 120)
Me.Text4.MaxLength = 0
Me.Text4.Multiline = True
Me.Text4.Name = "Text4"
Me.Text4.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Text4.ScrollBars = System.Windows.Forms.ScrollBars.Vertical
Me.Text4.Size = New System.Drawing.Size(305, 121)
Me.Text4.TabIndex = 27
'
'Text3
'
Me.Text3.AcceptsReturn = True
Me.Text3.BackColor = System.Drawing.SystemColors.Window
Me.Text3.Cursor = System.Windows.Forms.Cursors.IBeam
Me.Text3.ForeColor = System.Drawing.SystemColors.WindowText
Me.Text3.Location = New System.Drawing.Point(8, 72)
Me.Text3.MaxLength = 0
Me.Text3.Name = "Text3"
Me.Text3.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Text3.Size = New System.Drawing.Size(249, 19)
Me.Text3.TabIndex = 25
'
'Text2
'
Me.Text2.AcceptsReturn = True
Me.Text2.BackColor = System.Drawing.SystemColors.Window
Me.Text2.Cursor = System.Windows.Forms.Cursors.IBeam
Me.Text2.ForeColor = System.Drawing.SystemColors.WindowText
Me.Text2.Location = New System.Drawing.Point(152, 24)
Me.Text2.MaxLength = 0
Me.Text2.Name = "Text2"
Me.Text2.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Text2.Size = New System.Drawing.Size(105, 19)
Me.Text2.TabIndex = 23
Me.Text2.Text = "10003"
'
'Text1
'
```

```
Me.Text1.AcceptsReturn = True
Me.Text1.BackColor = System.Drawing.SystemColors.Window
Me.Text1.Cursor = System.Windows.Forms.Cursors.IBeam
Me.Text1.ForeColor = System.Drawing.SystemColors.WindowText
Me.Text1.Location = New System.Drawing.Point(8, 24)
Me.Text1.MaxLength = 0
Me.Text1.Name = "Text1"
Me.Text1.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Text1.Size = New System.Drawing.Size(137, 19)
Me.Text1.TabIndex = 22
'
'Label4
'
Me.Label4.BackColor = System.Drawing.SystemColors.Control
Me.Label4.Cursor = System.Windows.Forms.Cursors.Default
Me.Label4.ForeColor = System.Drawing.SystemColors.ControlText
Me.Label4.Location = New System.Drawing.Point(8, 104)
Me.Label4.Name = "Label4"
Me.Label4.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Label4.Size = New System.Drawing.Size(65, 13)
Me.Label4.TabIndex = 29
Me.Label4.Text = "Receive data"
'
'Timer1
'
Me.Timer1.Interval = 50
'
'Label3
'
Me.Label3.BackColor = System.Drawing.SystemColors.Control
Me.Label3.Cursor = System.Windows.Forms.Cursors.Default
Me.Label3.ForeColor = System.Drawing.SystemColors.ControlText
Me.Label3.Location = New System.Drawing.Point(8, 56)
Me.Label3.Name = "Label3"
Me.Label3.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Label3.Size = New System.Drawing.Size(65, 13)
Me.Label3.TabIndex = 28
Me.Label3.Text = "Send data"
'
'Label2
'
Me.Label2.BackColor = System.Drawing.SystemColors.Control
Me.Label2.Cursor = System.Windows.Forms.Cursors.Default
Me.Label2.ForeColor = System.Drawing.SystemColors.ControlText
Me.Label2.Location = New System.Drawing.Point(152, 8)
Me.Label2.Name = "Label2"
Me.Label2.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Label2.Size = New System.Drawing.Size(65, 13)
Me.Label2.TabIndex = 21
Me.Label2.Text = "Port No."
'
'Label1
'
Me.Label1.BackColor = System.Drawing.SystemColors.Control
Me.Label1.Cursor = System.Windows.Forms.Cursors.Default
Me.Label1.ForeColor = System.Drawing.SystemColors.ControlText
Me.Label1.Location = New System.Drawing.Point(8, 8)
Me.Label1.Name = "Label1"
Me.Label1.RightToLeft = System.Windows.Forms.RightToLeft.No
Me.Label1.Size = New System.Drawing.Size(73, 17)
Me.Label1.TabIndex = 20
```

```
            Me.Label1.Text = "IP address"
            '
            'Form1
            '
            Me.AutoScaleDimensions = New System.Drawing.SizeF(6.0!, 12.0!)
            Me.AutoScaleMode = System.Windows.Forms.AutoScaleMode.Font
            Me.ClientSize = New System.Drawing.Size(320, 253)
            Me.Controls.Add(Me.Button1)
            Me.Controls.Add(Me.Check1)
            Me.Controls.Add(Me.Text4)
            Me.Controls.Add(Me.Text3)
            Me.Controls.Add(Me.Text2)
            Me.Controls.Add(Me.Text1)
            Me.Controls.Add(Me.Label4)
            Me.Controls.Add(Me.Label3)
            Me.Controls.Add(Me.Label2)
            Me.Controls.Add(Me.Label1)
            Me.Name = "Form1"
            Me.Text = "Data link (server)"
            Me.ResumeLayout(False)
            Me.PerformLayout()

        End Sub
        Public WithEvents Button1 As System.Windows.Forms.Button
        Public WithEvents Check1 As System.Windows.Forms.CheckBox
        Public WithEvents Text4 As System.Windows.Forms.TextBox
        Public WithEvents Text3 As System.Windows.Forms.TextBox
        Public WithEvents Text2 As System.Windows.Forms.TextBox
        Public WithEvents Text1 As System.Windows.Forms.TextBox
        Public WithEvents Label4 As System.Windows.Forms.Label
        Friend WithEvents Timer1 As System.Windows.Forms.Timer
        Public WithEvents Label3 As System.Windows.Forms.Label
        Public WithEvents Label2 As System.Windows.Forms.Label
        Public WithEvents Label1 As System.Windows.Forms.Label

    End Class
```

■ Form1.vb (Program for the server)

