

FATEC

INVERTER TROUBLE SHOOTING COURSE (FR-E800)

● SAFETY PRECAUTIONS ●

(Read these precautions before using this product.)

When designing a system, always read the relevant manuals and give due consideration to safety. In addition, pay careful attention to the following points for proper handling during training.

[Precautions during training]



WARNING

- To prevent electric shock, do not touch the terminal block while the power is supplied.
- Before opening the safety cover, turn OFF the power, or check that it is sufficiently safe.
- Do not touch moving parts.



CAUTION

- Follow the instructor's directions during training.
- Do not remove the units of a demonstration machine or change the wiring without permission. Doing so may cause a failure, malfunction, injury and/or fire.
- If the demonstration machine emits an abnormal odor or sound, stop it by operating the Power switch or Emergency stop button.
- If any trouble occurs, notify the instructor immediately.

<Notes on descriptions in this school text>

- Connection diagrams in this school text appear with the control logic of the input terminals as the sink logic, unless otherwise specified.

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Memo

CHAPTER 1 IMPORTANCE OF PRODUCTIVE MAINTENANCE

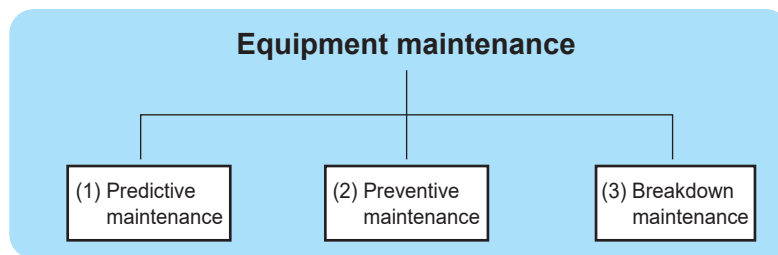
When a production system stops due to a failure or power failure, downtime causes a loss proportional to the duration of the downtime. Therefore, it is necessary to design a system that is not stopped by a failure or power failure.

In case the production system stops, quick recovery is an important issue. To improve the operating rate of the production system, each factory must have a team of maintenance personnel.

1.1 Types of equipment maintenance

Equipment maintenance includes predictive maintenance, preventive maintenance, and breakdown maintenance.

In general, to continue production at a factory, it is necessary to carry out predictive maintenance and periodic preventive maintenance for all equipment, devices, and lines. Additionally, prompt restoration of operations through breakdown maintenance is essential in the event of a failure or shutdown.



(1) Predictive maintenance

This refers to identifying signs of failure and maintaining them when they appear.

(2) Preventive maintenance

This refers to regular and predetermined maintenance work performed periodically to prevent breakage in advance. It also includes maintenance based on condition monitoring.

Remark

Maintenance based on condition monitoring

This involves checking the condition of the production equipment, and systematically adjusting the equipment and replacing parts according to that condition. Frequent inspections require significant time and effort, but eliminating unnecessary replacements of production equipment parts reduces costs.

(3) Breakdown maintenance

This refers to the maintenance of equipment and machinery in the event of issues that include failures, reduced production capacity, and instances of nonconforming products.

Remark

When equipment is newly constructed, it is also necessary to consider countermeasures by design and maintenance plans to ensure efficient maintenance.

Refer to Appendix for the general approach to maintenance and its management.

1.2 Maintenance-related functions of inverters

Mitsubishi Electric inverters have various maintenance-related functions.

These functions help prevent failures and reduce the cost of troubleshooting. In addition, these functions facilitate prompt response and quick resolution.

Maintenance	Overview	Related function of inverter
Predictive maintenance	When the monitored sign of trouble exceeds the predetermined level, replace relevant parts.	<ul style="list-style-type: none"> • Current detection function • Load characteristics fault detection • Life diagnosis
Preventive Maintenance	After a predetermined use period, replace relevant parts.	<ul style="list-style-type: none"> • Maintenance timer • Start count monitor
Breakdown maintenance	If equipment breaks, replace relevant parts.	<ul style="list-style-type: none"> • Trace function • Clock function • AI alarm diagnosis

Remark

In addition to the above, the environmental impact diagnosis function is provided for predictive maintenance (for coated models (-60/-06) only).

1.3 Failure stage

Generally, complicated system failure is categorized into three stages, initial failure, random failure, and wear-out failure as shown in Fig. 1.1.

Initial failures are considered to be removed in manufacturing and inspection processes by a manufacturer.

Because random failures are unforeseen and occur suddenly at any time within the useful life of equipment before it is worn, it is difficult to take the technical measure. At present, the measure only based on the statistical treatment can be taken.

Wear-out failures occur at nearly the end of useful life in the course of deterioration or as a result of wear, and increase suddenly as time proceeds. At Point t_b in Fig. 1.1 which means the replacement years, preventive maintenance will be made proper by changing specific parts for new ones.

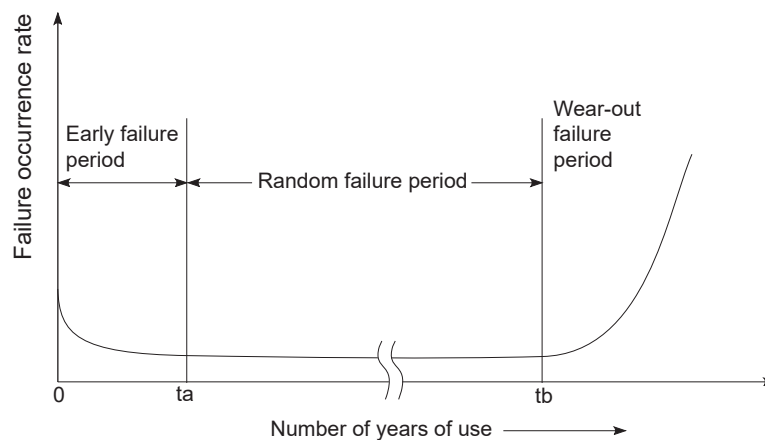


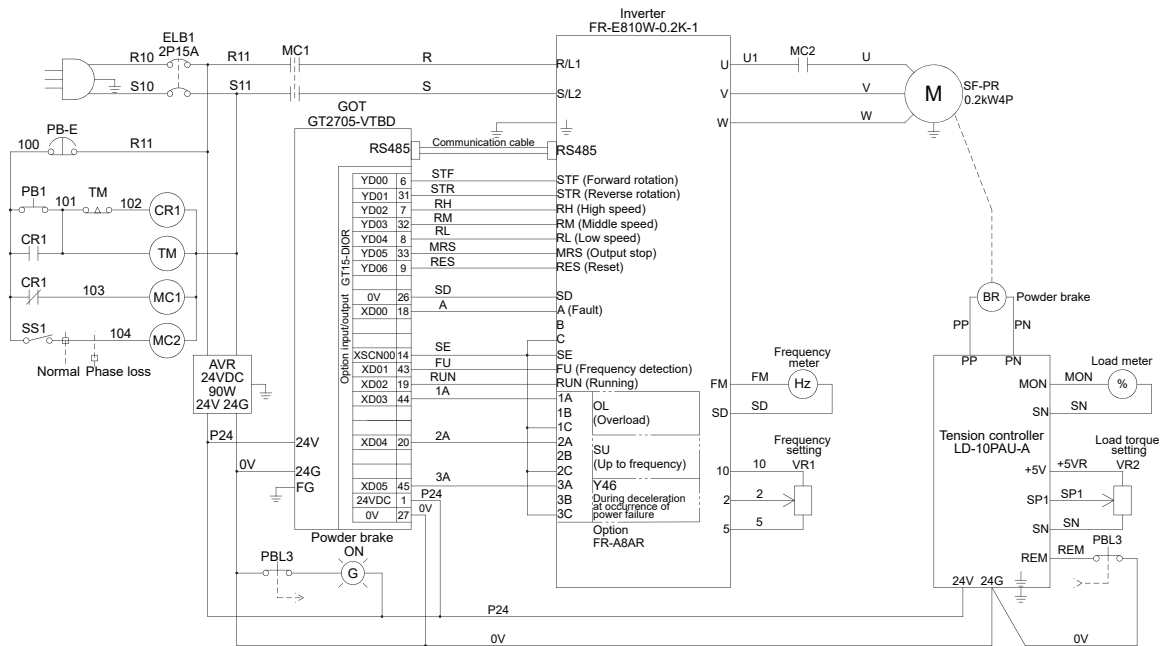
Fig. 1.1 Bath-tub curve

Memo

CHAPTER 2 UNDERSTANDING INVERTER SYSTEM

2.1 Demonstration machine configuration

The following shows the configuration of the inverter demonstration machine used for training.



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2.2 Appearance and item name of demonstration machine

The following figure shows the configuration of the inverter demonstration machine.

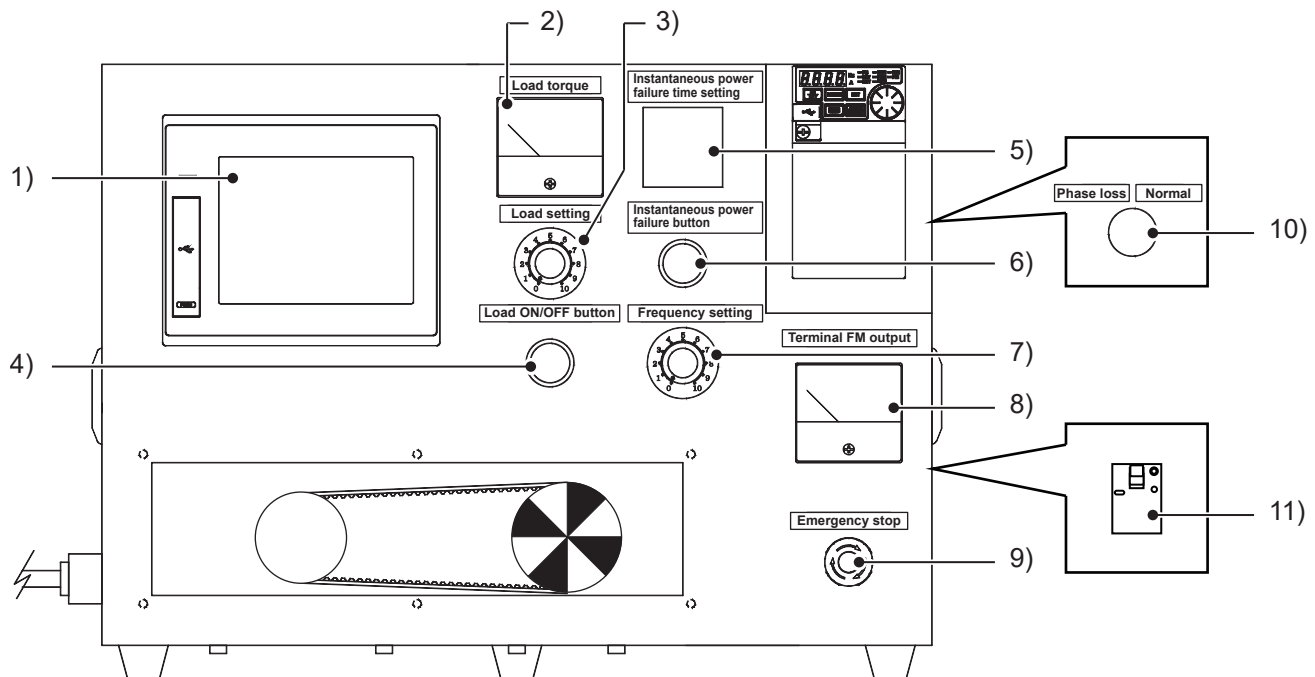
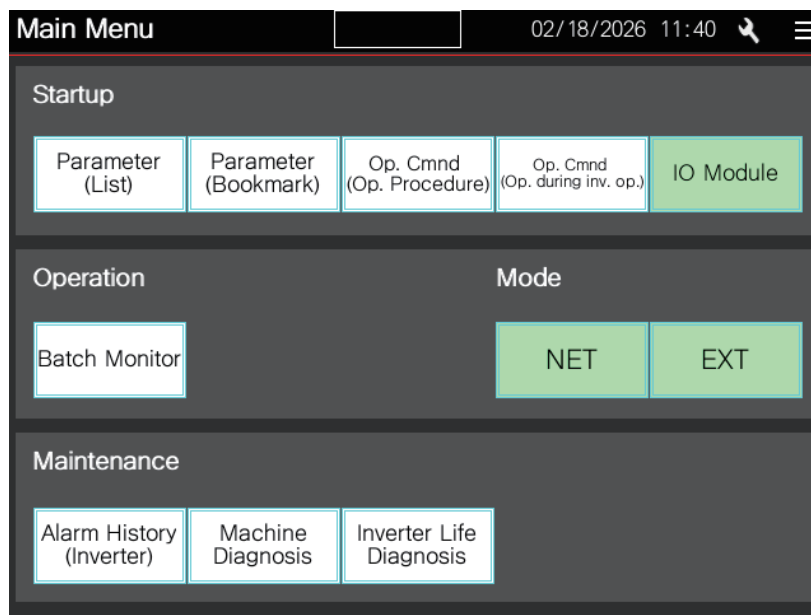


Fig. 2.1 Appearance of the inverter demonstration machine

No.	Name	Description
1)	GOT	You can operate the inverter on the screen.
2)	Load torque	Indicates the load torque applied to the motor.
3)	Load torque setting	Sets the load applied to the motor.
4)	Load ON/OFF button	Turns ON or OFF the load applied to the motor.
5)	Instantaneous power failure time setting	Sets the instantaneous power failure time of when the instantaneous power failure button is pressed.
6)	Instantaneous power failure button	Shuts OFF the power supply for the inverter.
7)	Frequency setting	Used to set the frequency for outputting analog voltage.
8)	Terminal FM output	Displays the output frequency (pulse output) from the inverter.
9)	Emergency stop	Shuts OFF the power in case of emergency.
10)	Phase loss generation switch	Used for the training described in 5.2.
11)	Power switch	Turn ON the power of the demonstration machine.

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2.3 GOT screen



2.4 Precautions for use

- (1) Set the maximum frequency to 60 Hz.
 - (2) Set the acceleration/deceleration time to one second or longer.
 - (3) Do not leave the demonstration machine for a long time with the Load ON/OFF button set to ON and the Load setting VR load torque setting high.
- Technically, frequency can be set to a value higher than 60 Hz and acceleration time can be set to a value shorter than one second. However, setting those values may damage the machine due to the use of the powder brake and the conveyor belt.