```
Imports System
Imports System.Net
Imports System.Net.Sockets
Imports System.Net.NetworkInformation
Imports System.Text

Public Class Form1

    Private Listener As TcpListener
    Private Client As TcpClient

    Private Sub Form1_Load(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles MyBase.Load
        Text1.Enabled = False     'Disable IP address
        Text3.Enabled = False     'Disable Send data
        Button1.Enabled = False 'Disable Send button
    End Sub

    Private Sub Check1_CheckStateChanged (ByVal sender As System.Object, ByVal e As System.EventArgs)
    Handles Check1.CheckStateChanged
        'Process for Connect
        Try
```

```
        If Check1.CheckState = CheckState.Checked Then
            Dim interfaces As NetworkInterface()
            Dim _currentInterface As NetworkInterface

            'Get local IP address
            interfaces = NetworkInterface.GetAllNetworkInterfaces
            For Each NetworkInterface As NetworkInterface In interfaces
                If NetworkInterface.Name = "Local Area Connection" Then
                    _currentInterface = NetworkInterface
                    Dim properties As IPInterfaceProperties
                    properties = _currentInterface.GetIPProperties

                    If properties.UnicastAddresses.Count > 0 Then
                        For Each info As UnicastIPAddressInformation In properties.UnicastAddresses
                            Text1.Text = info.Address.ToString
                        Next
                    End If
                End If
            Next

            'Wait connection from client
            Listener = New TcpListener(IPAddress.Parse(Text1.Text), Convert.ToInt32(Text2.Text))
            Timer1.Start()
            Listener.Start()
        Else
            Client = Nothing
            Timer1.Stop()
            Button1.Enabled = False 'Disable send button
            Text3.Enabled = False
            Listener.Stop()             'Stop listen
        End If
    Catch ex As Exception
        MessageBox.Show(ex.Message, Me.Text, MessageBoxButtons.OK, MessageBoxIcon.Error,
        MessageBoxDefaultButton.Button1)
    End Try
End Sub

Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
    'Send text
    Try
        Dim SendBuf As Byte() = System.Text.Encoding.Default.GetBytes(Text3.Text)
        Dim Stream As NetworkStream = Client.GetStream()
        Stream.Write(SendBuf, 0, SendBuf.Length)
    Catch ex As Exception
        'Disconnect
        Client = Nothing

        MessageBox.Show(ex.Message, Me.Text, MessageBoxButtons.OK, MessageBoxIcon.Error,
        MessageBoxDefaultButton.Button1)
    End Try
End Sub

Private Sub Timer1_Tick(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Timer1.Tick
    'Receive process
    Try
        '
        If Client Is Nothing Then
            '
            If Listener.Pending = False Then
                Text1.Enabled = False     'Disable IP address edit
                Text3.Enabled = False     'Disable send text edit
```

```
                    Button1.Enabled = False 'Disable send button
                Else
                    Client = Listener.AcceptTcpClient() 'Connect with client
                    Text1.Enabled = True     'Enable IP address edit
                    Text3.Enabled = True     'Enable    send text edit
                    Button1.Enabled = True 'Enable send button
                End If
            Else
                'Receive data
                Try
                    Dim Stream As NetworkStream = Client.GetStream
                    If Stream.DataAvailable Then
                        Dim bytes(1000) As Byte
                        Dim strReceivedData As String = ""
                        Dim datalength = Stream.Read(bytes, 0, bytes.Length)
                        strReceivedData = System.Text.Encoding.Default.GetString(bytes).Substring(0, datalength)
                        Text4.AppendText(strReceivedData)
                        Text4.AppendText(System.Environment.NewLine)
                    End If
                Catch ex As Exception
                    'Disconnect
                    Client = Nothing
                    MessageBox.Show(ex.Message, Me.Text, MessageBoxButtons.OK, MessageBoxIcon.Error,
                    MessageBoxDefaultButton.Button1)
                End Try
            End If

        Catch ex As Exception
            MessageBox.Show(ex.Message, Me.Text, MessageBoxButtons.OK, MessageBoxIcon.Error,
             MessageBoxDefaultButton.Button1)
        End Try
    End Sub

End Class
```

4.2.2. Sample program for real-time external control function

A sample program that establishes a data link using Microsoft Visual Studio Express Visual C++ (hereinafter VC) is shown below.

The procedures for creating the program are briefly explained below.

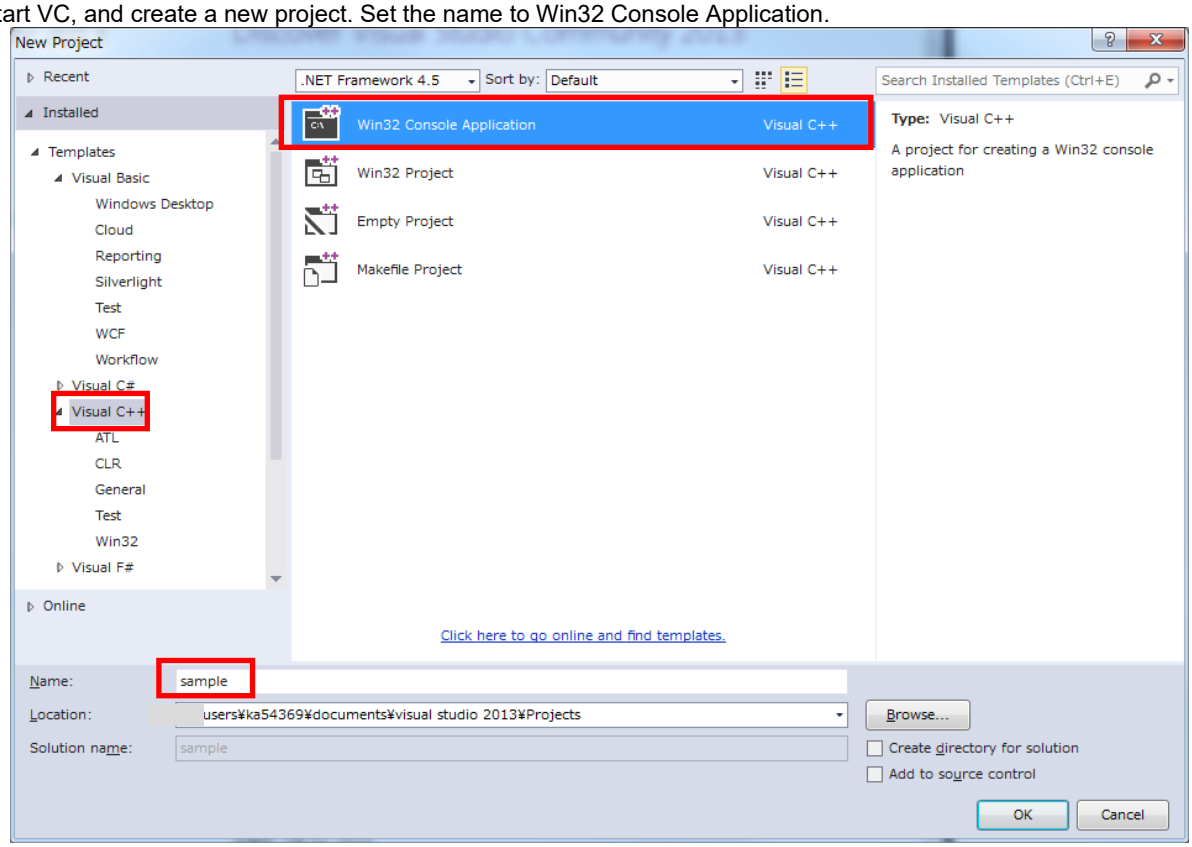
Refer to the software manuals for details on operating VC and creating the application.

(1) Create new project

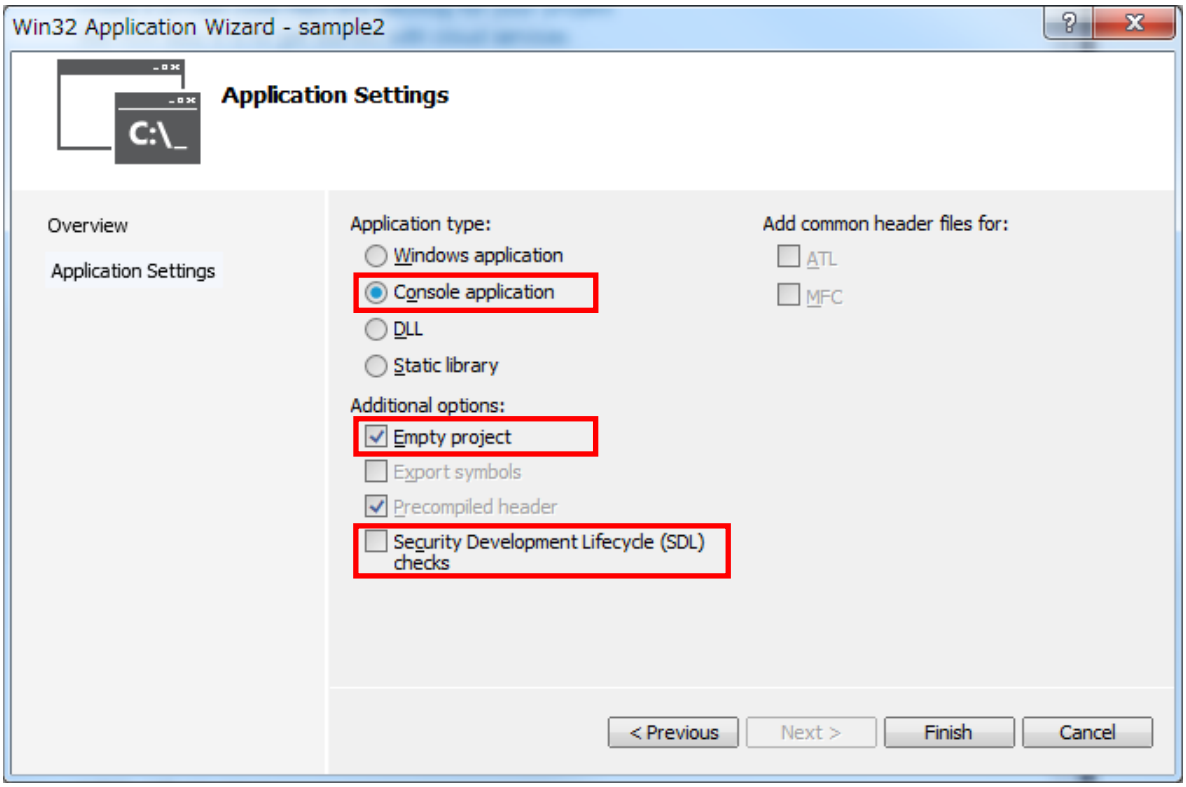
(2) Create program sample.cpp/strdef.h

(1) Create new project

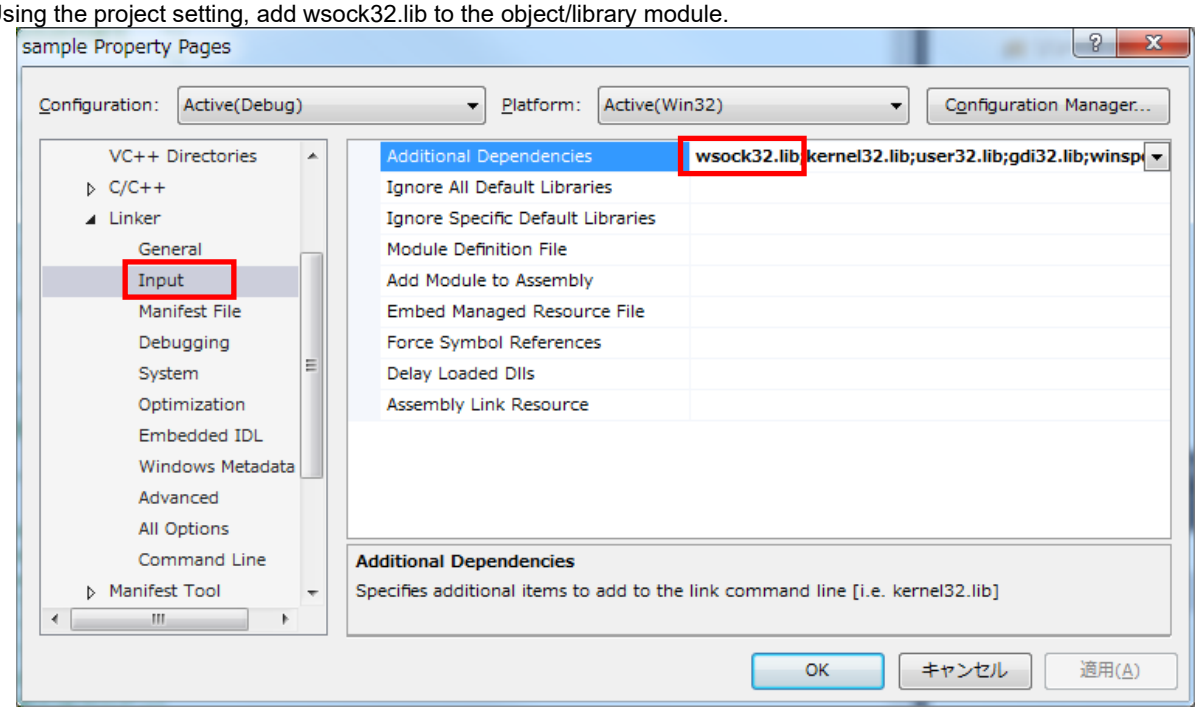
Start VC, and create a new project. Set the name to Win32 Console Application.



4. Appendix



Using the project setting, add wsock32.lib to the object/library module.



Copy files to sample folder.

• strdef.h

・ sample.cpp

Each text files saved from pdf manual.

■ Header file strdef.h