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2.5 Basic parameter settings

To configure the inverter settings, it is essential to understand the parameters.

To ensure smooth motor operation, the motor must start by rotating slowly.

Configuring the inverter parameters enables smooth motor rotation.

2.5.1 Parameters

Parameters are numerical values that determine the operation of the inverter. The type and number of parameters (referred to as "Pr.") vary depending on the inverter model. For basic variable-speed operation, the initial parameter values can be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameters can be set, changed, and checked on the operation panel.

2.5.2 Typical parameters

The following table lists the commonly used parameters.

Pr.	Name	Minimum setting increments	Initial value	Setting range	Description
0 G000	Torque boost	0.1%	6% *1	0 to 30%	Set this parameter to obtain a higher starting torque under V/F control. Also set this when a loaded motor cannot be driven, the warning "OL" occurs, and the inverter output is shut off with the fault indication "E.OC1".
			5% *1		
			4% *1		
			3% *1		
			2% *1		
1 H400	Maximum frequency	0.01 Hz	120 Hz	0 to 120 Hz	Set the upper limit for the output frequency.
2 H401	Minimum frequency	0.01 Hz	0 Hz	0 to 120 Hz	Set the lower limit for the output frequency.
3 G001	Base frequency	0.01 Hz	60 Hz	0 to 590 Hz	Set this parameter when the rated motor frequency is 50 Hz. Check the rating plate of the motor.
4 D301	Multi-speed setting (high speed)	0.01 Hz	60 Hz	0 to 590 Hz	Pre-set the speeds that will be switched among by terminals.
5 D302	Multi-speed setting (middle speed)	0.01 Hz	30 Hz	0 to 590 Hz	
6 D303	Multi-speed setting (low speed)	0.01 Hz	10 Hz	0 to 590 Hz	
7 F010	Acceleration time	0.1 s	5 s *2	0 to 3600 s	Set the acceleration time.
			10 s *2		
			15 s *2		
8 F011	Deceleration time	0.1 s	5 s *2	0 to 3600 s	Set the deceleration time.
			10 s *2		
			15 s *2		
9 H000, C103	Electronic thermal O/L relay	0.01 A	Inverter rated current *3	0 to 500 A	Protects the motor from heat. Set the rated motor current.

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Pr.	Name	Minimum setting increments	Initial value	Setting range	Description
79 D000	Operation mode selection	1	0	0	External/PU switchover mode
				1	Fixed to PU operation mode
				2	Fixed to External operation mode
				3	External/PU combined operation mode 1 (Start command from External, frequency command from PU)
				4	External/PU combined operation mode 2 (Frequency command from External, start command from PU)
				6	Switchover mode
				7	External operation mode (PU operation interlock)
Pr.CL	Parameter clear	1	0	(0), 1	0: Initial display (Parameters are not cleared.) 1: The settings of parameters except for calibration parameters and terminal function selection parameters are initialized.
ALLC	All parameter clear	1	0	(0), 1	0: Initial display (Parameters are not cleared.) 1: The settings of all the parameters, including calibration parameters and terminal function selection parameters, are initialized.

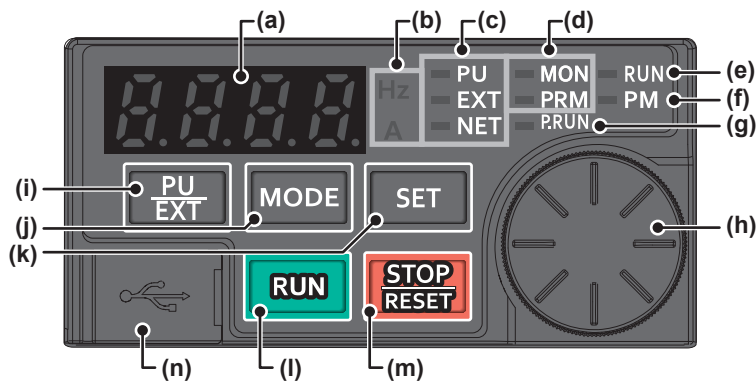
- *1 Differs depending on the capacity.
6%: FR-E820-0050(0.75K) or lower, FR-E840-0026(0.75K) or lower, FR-E820S-0050(0.75K) or lower, FR-E810W-0050(0.75K) or lower, FR-E846-0026(0.75K)
5%: FR-E860-0017(0.75K)
4%: FR-E820-0080(1.5K) to FR-E820-0175(3.7K), FR-E840-0040(1.5K) to FR-E840-0095(3.7K), FR-E820S-0080(1.5K) or higher, FR-E846-0040(1.5K) or higher
3%: FR-E820-0240(5.5K), FR-E820-0330(7.5K), FR-E840-0120(5.5K), FR-E840-0170(7.5K), FR-E860-0027(1.5K), FR-E860-0040(2.2K)
2%: FR-E820-0470(11K) or higher, FR-E840-0230(11K) or higher, FR-E860-0061(3.7K) or higher
- *2 Differs depending on the capacity.
5 s: FR-E820-0175(3.7K) or lower, FR-E840-0095(3.7K) or lower, FR-E860-0061(3.7K) or lower, FR-E820S-0110(2.2K) or lower, FR-E810W-0050(0.75K) or lower, FR-E846-0095(3.7K) or lower
10 s: FR-E820-0240(5.5K), FR-E820-0330(7.5K), FR-E840-0120(5.5K), FR-E840-0170(7.5K), FR-E860-0090(5.5K) or higher
15 s: FR-E820-0470(11K) or higher, FR-E840-0230(11K) or higher
- *3 The initial value for the FR-E820-0050(0.75K) or lower, FR-E840-0026(0.75K) or lower, FR-E860-0017(0.75K), FR-E820S-0050(0.75K) or lower, FR-E810W-0050(0.75K) or lower is set to the 85% of the inverter rated current.

☒ POINTS for understanding !

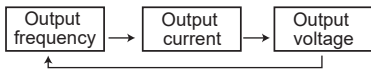
The initial parameter values are preset and can be used as they are to start operation. It is also possible to set parameters according to the applicable motor or equipment environment.

2 UNDERSTANDING INVERTER SYSTEM

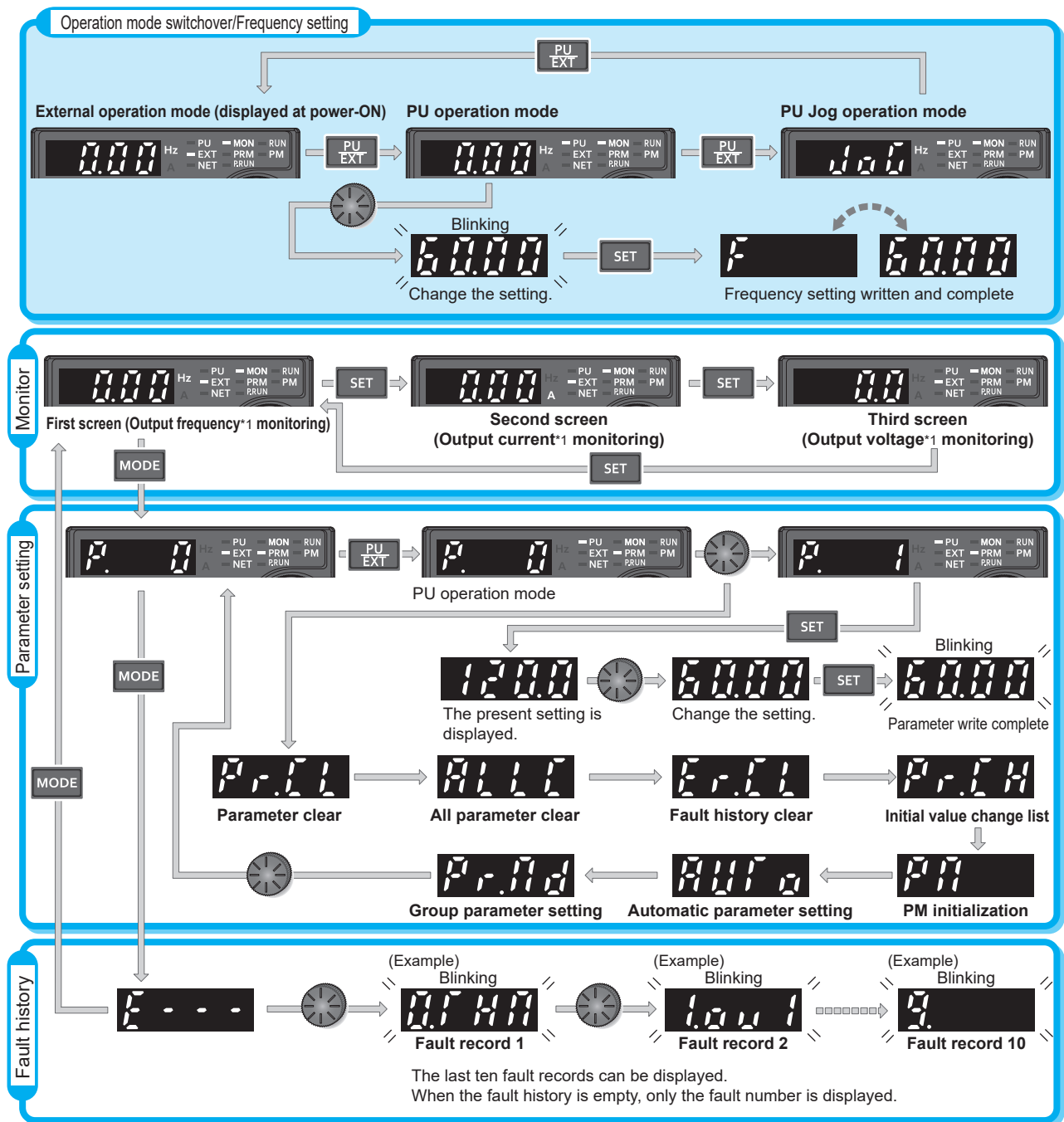
2.6 Operation panel



No.	Appearance	Name	Description
(a)		Monitor (4-digit LED)	Shows the frequency, parameter number, etc. (The monitor item can be changed according to the settings of M100 (Pr.52), M101 (Pr.774) to M103 (Pr.776).)
(b)		Unit indicator	Hz: ON when the actual frequency is monitored. (Blinks when the set frequency is monitored.) A: ON when the current is monitored. (Both "Hz" and "A" are OFF to indicate a value other than the frequency or the current.)
(c)		Operation mode indicator	PU: ON when the inverter is in the PU operation mode. EXT: ON when the inverter is in the External operation mode. (ON when the inverter in the initial setting is powered ON.) NET: ON when the inverter is in the Network operation mode. PU and EXT: ON when the inverter is in the External/PU combined operation mode 1 or 2.
(d)		Operation panel mode LED indicator	MON: ON or blinks only when the first, second, or third monitor is displayed. PRM: ON when the operation panel is in the parameter setting mode. The indicator blinks when the inverter is in the easy setting mode.
(e)		Operating status indicator	ON or blinks during inverter operation. ON: During forward rotation operation. Blinks slowly (1.4-second cycle): During reverse rotation operation. Blinks quickly (0.2-second cycle): Operation is disabled although the start command is given. *1
(f)		Control motor indicator	ON when the PM sensorless vector control is selected. The indicator blinks during test operation. The indicator is OFF when the inverter controls the induction motor.
(g)		PLC function indicator	ON when the PLC function is valid. (The indicator blinks when a fault occurs while the PLC function is valid.)
(h)		Setting dial	The setting dial of the Mitsubishi Electric inverters. Used to change the setting of frequency or parameter. Press the setting dial to perform the following operations: <ul style="list-style-type: none"> To display a set frequency in the monitor mode (the setting can be changed using M104 (Pr.992)) To display the present setting during calibration

No.	Appearance	Name	Description
(i)		PU/EXT key	Switches between the PU operation mode, the PUJOG operation mode, and the External operation mode. The easy setting of the inverter operation mode is enabled by pressing this key simultaneously with the MODE key. Also cancels the PU stop warning.
(j)		MODE key	Switches the operation panel to a different mode. The easy setting of the inverter operation mode is enabled by pressing this key simultaneously with the PU/EXT key. Every key on the operation panel becomes inoperable by holding this key for two seconds. The key lock function is disabled when E200 (Pr.161) = "0 (initial setting)".
(k)		SET key	Confirms each selection. When this key is pressed during operation, the monitor item changes. (The monitor item can be changed according to the settings of M100 (Pr.52), M101 (Pr.774) to M103 (Pr.776).) <div>When the initial setting is set  </div>
(l)		RUN key	Start command The direction of motor rotation depends on the E202 (Pr.40) setting.
(m)		STOP/RESET key	Stops the operation commands. Used to reset the inverter when the protective function is activated.
(n)		USB connector	FR Configurator2 is available by USB connection.

*1 Situations such as when the MRS/X10 signal is input, during the automatic restart after instantaneous power failure, after auto tuning is complete, when "SE" (incorrect parameter setting) alarm occurs.



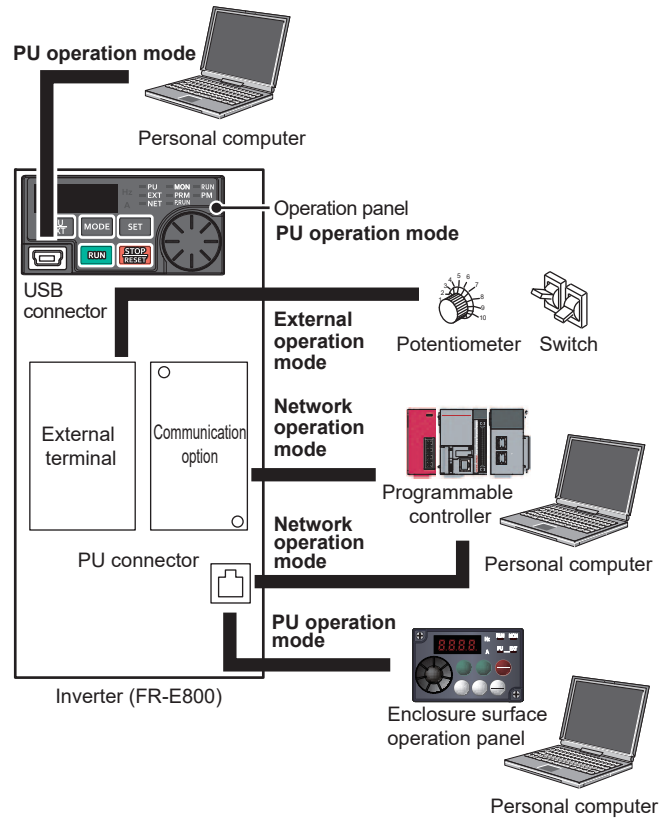
*1 The monitor item can be changed.