```
//***************************************************************************
// Real-time control sample program
// Communication packet data structure definition header file
//***************************************************************************
// strdef.h

#define VER_H7

/*************************************************************************/
/* Joint coordinate system (Set unused axis to 0)                        */
/* Refer to the instruction manual enclosed                              */
/* with each robot for details on each element.                          */
/*************************************************************************/
typedef struct{
    float    j1;            // J1 axis angle (radian)
    float    j2;            // J2 axis angle (radian)
    float    j3;            // J3 axis angle (radian)
    float    j4;            // J4 axis angle (radian)
    float    j5;            // J5 axis angle (radian)
    float    j6;            // J6 axis angle (radian)
    float    j7;            // Additional axis 1 (J7 axis angle) (radian)
    float    j8;            // Additional axis 2 (J8 axis angle) (radian)
} JOINT;

/*************************************************************************/
/* XYZ coordinate system (Set unused axis to 0)                          */
/* Refer to the instruction manual enclosed                              */
/* with each robot for details on each element.                          */
/*************************************************************************/
typedef struct{
    float    x;             // X axis coordinate value (mm)
    float    y;             // Y axis coordinate value (mm)
    float    z;             // Z axis coordinate value (mm)
    float    a;             // A axis coordinate value (radian)
    float    b;             // B axis coordinate value (radian)
    float    c;             // C axis coordinate value (radian)
    float    l1;            // Additional axis 1 (mm or radian)
    float    l2;            // Additional axis 2 (mm or radian)
} WORLD;

typedef struct{
    WORLD w;
    unsigned int sflg1;     // Structural flag 1
    unsigned int sflg2;     // Structural flag 2
} POSE;

/*************************************************************************/
/* Pulse coordinate system (Set unused axis to 0)                        */
/* These coordinates express each joint                                  */
/* with a motor pulse value.                                             */
/*************************************************************************/
typedef struct{
    long p1; // Motor 1 axis
    long p2; // Motor 2 axis
    long p3; // Motor 3 axis
    long p4; // Motor 4 axis
    long p5; // Motor 5 axis
    long p6; // Motor 6 axis
    long p7; // Additional axis 1 (Motor 7 axis)
```

```
    long p8; // Additional axis 2 (Motor 8 axis)
} PULSE;

/************************************************************/
/* Real-time function communication data packet      */
/************************************************************/
typedef struct enet_rtcmd_str {
    unsigned short Command;             // Command
#define MXT_CMD_NULL        0       // Real-time external command invalid
#define MXT_CMD_MOVE        1       // Real-time external command valid
#define MXT_CMD_END         255     // Real-time external command end

    unsigned short  SendType;           // Command data type designation
    unsigned short  RecvType;           // Monitor data type designation
                                        /////////// Command or monitor data type ///
#define MXT_TYP_NULL        0       // No data
                                        // For the command and monitor //////////////////
#define MXT_TYP_POSE        1       // XYZ data
#define MXT_TYP_JOINT       2       // Joint data
#define MXT_TYP_PULSE       3       // pulse data
                                        ////////// For position related monitor ///
#define MXT_TYP_FPOSE       4       // XYZ data (after filter process)
#define MXT_TYP_FJOINT      5       // Joint data (after filter process)
#define MXT_TYP_FPULSE      6       // Pulse data (after filter process)
#define MXT_TYP_FB_POSE     7       // XYZ data (Encoder feedback value)
#define MXT_TYP_FB_JOINT    8       // Joint data (Encoder feedback value)
#define MXT_TYP_FB_PULSE    9       // Pulse data (Encoder feedback value)
                                        // For current related monitors //////////////////
#define MXT_TYP_CMDCUR      10      // Electric current command
#define MXT_TYP_FBKCUR      11      // Electric current feedback

    union rtdata {                      // Command data
        POSE pos;                       // XYZ type [mm/rad]
        JOINT jnt;                      // Joint type [rad]
        PULSE pls;                      // Pulse type [pls]
        long lng1[8];                   // Integer type [% / non-unit]
    } dat;

    unsigned short SendIOType;          // Send input/output signal data designation
    unsigned short RecvIOType;          // Return input/output signal data designation

#define MXT_IO_NULL         0       // No data
#define MXT_IO_OUT          1       // Output signal
#define MXT_IO_IN           2       // Input signal

    unsigned short  BitTop;             // Head bit No.
    unsigned short  BitMask;            // Transmission bit mask pattern designation (0x0001-0xffff)
    unsigned short  IoData;             // Input/output signal data (0x0000-0xffff)

    unsigned short  TCount;             // Timeout time counter value
    unsigned long   CCount;             // Transmission data counter value

    unsigned short  RecvType1;          // Reply data-type specification 1
    union rtdata1 {                     // Monitor data 1
        POSE    pos1;                   // XYZ type [mm/rad]
        JOINT   jnt1;                   // JOINT type [mm/rad]
        PULSE   pls1;                   // PULSE type [mm/rad]
        long    lng1[8];                // Integer type [% / non-unit]
    } dat1;

    unsigned short  RecvType2;          // Reply data-type specification 2
```

```
        union rtdata2 {                         // Monitor data 2
            POSE    pos2;                       // XYZ type [mm/rad]
            JOINT   jnt2;                       // JOINT type [mm/rad]
            PULSE   pls2;                       // PULSE type [mm/rad] or Integer type [% / non-unit]
            long    lng2[8];                    // Integer type [% / non-unit]
        } dat2;

        unsigned short    RecvType3;            // Reply data-type specification 3
        union rtdata3 {                         // Monitor data 3
            POSE    pos3;                       // XYZ type [mm/rad]
            JOINT   jnt3;                       // JOINT type [mm/rad]
            PULSE   pls3;                       // PULSE type [mm/rad] or Integer type [% / non-unit]
            long    lng3[8];                    // Integer type [% / non-unit]
        } dat3;

    } MXTCMD;
```

■ Source file　sample.cpp

```
    // sample.cpp

    // Change the definition in the "strdef.h" file by the S/W version of the controller.
    // Refer to the "strdef.h" file for details.
    //

    #define _CRT_SECURE_NO_WARNINGS

    #include <windows.h>
    #include <iostream>
    #include <winsock.h>
    #include <stdio.h>
    #include <conio.h>
    #include <string.h>
    #include <math.h>
    #include "strdef.h"
    #define NO_FLAGS_SET 0

    #define MAXBUFLEN 512

    using namespace std;

    INT main(VOID)
    {
        WSADATA Data;
        SOCKADDR_IN destSockAddr;
        SOCKET destSocket;
        unsigned long destAddr;
        int status;
        int numsnt;
        int numrcv;
        char sendText[MAXBUFLEN];
        char recvText[MAXBUFLEN];
        char dst_ip_address[MAXBUFLEN];
        unsigned short    port;
        char msg[MAXBUFLEN];
        char buf[MAXBUFLEN];
        char type,type_mon[4];
        unsigned short IOSendType=0;        // Send input/output signal data designation
        unsigned short IORecvType=0;        // Reply input/output signal data designation
        unsigned short IOBitTop=0;
```

```
        unsigned short IOBitMask=0xffff;
        unsigned short IOBitData=0;

        cout << " Input connection destination IP address (192.168.0.20) ->";
        cin.getline(dst_ip_address, MAXBUFLEN);
        if(dst_ip_address[0]==0)      strcpy(dst_ip_address, "192.168.0.20");

        cout << " Input connection destination port No. (10000) -> ";
        cin.getline(msg, MAXBUFLEN);
        if(msg[0]!=0)       port=atoi(msg);
        else                                    port=10000;

        cout << " Use input/output signal?([Y] / [N])-> ";
        cin.getline(msg, MAXBUFLEN);
        if(msg[0]!=0 && (msg[0]=='Y' || msg[0]=='y')) {
            cout << " What is target? Input signal/output signal([I]nput / [O]utput)-> ";
            cin.getline(msg, MAXBUFLEN);
            switch(msg[0]) {
              case 'O':                         // Set target to output signal
              case 'o':
                    IOSendType = MXT_IO_OUT;
                    IORecvType = MXT_IO_OUT;
                    break;
              case 'I':                         // Set target to input signal
              case 'i':
              default:
                    IOSendType = MXT_IO_NULL;
                    IORecvType = MXT_IO_IN;
                    break;
        }

        cout << " Input head bit No. (0 to 32767)-> ";
        cin.getline(msg, MAXBUFLEN);
        if(msg[0]!=0)       IOBitTop = atoi(msg);
        else                IOBitTop = 0;

        if(IOSendType==MXT_IO_OUT) {        // Only for output signal
            cout << " Input bit mask pattern for output as hexadecimal (0000 to FFFF)-> ";
            cin.getline(msg, MAXBUFLEN);
            if(msg[0]!=0)           sscanf(msg,"%4x",&IOBitMask);
            else                    IOBitMask = 0;
            cout << " Input bit data for output as hexadecimal (0000 to FFFF)-> ";
            cin.getline(msg, MAXBUFLEN);
            if(msg[0]!=0)           sscanf(msg,"%4x",&IOBitData);
            else                    IOBitData = 0;
        }
    }
    cout << "--- Input the data type of command. ---¥n";
    cout << "[0: None / 1: XYZ / 2:JOINT / 3: PULSE]¥n";
    cout << "-- please input the number -- [0] - [3]-> ";
    cin.getline(msg, MAXBUFLEN);
    type = atoi(msg);

    for(int k=0; k<4; k++) {
        sprintf(msg,"--- input the data type of monitor ( %d-th ) ---¥n", k);
        cout << msg;
        cout << "[0: None]¥n";
        cout << "[1: XYZ / 2:JOINT / 3: PULSE] ..... Command value¥n";
        cout << "[4: XYZ/ 5: JOINT/ 6: PULSE] ..... Command value after the filter process¥n";
        cout << "[7: XYZ/ 5:JOINT/ 6:PULSE] ..... Feedback value.¥n";
        cout << "[10: Electric current value / 11: Electric current feedback] ... Electric current value.¥n";
```