2 UNDERSTANDING INVERTER SYSTEM

2.7 Operation mode

The inverter can be operated with various signals.

The operation mode specifies the source of the start command and the frequency command for the inverter.



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2.8 Types of operation methods

This section explains the operations (start, stop, and speed variation) that can be operated with the inverter.

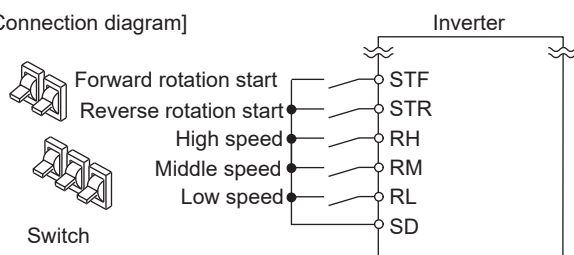
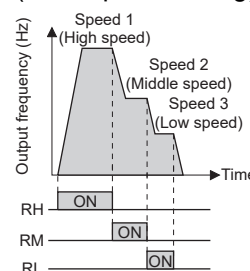
2.8.1 External operation mode (D000 (Pr.79) = "0 (initial value) or 2")

Operate the inverter with a frequency setting potentiometer or start switch connected to the control circuit terminals of the inverter.

(In this demonstration machine, the start switch is operated on the GOT screen.)

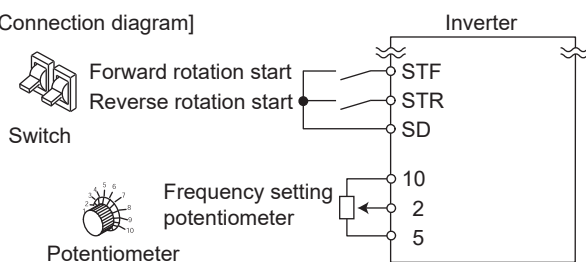
- Setting the frequency and giving a start command with switches (multi-speed setting)

[Connection diagram]



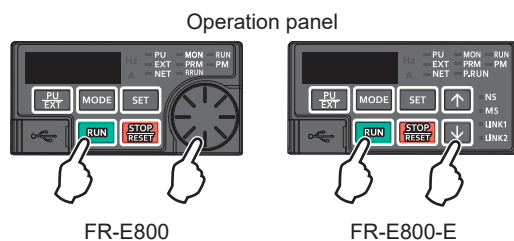
- Setting the frequency using an analog signal (voltage input)

[Connection diagram]



2.8.2 PU operation mode (D000 (Pr.79) = "0 (initial value) or 1")

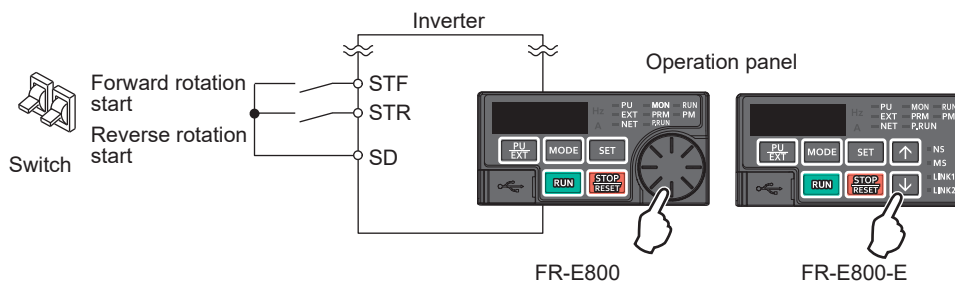
Select the PU operation mode when giving start and frequency commands by only the key operation of the operation panel or the parameter unit.



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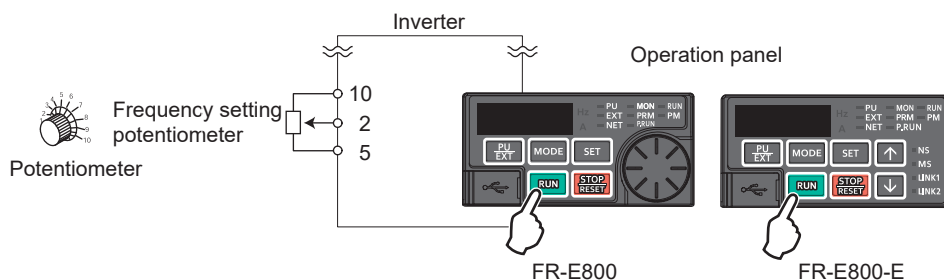
2.8.3 PU/External combined operation mode 1 (D000 (Pr.79) = "3")

Select the PU/External combined operation mode 1 when giving a frequency command from the operation panel or the parameter unit and giving a start command with the external start switches. (In this demonstration machine, the start switch is operated on the GOT screen.)



2.8.4 PU/External combined operation mode 2 (D000 (Pr.79) = "4")

Select the PU/External combined operation mode 2 when giving a frequency command from the external potentiometer or using multi-speed and other signals, and giving a start command by key operation of the operation panel or the parameter unit.



Remark

For the FR-E800 series, the direction of motor rotation started with the RUN key on the operation panel depends on the E202 (Pr.40) setting. (Initial value: "0" (forward))

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2.9 Parameter clear / All parameter clear

Set "1" in Pr.CL Parameter clear or ALLC All parameter clear to initialize the parameter. (The parameter cannot be cleared when E400 (Pr.77) Parameter write selection = "1".) Once the clear operation is performed, it cannot be undone. Make a backup in advance if necessary.

[Operating procedure]

1. Selecting the parameter setting mode
Press the MODE key to choose the parameter setting mode.
2. Selecting the parameter
Turn the setting dial until "Pr.CL" appears for Parameter clear or "ALLC" for All parameter clear, and press the SET key. "0 (initial value)" appears.
3. Parameter clear
Turn the setting dial to change the value to "1". Press the SET key to confirm the setting. "1" and "Pr.CL" ("ALLC") are displayed alternately after parameters are cleared.
 - Turn the setting dial to read another parameter.
 - Press the SET key to show the setting again.
 - Press the SET key twice to show the next parameter.

Setting	Description	
	Pr.CL Parameter clear	ALLC All parameter clear
0	Initial display (Parameters are not cleared.)	
1	The settings of parameters except for calibration parameters and terminal function selection parameters are initialized.	The settings of all the parameters, including calibration parameters and terminal function selection parameters, are initialized.

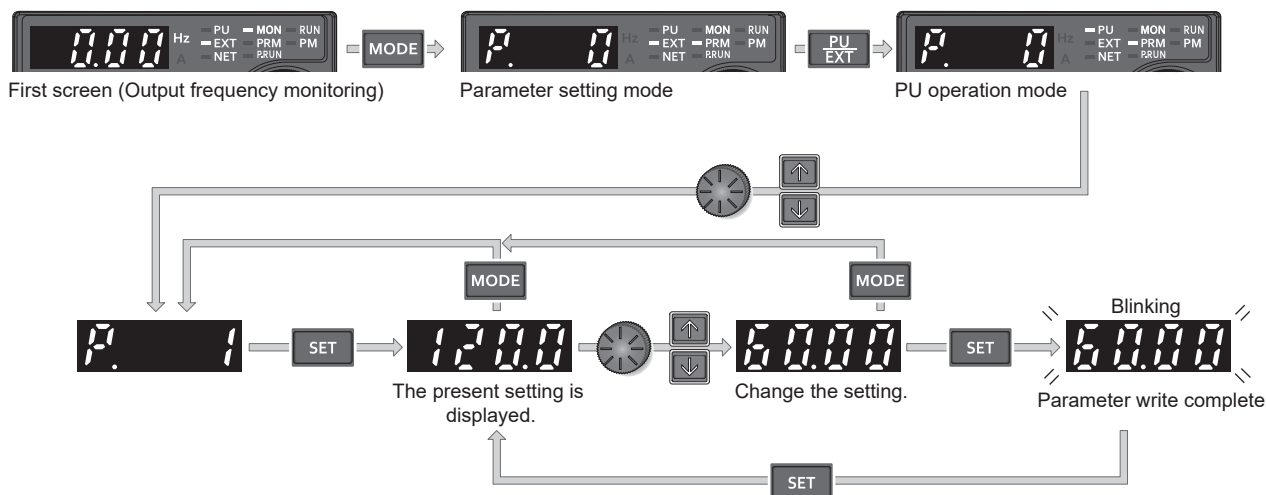
4. Turn OFF then ON the power of the demonstration machine for the option settings.

Remark

- "1" and "Er4" are displayed alternately when the operation mode is other than the PU operation mode.
Press the PU/EXT key. The PU LED turns ON, and "1" appears on the monitor. (When D000 (Pr.79) = "0 (initial value)")
- Stop the inverter first. Writing error occurs if Parameter clear is attempted while the inverter is running.
- To clear the parameter, the inverter must be in the PU operation mode even if "2" is set in E400 (Pr.77).
- For availability of Parameter clear or All parameter clear operation for each parameter, refer to the FR-E800 Instruction Manual (Function).

2.10 Parameter setting procedure (parameter display in numerical order)

This section explains how to change the setting value of H400 (Pr.1) Maximum frequency from 120 Hz to 60 Hz.



Set the following initial values for the demonstration machine.

- 1) Maximum frequency (H400 (Pr.1)) = 60 Hz
- 2) Electronic thermal O/L relay (H000 (Pr.9)) = 1.16 A
- 3) Terminal 2 frequency setting gain frequency (T022 (Pr.125)) = 60 Hz (Setting need not be changed as 60 Hz is initially set.)
- 4) Base frequency voltage (G002 (Pr.19)) = 200 V

Remark

- If a parameter write condition is not satisfied, a parameter write error appears.

Error indication	Description
Er 1	Parameter write error
Er 2	Write error during operation
Er 3	Calibration error
Er 4	Mode designation error

- When E400 (Pr.77) Parameter write selection = "0 (initial setting)", the parameter setting change is only available while the inverter is stopped and under the PU operation mode. To enable the parameter setting change while the inverter is running or under the operation mode other than PU operation mode, change the E400 (Pr.77) setting.

2.10.1 Parameter display by function group

Parameter numbers can be displayed by function group.

Since the parameter numbers are grouped by function, related parameters can be set easily.

(1) Changing to parameter numbers grouped by function

Pr.MD setting	Description
0	Default parameter display
1	Parameter display in numerical order
2	Parameter display by function group

[Operating procedure]

- 1.** Selecting the parameter setting mode
 Press the MODE key to choose the parameter setting mode. (The parameter number read previously appears.)
- 2.** Selecting the parameter
 Turn the setting dial until "Pr.MD" (Group parameter setting) appears.
 Press the SET key to confirm the selection. "0 (initial value)" will appear.
- 3.** Changing to the group parameter display
 Turn the setting dial to change the value to "2" (group parameter display). Press the SET key to confirm the Group parameter setting. "2" blinks after the setting is completed.

(2) Changing the parameter setting value with group parameter display

The following explains how to change the setting value of H400 (Pr.1) Maximum frequency from 120 Hz to 60 Hz.

[Operating procedure]

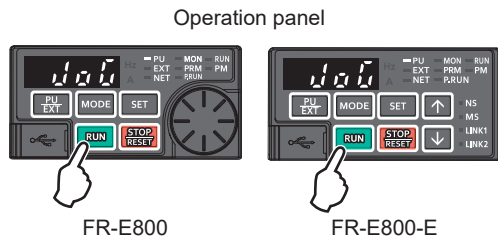
- 1.** Changing the operation mode
 Press the PU/EXT key to choose the PU operation mode. The PU LED turns ON.
- 2.** Selecting the parameter setting mode
 Press the MODE key to choose the parameter setting mode. (The parameter group number read previously appears.)
- 3.** Selecting the parameter group
 Turn the setting dial until "H4.." (Protective function parameter 4) appears. Press the SET key to confirm the selection. "H4--" will appear, which shows that the operation panel is ready for selection of a number in the group of monitor parameter 4.
- 4.** Selecting the parameter
 Turn the setting dial until "H400" (P.H400 Maximum frequency) appears. Press the SET key to display the present set value. "120.0 (initial value)" appears.
- 5.** Changing the setting value
 Turn the setting dial to change the value to "60.00". Press the SET key to confirm the setting. "60.00" blinks after the setting is completed.

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2.10.2 Giving a start command from the operation panel for JOG operation

Purpose of JOG operation: To check for incorrect connections or parameter settings at a slow speed (5 Hz).

JOG operation is performed while the RUN key is pressed.



The following shows the procedure to operate at 5 Hz.

[Operating procedure]

- 1.** Changing the operation mode
Press the PU/EXT key twice to choose the PUJOG operation mode. The display shows "JOG", and the PU LED is ON.
- 2.** Start → acceleration → constant speed
Hold down the RUN key. The frequency value on the monitor increases according to the setting of F002 (Pr.16) Jog acceleration/deceleration time, and "5.00" (5.00 Hz) appears on the monitor.
- 3.** Deceleration → stop
Release the RUN key. The frequency value on the monitor decreases according to the setting of F002 (Pr.16) Jog acceleration/deceleration time, "0.00" (0.00 Hz) appears on the monitor, and the motor stops rotating.

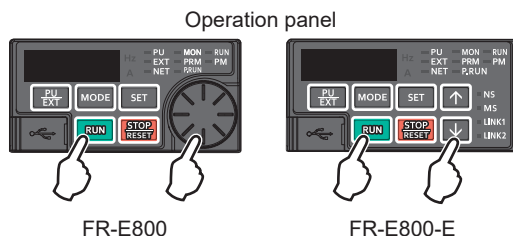
Remark

- To change the frequency, change the setting of D200 (Pr.15) Jog frequency (initial value: 5 Hz).
- To change the acceleration/deceleration time, change the setting of F002 (Pr.16) Jog acceleration/deceleration time (initial value: 0.5 second).
- The PU JOG operation is not available for the IP67 model as neither the operation panel keys or the parameter unit can be used.

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2.10.3 Operation using the operation panel

Use the operation panel (FR-DU08) to give a start command and a frequency command. (PU operation)



The following shows the procedure to operate at 30 Hz.

[Operating procedure]

1. Turning ON the power of the inverter
The operation panel is in the monitor mode.
2. Changing the operation mode
Press the PU/EXT key to choose the PU operation mode. The PU LED turns ON.
3. Setting the frequency
Turn the setting dial until the target frequency "30.00" (30.00 Hz) appears. The indication blinks for about 5 seconds.
While the value is blinking, press the SET key to enter the frequency. "F" and "30.00" are displayed alternately. After about 3 seconds of alternate display, the indication returns to "0.00" (the indication of a monitored value). (If the SET key is not pressed, the indication of the value returns to "0.00" (0.00 Hz) after about 5 seconds of blinking. In that case, turn the setting dial and set the frequency again.)
4. Start → acceleration → constant speed
Press the RUN key to start running. The frequency value on the monitor increases according to the setting of F010 (Pr.7) Acceleration time, and "30.00" (30.00 Hz) appears on the monitor. (To change the set frequency, perform the operation in above step 3. The previously set frequency appears.)
5. Deceleration → stop
Press the STOP/RESET key to stop.

Remark

- To display the set frequency in the standard model, press the setting dial while the inverter runs in the PU operation mode or in the External/PU combined operation mode 1 (D000 (Pr.79) = "3").
- The frequency can be set without pressing the SET key when E200 (Pr.161) Frequency setting/key lock operation selection = "1 or 11".
- For operation with the operator panel, the motor rotation direction can be changed with E202 (Pr.40) RUN key rotation direction selection.

Pr.	Name	Initial value	Setting range	Description
40	RUN key rotation	0	0	Forward rotation
E202	direction selection		1	Reverse rotation

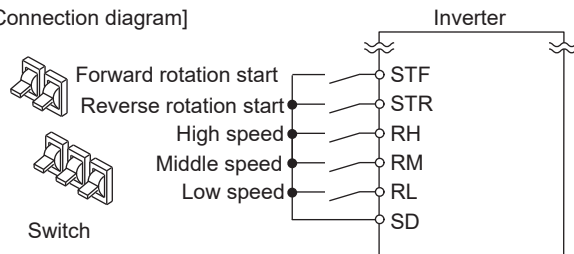
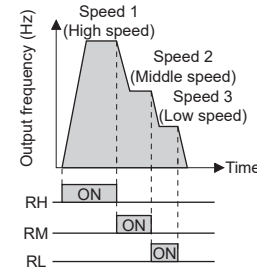
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2.10.4 Operation using external switches (External operation)

Turn ON the STF/STR signal to give a start command. (In this demonstration machine, the start switch is operated on the GOT screen.)

Turn ON the RH, RM, or RL signal to give a frequency command (multi-speed setting).

[Connection diagram]



The following shows the procedure to operate at a low speed (10 Hz).

[Operating procedure]

- 1.** Turning ON the power of the inverter
The operation panel is in the monitor mode.
- 2.** Setting the frequency
Turn ON the low-speed switch (RL).
- 3.** Start → acceleration → constant speed
Turn ON the start switch (STF or STR). "10.00" (10.00 Hz) appears.
- 4.** Deceleration → stop
Turn OFF the start switch (STF or STR) to stop motor operation.
Turn OFF the low-speed switch (RL).

Remark

- When both the forward rotation start switch (STF) and the reverse rotation start switch (STR) are turned ON, the motor cannot be started. If both are turned ON while the inverter is running, the inverter decelerates the motor to a stop.
- The initial value is 60 Hz for terminal RH in Group 1 (50 Hz in Group 2), 30 Hz for terminal RM, and 10 Hz for terminal RL. (To change the settings, use D301 (Pr.4), D302 (Pr.5), and D303 (Pr.6).)
- In the initial setting, if two or more speed switches (signals) are simultaneously turned ON, priority is given to the switch (signal) for the lower speed. For example, when both RH and RM signals turn ON, the RM signal (D302 (Pr.5)) has the higher priority.
- Up to 15-speed switching operation can be performed.
- Up to two external input terminals are available for the Ethernet model and the IP67 model. Use T700 (Pr.178) STF/DI0 terminal function selection and T701 (Pr.179) STR/DI1 terminal function selection to assign the functions to terminals DI0 and DI1.

2.11 Monitoring the status of the inverter

(1) Monitoring of output current and output voltage

Press the SET key on the operation panel in the monitor mode to switch the monitor item between output frequency, output current, and output voltage.

[Operating procedure]

- 1.** Press the MODE key during operation to monitor the output frequency. The [Hz] LED turns ON.
- 2.** Press the SET key to monitor the output current. This operation is valid during running or stopping under any operation mode. The [A] LED turns ON.
- 3.** Press the SET key to monitor the output voltage. Unit LEDs are both OFF.

(2) First priority monitor screen

The first priority monitor screen, which is displayed first when the operation panel switches to the monitor mode, is selectable.

To set it, press the SET key for a while when the desired monitor item is displayed on a monitor screen. The following show the procedure to set the monitor screen displaying the output current as the first priority monitor screen.

[Operating procedure]

- 1.** Change the mode of the operation panel to the monitor mode, and switch the monitor screen to the one on which the output current can be monitored.
- 2.** Press the SET key for a while (1 second). The output current monitor screen is set as the first priority monitor screen.
- 3.** When the operation panel is in the monitor mode next time, the output current monitored value is displayed first.

2.12 Calibration procedure for terminal FM when using the operation panel

Calibration procedure for terminal FM when using the operation panel

[Operating procedure]

1. Changing the operation mode
Press the PU/EXT key to choose the PU operation mode. The PU LED turns ON.
Calibration is also possible in the External operation mode.
* In the PU operation mode, set the command frequency to 60 Hz in advance.
2. Selecting the parameter setting mode
Press the MODE key to choose the parameter setting mode. (The parameter number read previously appears.)
3. Calibration parameter selection
Turn the setting dial until "C..." appears. Press the SET key to display "C---".
4. Selecting the parameter
Turn the setting dial until "C0" (M310 (C0 (Pr.900)) FM terminal calibration) appears. Press the SET key to enable the parameter setting.
The monitored value of the item (initially the output frequency) selected by M300 (Pr.54) FM terminal function selection will appear.
5. Pulse output via terminal FM
If stopped, press the RUN key to start the inverter operation. (To monitor the output frequency, motor connection is not required.)
When a monitor that does not require inverter operation is set in M300 (Pr.54), calibration is also possible during a stop status.
* In the External operation mode, operate the inverter at 60 Hz (high-speed RH).
6. Scale adjustment
Turn the setting dial to move the meter needle to a desired position.
7. Setting completed
Press the SET key to confirm the setting. The monitor indicator blinks.
After completing the setting, stop the operation.
 - Turn the setting dial to read another parameter.
 - Press the SET key to return to the "C---" display.
 - Press the SET key twice to show the next parameter.

Remark

- For calibration using FR Configurator2, conditions vary depending on the Version of FR Configurator2. For details, refer to the Instruction Manual of FR Configurator2.

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Remark

- Calibration can also be made for External operation. Set the frequency in the External operation mode, and make calibration in the above procedure.
- Calibration can be performed during operation.
- For operation outline of the parameter unit (FR-PU07), refer to the FR-PU07 Instruction Manual.
- By using the operation panel or the parameter unit, you can adjust (calibrate) terminal FM and terminal AM to full-scale deflection.

Pr.	Name	Initial value	Setting range	Description
C0 (900) M310 ^{*1*2}	FM terminal calibration	—	—	Calibrates the scale of the meter connected to terminal FM.
C1 (901) M320 ^{*1*3}	AM terminal calibration	—	—	Calibrates the scale of the analog meter connected to terminal AM.
867 M321 ^{*3}	AM output filter	0.01 s	0 to 5 s	Set a filter for output via terminal AM.
1200 M390 ^{*3}	AM output offset calibration	3000	2700 to 3300	Calibrates the scale of the meter when the analog output is 0.

*1 On the LCD operation panel or the parameter unit used as the command source, the parameter number in parentheses appears.

*2 The setting is available only for the FR-E800-1.

*3 The setting is available only for the FR-E800-4 and FR-E800-5.

2.13 Parameter number 79: Operation mode selection

Select the operation mode of the inverter.

The mode can be changed among operation using external signals (External operation), operation by the operation panel or parameter unit (PU operation), combined operation of PU operation and External operation (External/PU combined operation), and Network operation (via RS-485 communication or Ethernet communication, or when a communication option is used).

Pr.	Name	Initial value	Setting range	Description
79 D000	Operation mode selection	0	0 to 4, 6, 7	Selects the operation mode.

The following table lists valid and invalid commands in each operation mode.

D000 (Pr.79) setting	Description			LED indicator ■ : OFF ■ : ON
0 (initial value)	External/PU switchover mode. The inverter operation mode can be selected by pressing the PU/EXT key. At power ON, the inverter is in the External operation mode.			PU operation mode ■ PU ■ EXT ■ NET External operation mode ■ PU ■ EXT ■ NET NET operation mode ■ PU ■ EXT ■ NET
1	Operation mode Fixed to PU operation mode.	Frequency command Sent from the operation panel or parameter unit.	Start command Input using the RUN key on the operation panel or the FWD/REV key on the parameter unit	PU operation mode ■ PU ■ EXT ■ NET
2	Fixed to External operation mode. However, the inverter operation mode can also be changed to the Network operation mode.	Sent using external signals (input via terminal 2 or 4, using the JOG signal, using the multi-speed setting function, etc.).	Sent using external signals (via terminal STF or STR).	External operation mode ■ PU ■ EXT ■ NET NET operation mode ■ PU ■ EXT ■ NET
3	External/PU combined operation mode 1	Sent from the operation panel or parameter unit, or sent using external signals (input using the multi-speed setting function or via terminal 4). ^{*1}	Sent using external signals (via terminal STF or STR).	External/PU combined operation mode ■ PU ■ EXT ■ NET
4	External/PU combined operation mode 2	Sent using external signals (input via terminal 2 or 4, using the JOG signal, using the multi-speed setting function, etc.).	Input using the RUN key on the operation panel or the FWD/REV key on the parameter unit	

D000 (Pr.79) setting	Description	LED indicator ■: OFF ■: ON
6	Switchover mode. Switching from among the PU, External, and NET operation modes can be performed during operation.	PU operation mode ■ PU ■ EXT ■ NET External operation mode ■ PU ■ EXT ■ NET NET operation mode ■ PU ■ EXT ■ NET
7	External operation mode (PU operation interlock). X12 signal ON: Switchover to PU operation mode enabled (signal is OFF during External operation). X12 signal OFF: Switchover to PU operation mode disabled.	

*1 The following is the frequency commands listed in descending order of priority when "3" is set in D000 (Pr.79): Multi-speed setting function (RL/RM/RH/REX signal) > PID control (X14 signal) > terminal 4 analog input (AU signal) > set frequency (digital input from the PU).

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2.14 FR Configurator2

The software can be easily used by a personal computer from inverter setting up to maintenance. It can be effectively used as a support tool for Mitsubishi Electric inverter operations from startup to maintenance.

2.14.1 Operating environment for FR Configurator2

Component ^{*1}	Description
Personal computer	IBM PC/AT compatible machine with DVD drive (for installation), USB port, serial port, or Ethernet port
	Operating system ^{*2} Windows® 11 (Home, Pro, Enterprise) Windows® 10 (Home, Pro, Enterprise, IoT Enterprise ^{*3})
	Processor Intel Core i3 or higher, or equivalent
	Memory 4 GB or more: Windows® 11, Windows® 10 (64-bit Edition) 2 GB or more: Windows® 10 (32-bit Edition)
	Disk space Free area of 7 GB or more
Display	Applicable to display at resolution of 1024 × 768 (XGA) or higher, and 256 colors or more. Compatible with the above personal computer.
Keyboard	Compatible with the above personal computer
Mouse	Compatible with the above personal computer
Printer	Compatible with the above personal computer

^{*1} FR Configurator2 may not operate properly depending on the type of personal computer, peripheral devices, or software used.

^{*2} Operation on an operating system not listed here is not guaranteed.

^{*3} 32-bit Edition is not supported.

2.14.2 Screen examples

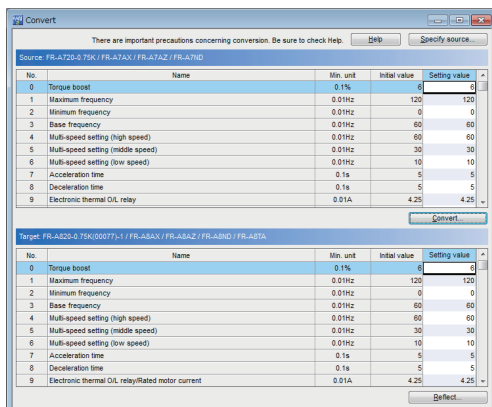


Fig. 2.2 Convert function screen



Fig. 2.3 Graph display screen

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2.14.3 Function

The following functions can be performed efficiently on a personal computer.

(* The free trial version with limited functions can be downloaded at Mitsubishi Electric FA Global Website.)