```
        cout << "Input the numeral [0] to [11] -> ";
        cin.getline(msg, MAXBUFLEN);
        type_mon[k] = atoi(msg);
}
sprintf(msg, "IP=%s / PORT=%d / Send Type=%d / Monitor Type0/1/2/3=%d/%d/%d/%d", dst_ip_address, port , type,
type_mon[0], type_mon[1], type_mon[2], type_mon[3]);
cout << msg << endl;

cout << "[Enter]= End / [d]= Monitor data display";
cout << "[z/x]= Increment/decrement first command data transmitted by the delta amount. ";

cout << " Is it all right? [Enter] / [Ctrl+C] ";
cin.getline(msg, MAXBUFLEN);

// Windows Socket DLL initialization
status=WSAStartup(MAKEWORD(1, 1), &Data);
if (status != 0)
cerr << "ERROR: WSAStartup unsuccessful" << endl;

// IP address, port, etc., setting
memset(&destSockAddr, 0, sizeof(destSockAddr));
destAddr=inet_addr(dst_ip_address);
memcpy(&destSockAddr.sin_addr, &destAddr, sizeof(destAddr));
destSockAddr.sin_port=htons(port);
destSockAddr.sin_family=AF_INET;

// Socket creation
destSocket=socket(AF_INET, SOCK_DGRAM, 0);
if (destSocket == INVALID_SOCKET) {
        cerr << "ERROR: socket unsuccessful" << endl;
        status=WSACleanup();
        if (status == SOCKET_ERROR)
                cerr << "ERROR: WSACleanup unsuccessful" << endl;
        return(1);
}

MXTCMD          MXTsend;
MXTCMD          MXTrecv;
JOINT           jnt_now;
POSE            pos_now;
PULSE           pls_now;

unsigned long   counter = 0;
int loop = 1;
int disp = 0;
int disp_data = 0;
int ch;
float delta=(float)0.0;
long ratio=1;
int     retry;
        fd_set          SockSet;        // Socket group used with select
        timeval         sTimeOut;       // For timeout setting

memset(&MXTsend, 0, sizeof(MXTsend));
memset(&jnt_now, 0, sizeof(JOINT));
memset(&pos_now, 0, sizeof(POSE));
memset(&pls_now, 0, sizeof(PULSE));

while(loop)             {

        memset(&MXTsend, 0, sizeof(MXTsend));
```

```
memset(&MXTrecv, 0, sizeof(MXTrecv));

// Transmission data creation
if(loop==1) {        // Only first time
        MXTsend.Command = MXT_CMD_NULL;
        MXTsend.SendType = MXT_TYP_NULL;
        MXTsend.RecvType = type;
        MXTsend.SendIOType = MXT_IO_NULL;
        MXTsend.RecvIOType = IOSendType;
        MXTsend.CCount = counter = 0;
}
else {                                    // Second and following times
        MXTsend.Command = MXT_CMD_MOVE;
        MXTsend.SendType = type;
        MXTsend.RecvType = type_mon[0];
        MXTsend.RecvType1= type_mon[1];
        MXTsend.RecvType2= type_mon[2];
        MXTsend.RecvType3= type_mon[3];
        switch(type) {
                case MXT_TYP_JOINT:
                        memcpy(&MXTsend.dat.jnt, &jnt_now, sizeof(JOINT));
                        MXTsend.dat.jnt.j1 += (float)(delta*ratio*3.141592/180.0);
                        break;
                case MXT_TYP_POSE:
                        memcpy(&MXTsend.dat.pos, &pos_now, sizeof(POSE));
                        MXTsend.dat.pos.w.x += (delta*ratio);
                        break;
                case MXT_TYP_PULSE:
                        memcpy(&MXTsend.dat.pls, &pls_now, sizeof(PULSE));
                        MXTsend.dat.pls.p1 += (long)((delta*ratio)*10);
                        break;
                default:
                        break;
        }
        MXTsend.SendIOType = IOSendType;
        MXTsend.RecvIOType = IORecvType;
        MXTsend.BitTop = IOBitTop;
        MXTsend.BitMask =IOBitMask;
        MXTsend.IoData = IOBitData;
        MXTsend.CCount = counter;
}

// Keyboard input
// [Enter]=End / [d]= Display the monitor data, or none / [0/1/2/3]= Change of monitor data display
// [z/x]=Increment/decrement first command data transmitted by the delta amount
while(_kbhit()!=0) {
        ch=_getch();
        switch(ch) {
        case 0x0d:
                MXTsend.Command = MXT_CMD_END;
                loop = 0;
                break;
        case 'Z':
        case 'z':
                delta += (float)0.1;
                break;
        case 'X':
        case 'x':
                delta -= (float)0.1;
                break;
        case 'C':
```

```
        case 'c':
                delta = (float)0.0;
                break;
        case 'd':
                disp = ~disp;
                break;
        case '0': case '1':         case '2': case '3':
                disp_data = ch - '0';
                break;
        }
}

memset(sendText, 0, MAXBUFLEN);
memcpy(sendText, &MXTsend, sizeof(MXTsend));
if(disp) {
        sprintf(buf, "Send       (%ld):",counter);
        cout << buf << endl;
}
numsnt=sendto(destSocket, sendText, sizeof(MXTCMD), NO_FLAGS_SET, (LPSOCKADDR) &destSockAddr,
sizeof(destSockAddr));
if (numsnt != sizeof(MXTCMD)) {
        cerr << "ERROR: sendto unsuccessful" << endl;
        status=closesocket(destSocket);
        if (status == SOCKET_ERROR)
                cerr << "ERROR: closesocket unsuccessful" << endl;
        status=WSACleanup();
        if (status == SOCKET_ERROR)
                cerr << "ERROR: WSACleanup unsuccessful" << endl;
                return(1);
}

memset(recvText, 0, MAXBUFLEN);