Function	Description	Release version	Free trial version
Parameter list	Displays the parameter list and the initial value change list, and allows editing and setting of the parameters. Parameters can also be set by function in the [Settings by function] window.	○	○
Safety parameter setting	Displays the safety parameter list and the initial value change list, and allows editing and setting of the safety parameters.	○	○
Convert	Parameter settings of the conventional models can be copied to the 800 series parameter settings.	○	○
Diagnosis	Shows the fault history, serial number, life check, diagnosis result output, Ethernet status, and online status.	○	○
AI fault diagnosis	When a fault occurs and the fault indication is displayed, probable causes of the fault are determined using AI technology to suggest corrective actions.	○	×
Graph	Displays the monitored values in a graph with the high speed sampling, monitor sampling, or USB trace file reading.	○	×
Batch monitor	Displays the monitored items of the inverter in a batch.	○	×
I/O terminal monitor	Displays the I/O terminal status in a batch.	○	×
Test operation	Displays the frequency of the selected inverter, switches and displays the operation modes, sends commands of the forward or reverse operations, and writes the set frequency.	○	○
Developer	Creates a sequence program, writes it to the inverter, and enables operators to use the PLC function of the inverter.	○	×
USB memory parameter copy file edit	Used for editing the parameter setting values (USB memory parameter copy file) read from the inverter to the USB memory.	○	×
Ethernet parameter setting	Used for setting parameters of the inverter for Ethernet communication.	○	○
iQSS backup file conversion	Used for converting a file in the backup/restore format generated by the Mitsubishi Electric GOT (Human Machine Interface). The file is converted into the format that can be used for editing the USB memory parameter copy file or in Developer.	○	○
Firmware update	The inverter firmware can be updated by using Firmware Update Tool.	○	○
Help	Displays the contents of the Instruction Manuals of the inverter and software.	○	○

(○: Available, ×: Unavailable)

Some functions may not be available depending on the model or other factors. For details, refer to the Instruction Manual of FR Configurator2.

Connecting the USB power supply / 24 V external power supply for the FR-E800 series

Some functions are restricted during USB power delivery / 24 V external power supply operation.

Only the following functions operate normally.

Function			USB power delivery	24 V external power supply operation
Parameter list function	Parameter list		○	○
	Settings by function	Motor setting	○	○
		Analog input terminal calibration	○	○
		Output terminal calibration	○	○
		Trace setting	○	○
		Input terminal assignment	○	○
		Output terminal assignment	○	○
		Point table	○	○
		Unit selection	○	○
Safety parameter setting			○	○
Convert			○	○
Batch monitor function			○	○
I/O terminal monitor			✕	○
Diagnostic function	Fault history function		✕	○
	Serial number function		○	○
	Life check		○	○
	Online status display		○	○
PLC function			○	○
USB memory parameter copy file edit			○	○
Ethernet parameter setting function			○	○
Help			○	○

○: Available ×: Not available

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2.15 Setup

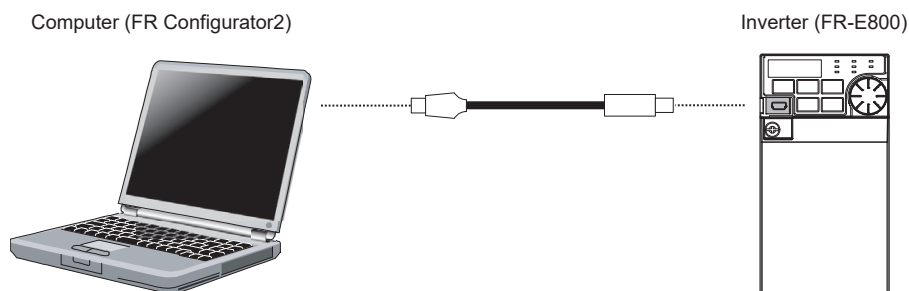
2.15.1 Connecting the demonstration machine

In this course, we will introduce the connection using USB.

(For information on other connection methods, refer to the FR Configurator2 Instruction Manual.)

[Connection procedure]

1. Connect the personal computer and the inverter using the USB cable. Connect the USB cable to the USB device (mini B connector) on the inverter.



2. Check the inverter parameter settings.
Set the following communication parameters for connection using the USB connector of the inverter.
To set parameters or input operation commands, set the following command source parameter and switch the operation mode to PU operation mode.

Parameter setting	
Communication parameter	Command source parameter
N041 (Pr.548) USB communication check time interval = "9999 (initial value)"	D013 (Pr.551) PU mode operation command source selection = "3 or 9999" (initial value: 9999)

Remark

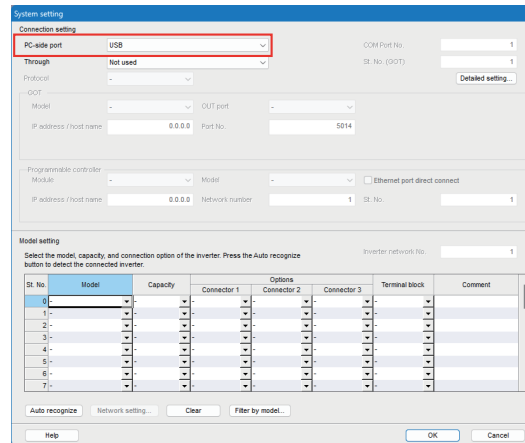
Always reset the inverter after making the initial settings of the parameters. After changing the communication-related parameters, communication cannot be made until the inverter is reset.

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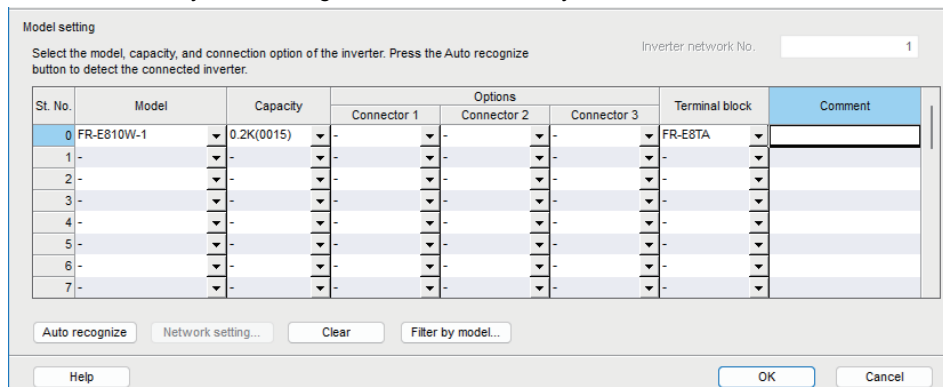
2.15.2 Creating a project

Start FR Configurator2, select [New] in the [Project] menu or select  on the tool bar to display the "System setting" window.

1. In the "Connection setting" of the "System setting" window, select "USB" for the PC-side port.



2. The inverter information can be applied to the system settings by detecting the connected inverters automatically or selecting the inverters manually.



Automatic detection

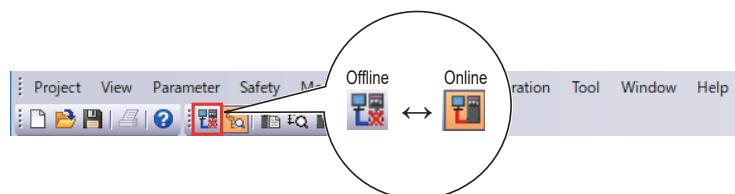
Click  to start detecting the communicable inverters.

When automatic inverter detection is finished, the inverter information is reflected to the system window.

Manual model setting

Set the model "FR-E810W-1" and set the capacity "0.2K". (The terminal block "FR-E8TA" will be set.)

3. Click [OK].
4. Click the [Online/offline] button to switch to online. The procedure is complete when the online connection is established.



Remark

The connection status is switched to offline in the following cases:

- The inverter power is turned OFF.
 - The inverter is reset.
 - The USB cable is disconnected.
-

2.16 Graph

The inverter output frequency, current, and other data is sampled, and the result is displayed in a graph (waveform). Sampled data can be saved to a file (*.jpg, *.emf, *.gp4, *.xlsx, or *.csv file), and sampling data saved to a file can be read (*.gp4 file, or *.st1 import) and displayed.

The [Graph] window can be displayed by selecting [Graph] from the [Monitor] menu, or by clicking



on the toolbar.

There are two types of sampling methods.

(1) High speed sampling

Data is collected with the shortest sampling interval, approx. 0.125 [ms]. The target station of the sampling is only 1 station. The high speed sampling is available when the connection method is USB or Ethernet connection.

The high speed sampling is not available when the computer is connected with the inverter via CC-Link IE TSN communication.

(2) Monitor sampling

The sampling interval varies depending on communication settings (communication speed, communication port) and the number of sampling items.

Setting item	Specifications
Sampling interval	High speed sampling: Set to between approx. 0.125 [ms] (mask count: 0) and approx. 20 [ms] (mask count: 30) Monitor sampling: Set to the range from 50 [ms] to 60000 [ms] (varies due to communication speed, communication port, and number of sampling items)
Sampling time [ms]	High speed sampling: Maximum = (mask count + 1) × 4000 Monitor sampling: Maximum = sampling interval × 4000
Analog data	Analog data for 4 channels can be sampled.
Digital data	Digital data for 4 channels can be sampled.

(3) Trace data display

Trace data, stored in the USB memory device by the inverter, can be read or imported to be displayed in the graph window. For details on the trace function, refer to the Instruction Manual of the inverter.

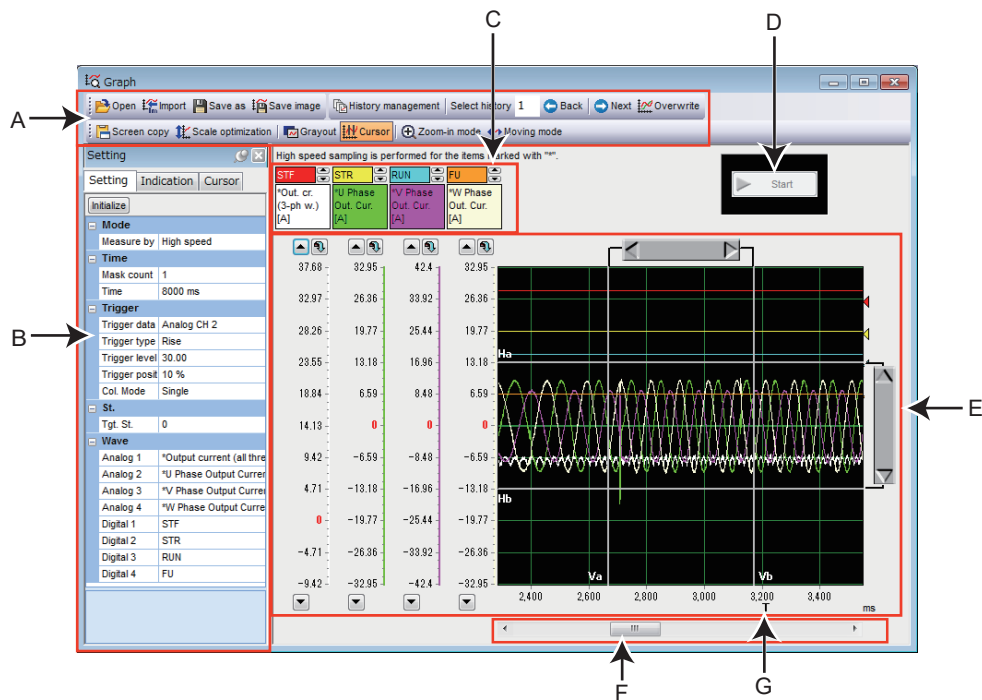
Setting item	Specifications
Analog data	Analog data for 8 channels can be displayed in the graph window.
Digital data	Digital data for 8 channels can be displayed in the graph window.

Remark

- Running other applications during high speed sampling, or performing personal computer file operations during high speed sampling, etc., will cause communication errors (error code 0x80020007 or 0x80020008) or buffer overflow errors to occur, and data will not be able to be displayed correctly. In this case, execute such countermeasures as terminating the other applications, refraining from operation of FR Configurator2, and increasing the mask count setting of the sampling interval.
- The sampling interval varies depending on the inverter control method and presence/absence of plug-in options.

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2.16.1 Graph window



Symbol	Name	Function/description
A	Toolbar	Allows operation of the file, history control, and graph display settings.
B	Properties	Setting of the measurement conditions, display conditions, and cursor can be done in the properties.
C	Sampling item column	Displays the contents of the analog CH and digital CH set by [Waveform] in the settings tab of the condition properties.
D	Measurement start/stop button	 Start Starts sampling.
		 Stop Stops sampling. This button only appears when operating.
E	Graph display area	Displays the sampled data in a graph.
F	Horizontal axis scroll bar	Allows scrolling of the displayed section in the graph display area.
G	Trigger position	Shows the position in which the trigger completes. "T" on the graph horizontal axis denotes measuring time period.

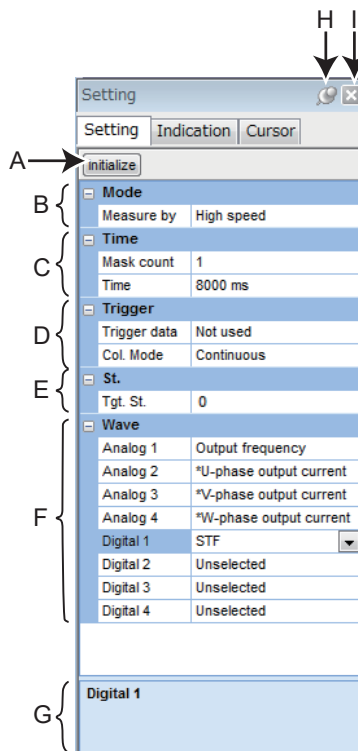
Remark

- If a normal communication with inverter is not maintained (communication error, etc.), the sampling stops.
- If a fault occurs during sampling, sampling continues.
- During sampling, other communication tasks such as parameter reading are unavailable.
- When parameter write is performed during measurement of graph, waveform data may be incorrect.
- When the negative output of monitor item is enabled/disabled during measurement of graph, the waveform data will be incorrect.

2 UNDERSTANDING INVERTER SYSTEM

2.16.2 Sampling settings

The sampling settings column can be shown by selecting the [Setting] tab in the property conditions. The time, trigger, station, and waveform of the analog CH can be set as analog data, and that of the digital CH can be set as digital data.



Symbol	Name	Function/description
A	Initialize	Initialize sampling settings.
B	Mode	Set the measurement mode for sampling.
C	Time	Mask count Set the interval for data sampling measurement.
		Measurement time (ms) Displays the maximum time for data sampling measurement.
D	Trigger	Set the condition to start sampling measurement.
E	St. (Station)	Selects the station to be set for sampling.
F	Wave ^{*1*}	Selects the items to be sampled. For analog data, 4 CHs (8 CHs of trace data) can be selected, and for digital data, 4 CHs (8 CHs of trace data) can be selected.
G	Help area	Shows a description of the currently selected item.
H	Show/hide switching pin	The show/hide switching pin is used to show or hide the property window.
I	Close	Closes the currently-selected tab ([Setting], [Indication], or [Cursor]) of the property window. To open the closed tab again, from [Graph (Z)] of the menu bar, choose [Property window] and click the tab to open.

*1 For the position command, current position, and droop pulse, if either the parameter for the upper or lower digits is selected in the Wave section, "Unselected" is shown for the channel and the waveform is not displayed. Even when both upper and lower digit parameters are selected, "Unselected" is shown for the channel for the upper digit parameter. The upper digit value is connected to the lower digit value, and the monitor item name is shown for the channel for the lower digit parameter. The waveform is displayed for the channel for the lower digit parameter.

*2 When the winding length (upper) and the winding length (lower) are monitored, if only the winding length (upper) is selected in the Wave section, "Unselected" is shown for the channel and the waveform is not displayed.

Remark

- Virtual network terminals are displayed for the digital data when the high speed mode is selected.

Setting range and setting unit of sampling interval and sampling time

The setting range of the sampling interval and sampling time are different for high speed sampling and monitor sampling.

(1) High speed sampling (only for direct USB/Ethernet connections between inverters and the personal computer)

The sampling interval can be about 0.125 [ms] (mask count 0) to about 20 [ms] (mask count 30). The sampling time can be up to "(mask count + 1) × 4000". The sampling interval varies depending on the control mode.

(2) Monitor sampling

The sampling interval and the sampling time vary depending on communication settings. The minimum sampling interval is calculated by multiplying the number of sampling items by the lower limit value. The lower limit of the sampling interval is as shown in the following table.

Communication port	Communication speed [bps]	Sampling interval lower limit [ms]
Serial port	4800	250
	9600	150
	19200	100
	38400	100
	57600	50
	115200	50
USB	—	50
Ethernet	—	100

For the sampling interval and sampling time maximum values, minimum values, and setting units under actual measurement conditions, refer to the following table.

	Maximum value	Minimum value	Setting unit
Sampling interval [ms]	60000	Sampling interval lower limit (table above) × number of sampling items ^{*1}	1
Sampling time [ms]	Sampling interval × 4000	Sampling interval × 50 ^{*2}	1

^{*1} If a fault trigger is set, the fault trigger is also counted as a sampling item.

^{*2} Even if a sampling time shorter than 3000 [ms] is set, the minimum sampling time of 3000 [ms] applies.

Example: Connected to the serial port with a communication speed of 19200 bps, when monitoring three items of output frequency, output current, and output voltage as data items to be displayed in a graph.

Sampling interval lower limit = 100 [ms]

Sampling interval maximum value = 60000 [ms] (60 [s])

Sampling interval minimum value = 100 × 3 = 300 [ms]

Sampling time maximum value = 60000 × 4000 = 240000000 [ms] (approx. 66.67 [h])

Sampling time minimum value = 300 × 50 = 15000 [ms] (15 [s])

High speed mode sampling menu

The following table shows the additional menu available when the high speed sampling is selected in the measurement mode selection. High speed sampling is applicable to the items whose name contains an asterisk (*) at the beginning. For information about the list of items on each measurement mode and the details of each item, refer to the section about monitor items in the Instruction Manual of the inverter.

Sampling item	Model				
	A800/A800-LC/ A800-CRN/ A800-ELV	B and B3	A800-R2R and B4	F800	E800(-E/-SCE) E806-SCE
Winding length (upper + lower)	x	x	o	x	x
Winding length (lower)	x	x	o	x	x
*Output frequency	o	o	o	o	o
*U-phase output current	o	o	o	o	o
*V-phase output current	o	o	o	o	o
*W-phase output current	o	o	o	o	o
Converter output voltage	o	o	o	o	o
*Output current (all three phases)	o	o	o	o	o
*Excitation current (A)	o	o	o	o	o
*Torque current (A)	o	o	o	o	o
Terminal 2	o	o	o	o	o
Terminal 4	o	o	o	o	o
Terminal 1	o	o	o	o	x
*Excitation current (%)	o	o	o	o	o
*Torque current (%)	o	o	o	o	o
Position command	o	o	x	x	o
Current position	o	o	x	x	o
Droop pulse	o	o	x	x	o
*Ideal speed command	x	x	x	x	o
*Output frequency (signed)	o	o	o	o	o
*Motor speed (with sign)	o	o	o	o	o
*Speed command (with sign)	o	o	o	o	o
*Torque command	o	o	o	x	o
*Motor torque	o	o	o	x	o
*Excitation current command	o	o	o	o	o
*Torque current command	o	o	o	o	o

o: Available x: Not available

2 UNDERSTANDING INVERTER SYSTEM

Remark

- When changing the sampling setting mode (monitor/high speed), change the sampling items before setting. Because the monitor contents change if the mode is changed, unshared sampling items are cleared.
- When setting sampling items, set analog data (CH1 to CH4) sequentially from the analog data CH1, and digital data (CH1 to CH4) sequentially from the digital data CH1.
- When the position command, current position, or droop pulse is sampled, the upper and lower sets of data are combined to display a waveform, occupying two channels. For the latter of the two channels, "Unselected" is shown, and another item cannot be selected to display a waveform.
- When sampling the voltage input of terminal 2, terminal 4, and terminal 1, M043 (Pr.241) Analog input display unit switchover will be set to "0" (% display), and the sampled data will be shown as 10 V = 100%.
- Example: If T000 (Pr.73) = 1 (Terminal 2 input 0 to 5 V), M043 (Pr.241) = 0 (% display)
Sampling data of the graph will be shown at 50% even if 5 V is input to terminal 2.

2.16.3 Trigger settings

Setting a trigger allows sampling to start when an alarm occurs or sampling item conditions are met.

Trigger	
A →	Trigger data Analog CH 1
B →	Trigger type Rise
C →	Trigger level 0.00
D →	Trigger posit 10 %
E →	Col. Mode Single

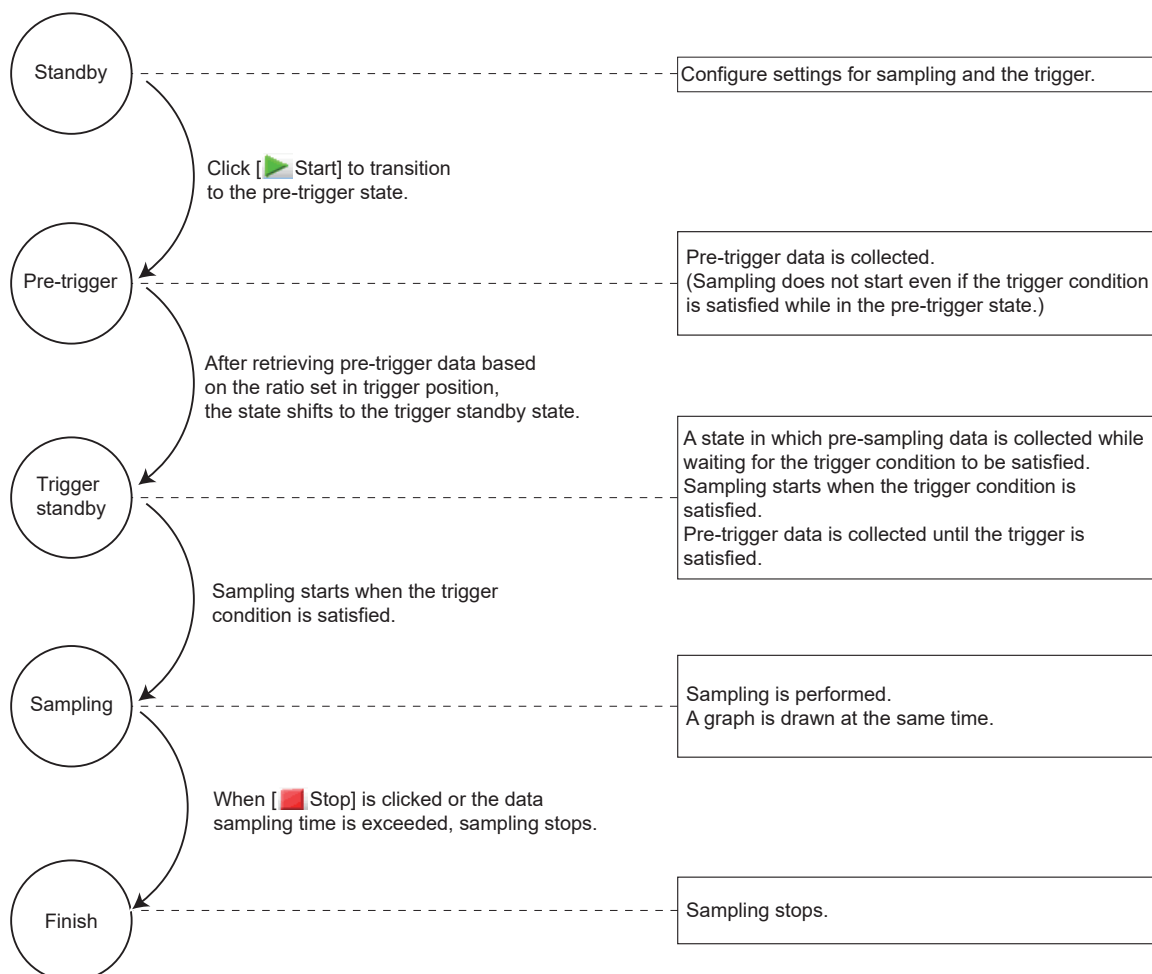
Symbol	Name	Function/description
A	Trigger data	Selects the signal that triggers the start of sampling. The trigger signals are as follows. <ul style="list-style-type: none"> • Not used. • Analog CH, digital CH (sampling starts if the sampling items meet the conditions) • Fault (Sampling starts if a fault occurs.)
B	Trigger type	Selects the conditions to determine trigger condition satisfaction from rise or fall. (Only appears when trigger data is set to analog CH or digital CH.) <ul style="list-style-type: none"> • Rise Analog CH: When the value specified by the trigger level is exceeded Digital CH: When the signal changes from OFF to ON • Fall Analog CH: When the value drops to a level lower than the trigger level Digital CH: When the signal changes from ON to OFF
C	Trigger level	Set the threshold to determine trigger condition satisfaction by the analog signal. (Only appears when the trigger data is set to analog CH.)
D	Trigger position	Set the ratio of sampling data to collect before the trigger conditions are met. (Only appears when trigger data is set to analog CH, digital CH, or fault.)
E	Col. Mode (Collection mode)	Sets whether the sampling should be continuously operated. Single: Sampling is performed only once. Continuous: Sampling is performed continuously.

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Remark

- Activation of analog data
The trigger will not start if the trigger starting conditions have already been met when [▶ Start] is selected. If "Rise" is selected, the trigger occurs when the set value in "level" is exceeded, and with "Fall", the trigger occurs when the set value drops to a level lower than "level". Example: If trigger start condition is "Rise" and the level is set to "3" If the level is 4 when sampling starts, the trigger will not start. When changed from less than 3 to 3 or more, the trigger conditions are met and sampling will start.
- If the machine speed is displayed by setting M000 (Pr.37) Speed display to a value other than 0
To set the "Output frequency" or "Frequency" as the trigger data, enter the trigger activation machine speed as is to the "level" column. For example, if M000 (Pr.37) Speed display is set to "1800" with "Output frequency" as the sampling item, and the trigger is to be activated at "900", input "900" as is to the "level" column.

Trigger standby state



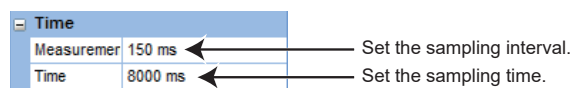
2.16.4 Graph measurement procedure example (monitoring output frequency, terminal RUN, and terminal FU)

(1) Measurement without a trigger

1. Specify the station number to be measured as the "Tgt. St." (Target station). Next, select "Output frequency" for the "Analog 1" column of "Wave", "RUN" for "Digital 1", and "FU" for "Digital 2".

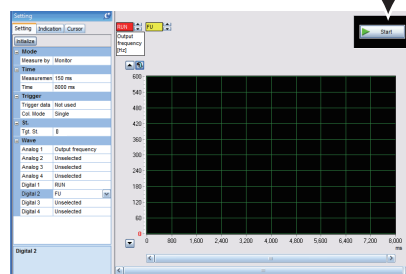


2. The sampling interval can be set for "measurement interval", and the sampling time can be set for "Time".



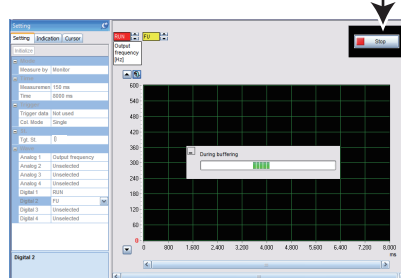
3. Measurement will start by clicking [Start].

Select "Start".

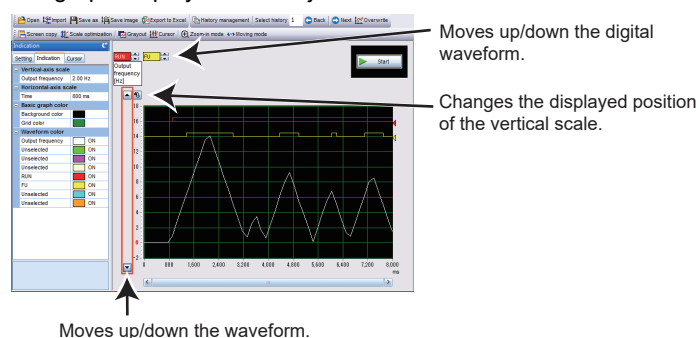


4. Measurement is finished by clicking [Stop], or when the set sampling time is elapsed.

Select "Stop".



5. The graph display can be adjusted.



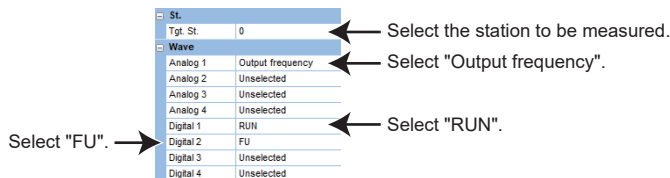
6. Data can be saved to a file by "Save as".