retry = 1;                              // No. of reception retries
while(retry) {
        FD_ZERO(&SockSet);              // SockSet initialization
        FD_SET(destSocket, &SockSet); // Socket registration
        sTimeOut.tv_sec = 1;            // Transmission timeout setting (sec)
        sTimeOut.tv_usec = 0;           //                                 (micro sec)
        status = select(0, &SockSet, (fd_set *)NULL, (fd_set *)NULL, &sTimeOut);
        if(status == SOCKET_ERROR) {
                return(1);
        }
        if((status > 0) && (FD_ISSET(destSocket, &SockSet) != 0)) {     // If it receives by the time-out
                numrcv=recvfrom(destSocket, recvText, MAXBUFLEN, NO_FLAGS_SET, NULL, NULL);
                if (numrcv == SOCKET_ERROR) {
                        cerr << "ERROR: recvfrom unsuccessful" << endl;
                status=closesocket(destSocket);
                if (status == SOCKET_ERROR)
                        cerr << "ERROR: closesocket unsuccessful" << endl;
                status=WSACleanup();
                if (status == SOCKET_ERROR)
                        cerr << "ERROR: WSACleanup unsuccessful" << endl;
                return(1);
        }
        memcpy(&MXTrecv, recvText, sizeof(MXTrecv));
        char str[10];
        if(MXTrecv.SendIOType==MXT_IO_IN)   sprintf(str,"IN%04x", MXTrecv.IoData);
        else if(MXTrecv.SendIOType==MXT_IO_OUT)   sprintf(str,"OT%04x", MXTrecv.IoData);
        else                                                    sprintf(str,"------");
```

```
int DispType;
void *DispData;
switch(disp_data) {
	case 0:
		DispType = MXTrecv.RecvType;
		DispData = &MXTrecv.dat;
		break;
	case 1:
		DispType = MXTrecv.RecvType1;
		DispData = &MXTrecv.dat1;
		break;
	case 2:
		DispType = MXTrecv.RecvType2;
		DispData = &MXTrecv.dat2;
		break;
	case 3:
		DispType = MXTrecv.RecvType3;
		DispData = &MXTrecv.dat3;
		break;
	default:
		break;
}

switch(DispType) {
	case MXT_TYP_JOINT:
	case MXT_TYP_FJOINT:
	case MXT_TYP_FB_JOINT:
		if(loop==1) {
			memcpy(&jnt_now, DispData, sizeof(JOINT));
			loop = 2;
		}
		if(disp) {
			JOINT *j=(JOINT*)DispData;
			sprintf(buf, "Receive (%ld): TCount=%d
				Type(JOINT)=%d¥n %7.2f,%7.2f,%7.2f,%7.2f,%7.2f,%7.2f,%7.2f,%7.2f (%s)"
				,MXTrecv.CCount,MXTrecv.TCount,DispType
				,j->j1, j->j2, j->j3 ,j->j4, j->j5, j->j6, j->j7, j->j8, str);
			cout << buf << endl;
		}
		break;
	case MXT_TYP_POSE:
	case MXT_TYP_FPOSE:
	case MXT_TYP_FB_POSE:
		if(loop==1) {
			memcpy(&pos_now, &MXTrecv.dat.pos, sizeof(POSE));
			loop = 2;
		}
		if(disp) {
			POSE *p=(POSE*)DispData;
			sprintf(buf, "Receive (%ld): TCount=%d
				Type(POSE)=%d¥n %7.2f,%7.2f,%7.2f,%7.2f,%7.2f,%7.2f, %04x,%04x (%s)"
				,MXTrecv.CCount,MXTrecv.TCount,DispType
				,p->w.x, p->w.y, p->w.z, p->w.a, p->w.b, p->w.c, p->sflg1, p->sflg2, str);
			cout << buf << endl;
		}
		break;
	case MXT_TYP_PULSE:
	case MXT_TYP_FPULSE:
	case MXT_TYP_FB_PULSE:
	case MXT_TYP_CMDCUR:
	case MXT_TYP_FBKCUR:
```

```
                        if(loop==1) {
                                memcpy(&pls_now, &MXTrecv.dat.pls, sizeof(PULSE));
                                loop = 2;
                        }
                        if(disp) {
                                PULSE *l=(PULSE*)DispData;
                                sprintf(buf, "Receive (%ld): TCount=%d
                                        Type(PULSE/OTHER)=%d¥n %ld,%ld,%ld,%ld,%ld,%ld,%ld,%ld (%s)"
                                        ,MXTrecv.CCount,MXTrecv.TCount,DispType
                                        ,l->p1, l->p2, l->p3, l->p4, l->p5, l->p6, l->p7, l->p8, str);
                                cout << buf << endl;
                        }
                        break;
                case MXT_TYP_NULL:
                        if(loop==1) {
                                loop = 2;
                        }
                        if(disp) {
                                sprintf(buf, "Receive (%ld): TCount=%d    Type(NULL)=%d¥n (%s)"
                                        ,MXTrecv.CCount,MXTrecv.TCount, DispType, str);
                                cout << buf << endl;
                        }
                        break;
                default:
                        cout << "Bad data type.¥n" << endl;
                        break;
                }
                counter++;                      // Count up only when communication is successful
                retry=0;                        // Leave reception loop
        }
        else {                                  // Reception timeout
                cout << "... Receive Timeout!   <Push [Enter] to stop the program>" << endl;
                retry--;                        // No. of retries subtraction
                if(retry==0) loop=0;            // End program if No. of retries is 0
        }
    } /* while(retry) */
} /* while(loop) */

// End
cout << "/// End /// ";
sprintf(buf, "counter = %ld", counter);
cout << buf << endl;

// Close socket
status=closesocket(destSocket);
if (status == SOCKET_ERROR)
    cerr << "ERROR: closesocket unsuccessful" << endl;
status=WSACleanup();
if (status == SOCKET_ERROR)
    cerr << "ERROR: WSACleanup unsuccessful" << endl;

return 0;
}
```

4.3. Viewing option card information

Option card information can be viewed in RT ToolBox3 (option).
The information of CC-Link IE Field Network Basic or Modbus TCP option card connected via Ethernet can be read in the Properties window by selecting [Online] → [Board] and clicking "Slot8:xxxx" in the tree structure of the workspace in online mode.
* The option card information in the Properties window is not updated automatically. To update the information, change the mode to offline, then online, and perform the above step again.

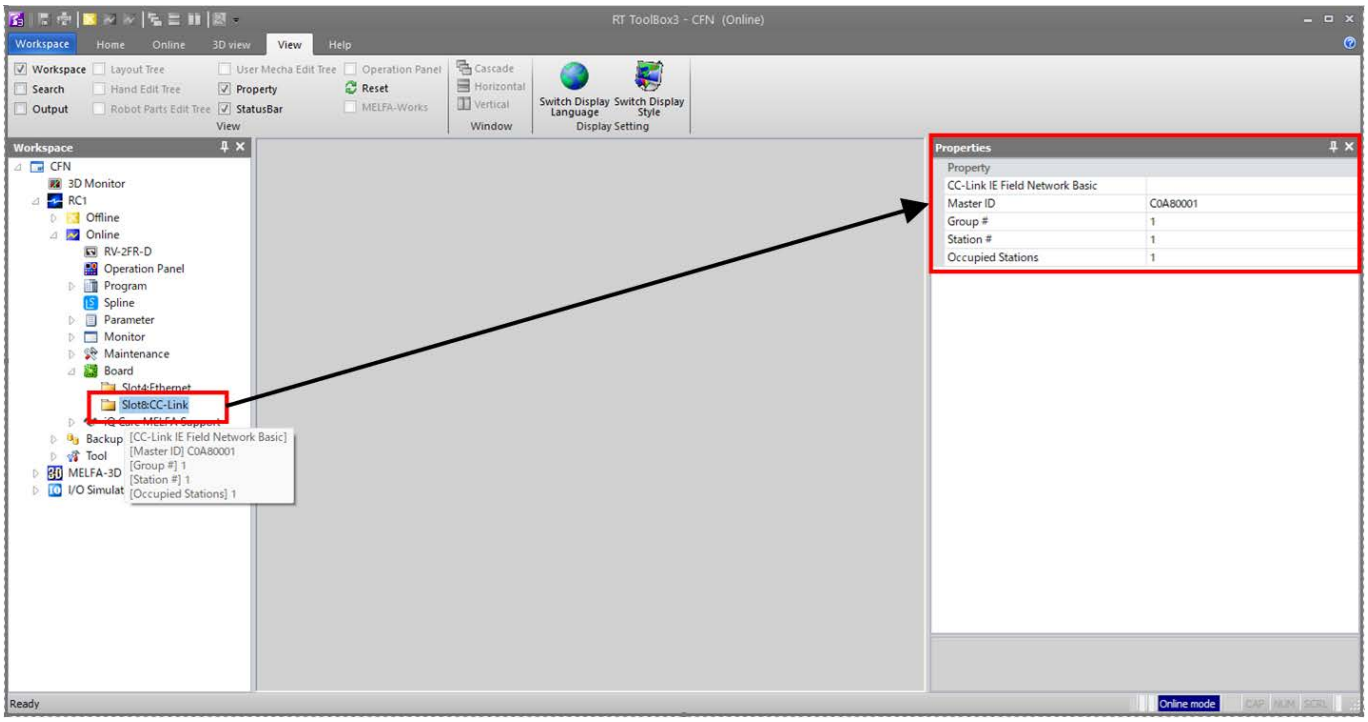


Fig. 4-1 Example of viewing option card information (For CC-Link IE Field Network Basic)

The following fields will be displayed depending on the network type.

For CC-Link IE Field Network Basic

Table 4-1 Option card information (For CC-Link IE Field Network Basic)

Display item		Display example	Meaning	Remarks
Option card name		CC-Link	Option card name	
Option card information	[CC-Link IE Field Network Basic]	-(Blank)	CC-Link IE Field Network Basic	
	[Master ID]	C0A80001	Master ID	
	[Group #]	1	Group number	
	[Station #]	1	Station number	
	[Occupied Stations]	1	Number of occupied stations	

For Modbus TCP

Table 4-2 Option card information (For Modbus TCP)

Display item		Display example	Meaning	Remarks
Option card name		Modbus TCP	Option card name	
Option card information	[IP]	192.168.0.20	IP address	NETIP setting value
	[Subnet]	255.255.255.0	Subnet mask	NETMSK setting value
	[Gateway]	192.168.0.254	Default gateway	NETGW setting value
	[Post]	502	Port number	MBTCPPRT setting value
	[Protocol]	TCP	Protocol setting	MBTCPCP setting value (0: TCP / 1: UDP)

Trademarks

- No part of this document may be reproduced without express permission of Mitsubishi Electric Corporation.
- Please note that the information in this manual is subject to change without notice in the future.
- The specification values in this manual are obtained with the Mitsubishi standard test method.
- Although this manual has been prepared to contain accurate information, please contact us if you find any errors or have questions.
- This is the original document.
- Microsoft, Windows, and Windows 11 are registered trademarks of Microsoft Corporation in the United States and other countries.
- The official name of Windows® is Microsoft®Windows®Operating System.
- Windows® 11 is a product name of Microsoft Corporation in the United States.
- Ethernet is registered trademarks or trademarks of Xerox Corporation in the United States.
- The product names used in this manual are trademarks or registered trademarks of respective owners.
- In the body text of this manual, ® and TM marks are omitted.
- Referenced Standard (Requirement of Chinese standardized law): This Product is designed and manufactured accordance with GB 11291.1.
- Illustrations in this Instruction Manual may differ from the actual products.

Copyright(C) 2015 MITSUBISHI ELECTRIC CORPORATION

Copyrights

- The screens (screenshots) are used in accordance with the Microsoft Corporation guideline.

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

Jan. 2026 MEE Printed in Japan on recycled paper. Specifications are subject to change without notice.