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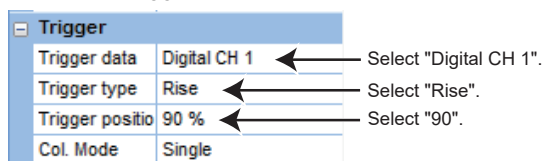
(2) Measurement with a trigger

Trigger data: Digital CH1

1. Specify the station number to be measured as the "Tgt. St." (Target station). Next, select "Output frequency" for the "Analog 1" column of "Wave", "RUN" for "Digital 1", and "FU" for "Digital 2".



2. Trigger setting:
Select "Fault" from the "Trigger data" column.
Select "90%" from the "Trigger position" column.

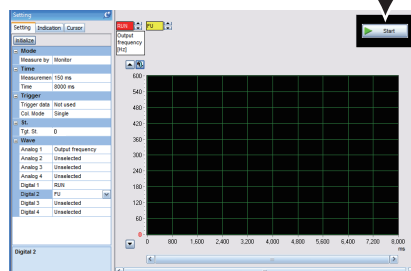


Remark

- In this example, "Trigger position" is set to "90%". After clicking [Start], the rise of the terminal RUN signal will be ignored and measurement will not start until 90% of the sampling time elapses.

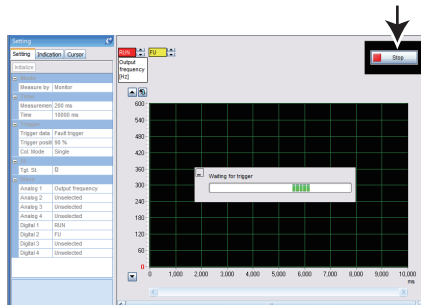
3. Measurement will start by clicking [Start].

Select "Start".

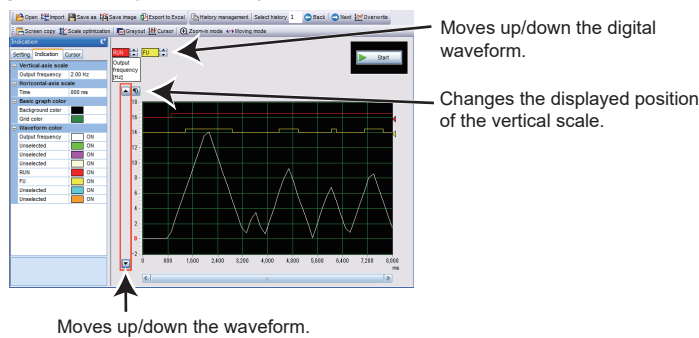


4. Operation starts automatically if an inverter alarm occurs.
5. Measurement is finished by clicking [Stop], or when the set sampling time is elapsed.

Select "Stop".



6. The graph display can be adjusted.



7. Data can be saved to a file by "Save as".

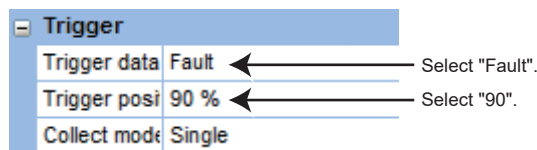
(3) Measurement with a trigger

Trigger data: Fault

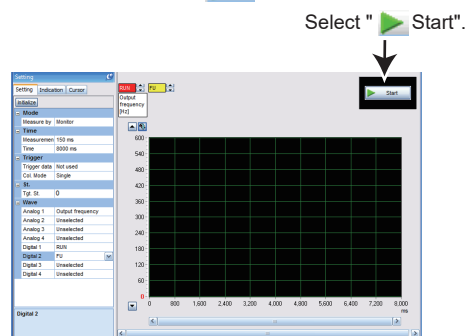
1. Specify the station number to be measured as the "Tgt. St." (Target station). Next, select "Output frequency" for the "Analog 1" column of "Wave", "RUN" for "Digital 1", and "FU" for "Digital 2".



2. Select "Fault" from the "Trigger data" column and select "90%" from the "Trigger position" column.

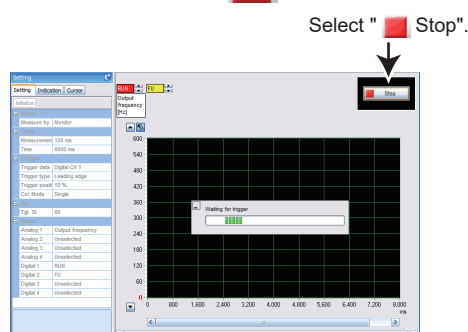


3. Measurement will start by clicking [Start].



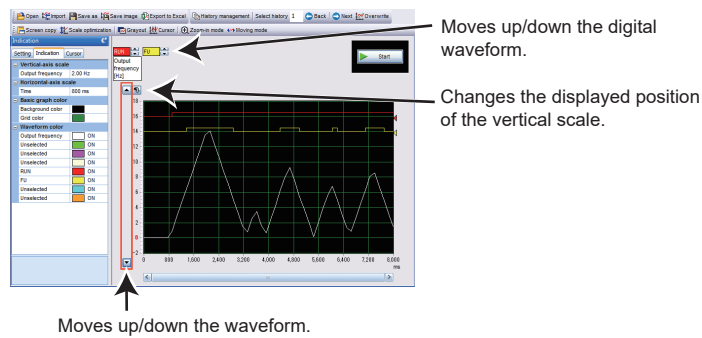
4. Operation starts automatically if an inverter alarm occurs.

5. Measurement is finished by clicking [Stop], or when the set sampling time is elapsed.



2 UNDERSTANDING INVERTER SYSTEM

6. The graph display can be adjusted.



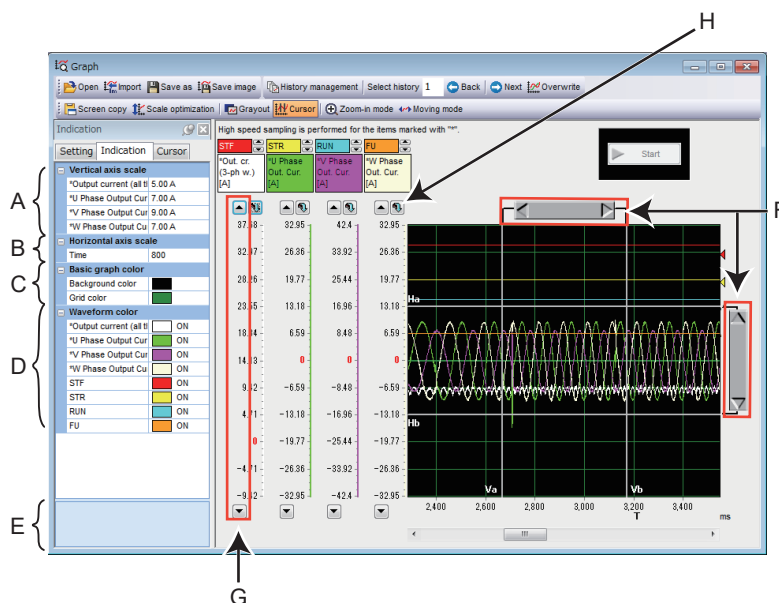
7. Data can be saved to a file by "Save as".

Remark

In this example, "Trigger position" is set to "90%". After clicking [ Start], the rise of the terminal RUN signal will be ignored and measurement will not start until 90% of the sampling time elapses.

2.16.5 Changing scale and the graph display

The scale and waveform data display of the displayed graph can be changed. The graph's displayed portion can be divided into a grid of 10 vertical and 10 horizontal sections. The scale of the vertical axis and the horizontal axis can be changed by setting a numerical value for each 1 divided grid. It is possible to slide and display the selected graph up and down by calibrating of the 0 position. The scale value displayed on the vertical axis changes according to changes in the vertical axis scale.

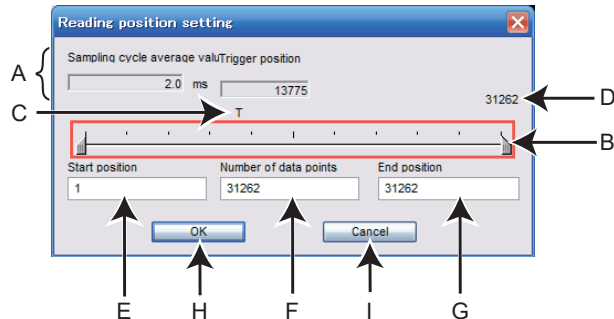


Symbol	Name	Function/description
A	Vertical axis scale	Changes the vertical axis scale intervals for the analog CH set as sampling items.
B	Horizontal axis scale	Changes the horizontal axis scale interval based on the set operating time.
C	Basic graph color	Changes the background color of the graph and the color of the grid lines.
D	Waveform color	Changes the color of the measured waveform data.
E	Help area	Shows a description of the currently selected item.
F	Cursor bar	Adjusts the cursor position.
G	Scroll buttons for each analog channel	Moves up/down the graph waveform data for each analog channel.
H	Scroll destination setting button	Displays a dialog box to directly input a numerical value for the position of the travelling target of the waveform data.

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•Reading position setting window

When displaying the trace data (*.st1), which is saved in the recorder mode, on the graph window, the start position and end position of the waveform data can be specified. The reading area of waveform data can be specified by sliding pointers or entering numerical values into the start position and end position input boxes.



Symbol	Name	Function/description
A	Sampling cycle average value	Displays the sampling cycle.
B	Reading position setting slide bar	Sets the reading start position, the number of reading data points, and the reading end position.
C	Trigger position	Displays the trigger position saved in the trace file.
D	Number of all points	Displays the number of points sampled and saved in the trace file.
E	Start position	Set the reading start position for the waveform data in sampling point number.
F	Number of points	Set the number of sampling points to display in the graph window.
G	End position	Set the reading end position for the waveform data in sampling point number.
H	OK	Applies the settings in the read position setting window and reads the trace data.
I	Cancel	Closes the window without applying the settings of the reading position setting window.

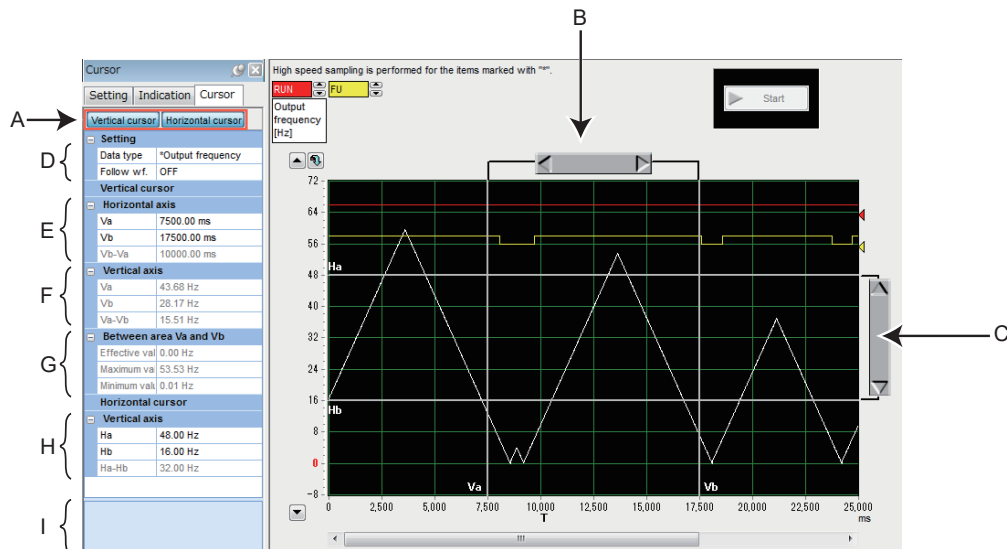
Remark

When opening the trace data (*.st1) saved in the recorder mode using the graph function, reading of the file may take time.

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2.16.6 Cursor function

The numeric value of the waveform at the cursor, effective value, maximum value, and minimum value between any 2 points can be displayed.



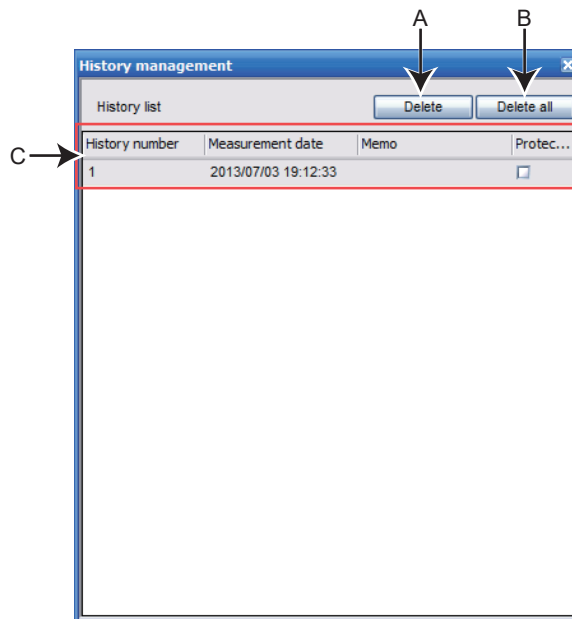
Symbol	Name	Function/description	
A	Vertical/horizontal cursor	Press the Vertical or Horizontal cursor button to show/hide the cursor bar for cursors Va and Vb or the cursor bar for cursors Ha and Hb.	
B	Cursor bar (Horizontal axis)	Specifies the position between cursor Va and cursor Vb.	
C	Cursor bar (Vertical axis)	Specifies the position between cursor Ha and cursor Hb.	
D	Setting	Data type	Selects the analog CH subject to the cursor measurement.
		Follow w.f. (Follow waveform)	ON: Moves the cursor so as not to change the value of the vertical axis or horizontal axis scale. OFF: Moves the cursor so as not to change the position of the graph display area.
E	Horizontal axis	Va	Shows the time (ms) at cursor point Va.
		Vb	Shows the time (ms) at cursor point Vb.
		Vb-Va	Shows the time (ms) between cursor points Va and Vb.
F	Vertical axis	Va	Shows the measured values at cursor point Va on the waveform.
		Vb	Shows the measured values at cursor point Vb on the waveform.
		Va-Vb	Shows the values between cursor points Va and Vb.
G	Between area Va and Vb	Effective value	Calculates and displays the effective value between cursor Va and cursor Vb.
		Maximum value	Shows the maximum value between cursor Va and cursor Vb.
		Minimum value	Shows the minimum value between cursor Va and cursor Vb.
H	Vertical axis	Ha	Shows the value at cursor point Ha.
		Hb	Shows the value at cursor point Hb.
		Ha-Hb	Shows the difference between the values at cursor points Ha and Hb.
I	Help area	Shows a description of the currently selected item.	

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2.16.7 Displaying history

Data of the past 20 samplings (including the current data) can be saved and displayed. The graph data at the time of sampling is stopped is saved. When the number of records exceeds 20, the oldest set of data will be deleted for every new data sampled.

The "History management" window will be displayed by selecting [History management...] from the [Graph (Z)] menu while the graph window is displayed, or by clicking  on the toolbar.



Symbol	Name	Function/description	
A	Delete	Deletes the selected history.	
B	Delete all	Deletes all records. However, protected records will not be deleted.	
C	History list	History number	Records are displayed in ascending order by number from the newest to the oldest. Up to 20 records can be saved.
		Measurement date	Shows the date and time when sampling was executed.
		Memo	A field for comments.
		Protection	Prevents the checked records from being deleted by the delete button or by continuous sampling. Up to 10 records can be protected.

Remark

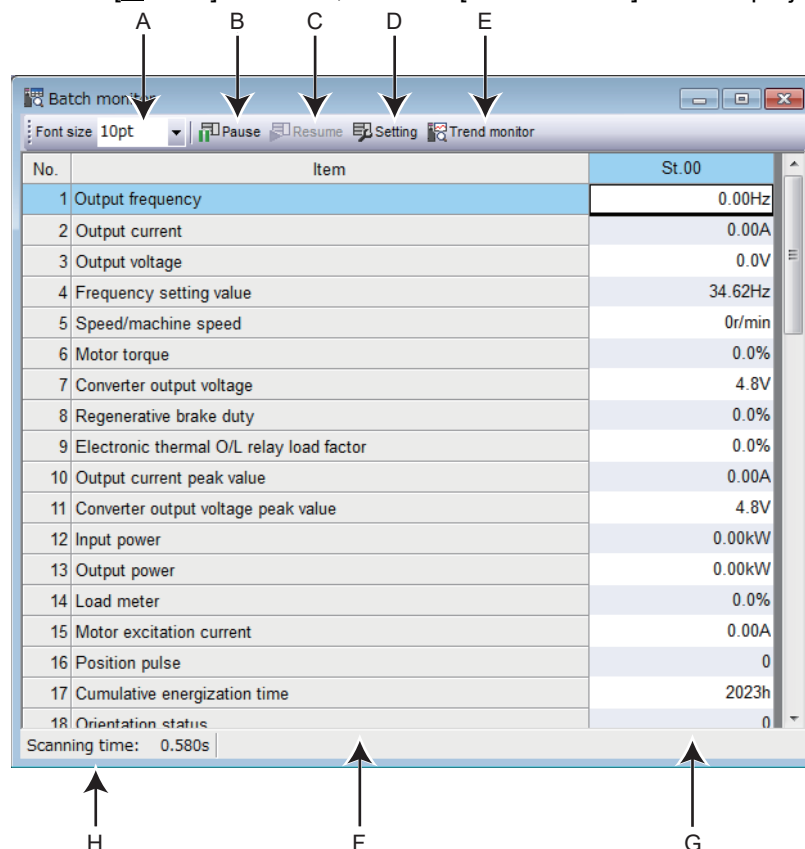
- When continuously sampling, all acquired data will be added sequentially to the history, and the next sampling will be performed.
- When graphs are displayed overlapped each other, cursor functions are available only for the currently displayed graph.
- The unit (unit symbol) used for the latest sampling is indicated as the unit of the sampling data. Take care when changing the unit.

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2.17 Batch monitor

2.17.1 Batch monitor window

"Batch monitor" monitors two or more items at a time. To show the "Batch monitor" window, select [Batch monitor] from the [Monitor] menu bar, or select [Batch monitor] from the project tree area.



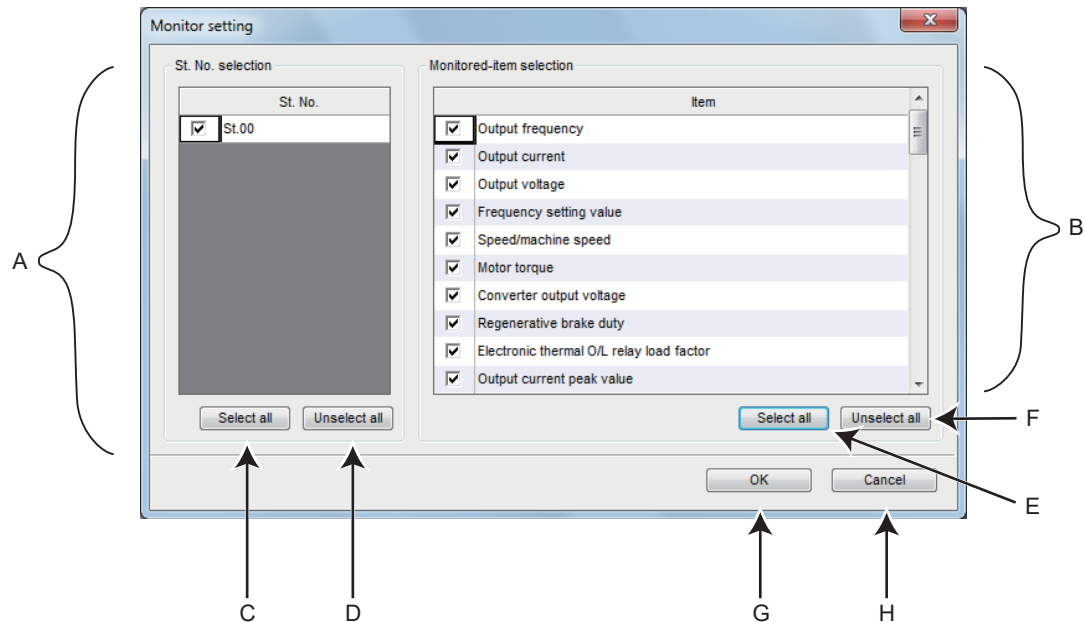
Symbol	Name	Function/description
A	Font size	Changes the size of monitor item characters.
B	Pause	Pauses acquisition of monitor data.*1
C	Resume	Resumes acquisition of monitor data.*1
D	Setting	Set monitor items to display. (Refer to page 2-45.)
E	Trend monitor	Displays the window for selecting items to be monitored in a graph. (Refer to page 2-46.)
F	Item	Shows the monitor item.
G	St. No. (Station number)	Shows the acquired data of the corresponding station.
H	Scanning time	Shows the elapsed time from the last update.

*1 The [Pause] and [Resume] buttons are effective for the batch monitor window and all trend monitor windows.

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2.17.2 Monitor setting window

The station number and monitor item to be displayed in the "Batch monitor" window can be set by the monitor setting window. Selecting a monitor item will add the item in the batch monitor window.

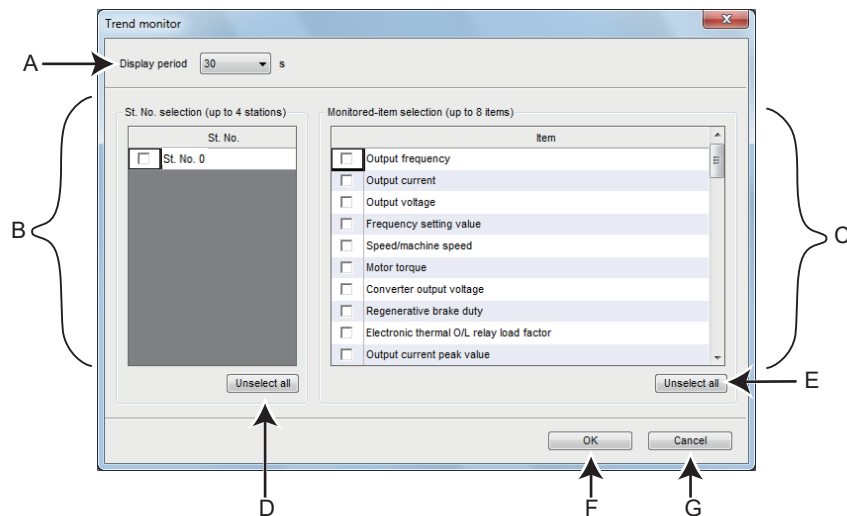


Symbol	Name	Function/description
A	St. No. selection	Select station(s) for displaying the graph of monitor items.
B	Monitored-item selection	Set monitor items to display.
C	Select all	Selects all station numbers.
D	Unselect all	Unselects all station numbers.
E	Select all	Selects all monitor items.
F	Unselect all	Unselects all monitor items.
G	OK	Applies all selected station numbers and monitored items to the batch monitor window.
H	Cancel	Discards the monitor settings, and closes the monitor setting window.

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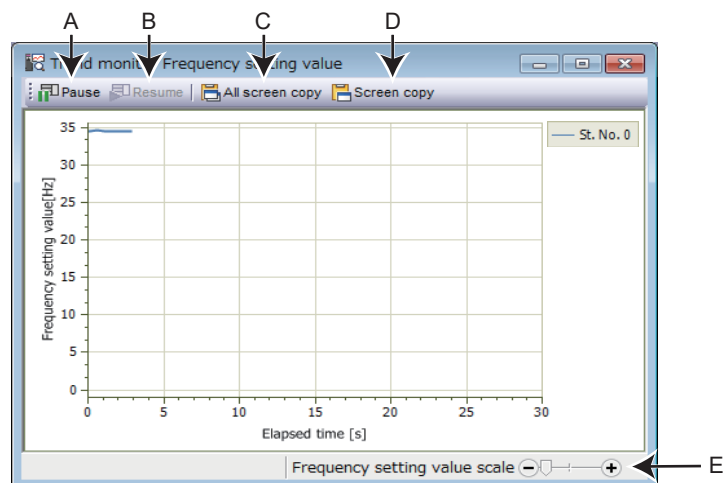
2.17.3 Trend monitor window

Select the trend monitor in the "Batch monitor" window to select items to be displayed in a graph. Select the checkbox to display the graph.



Symbol	Name	Function/description
A	Display period	Select the maximum point of the scale in seconds for the elapsed time axis of a graph in the trend monitor window.
B	St. No. selection	Select station(s) for displaying the graph of monitor items.
C	Monitored-item selection	Set monitor items to display.
D	Unselect all	Unselects all station numbers.
E	Unselect all	Unselects all monitor items.
F	OK	Applies the selection of the station and monitor items to the trend monitor window.
G	Cancel	Discards the monitor settings, and closes the monitor setting window.

After selecting the monitored items in the trend monitor setting window, the trend monitor window appears.



Symbol	Name	Function/description
A	Pause	Pauses acquisition of monitor data.*1
B	Resume	Resumes acquisition of monitor data.*1
C	All screen copy	Saves all of the displayed trend monitor windows to the clipboard.
D	Screen copy	Saves the trend monitor window to the clipboard. This button is effective for the window on which the button is placed.
E	Frequency setting value scale	Scales the vertical axis.

*1 The [Pause] and [Resume] buttons are effective for the batch monitor window and all trend monitor windows.

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2.17.4 Monitor item

For information about the list of items and the details of each item, refer to the section about monitor items in the Instruction Manual of the inverter.

Remark

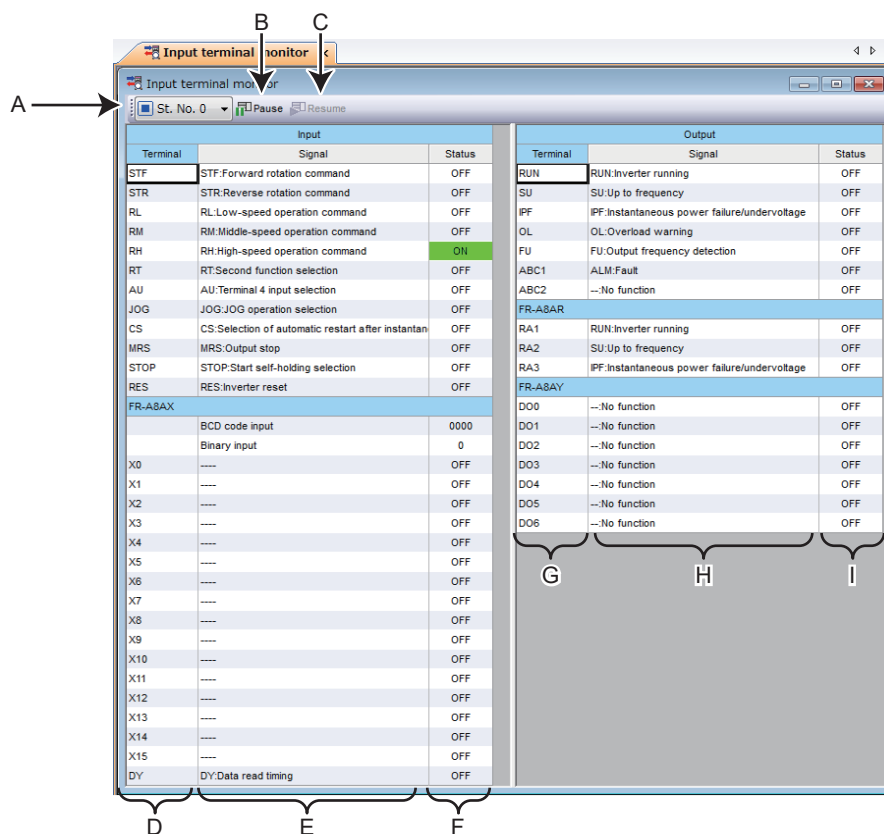
- If a communication error occurs, batch monitoring will be stopped. To perform batch monitoring again, go offline once after correcting the cause of the communication error, and then go online again.
- If an inverter fault occurs during batch monitoring, the output frequency, output current, and output voltage monitors hold the monitored values at the time the fault.

2 UNDERSTANDING INVERTER SYSTEM

2.18 I/O terminal monitor

2.18.1 I/O terminal monitor window

The "I/O terminal monitor" window shows the signals assigned to the I/O terminals of the control circuit and the ON/OFF status of the signals. To display the "I/O terminal monitor" window, select [I/O terminal monitor...] in the [Monitor] menu, or select  on the toolbar.

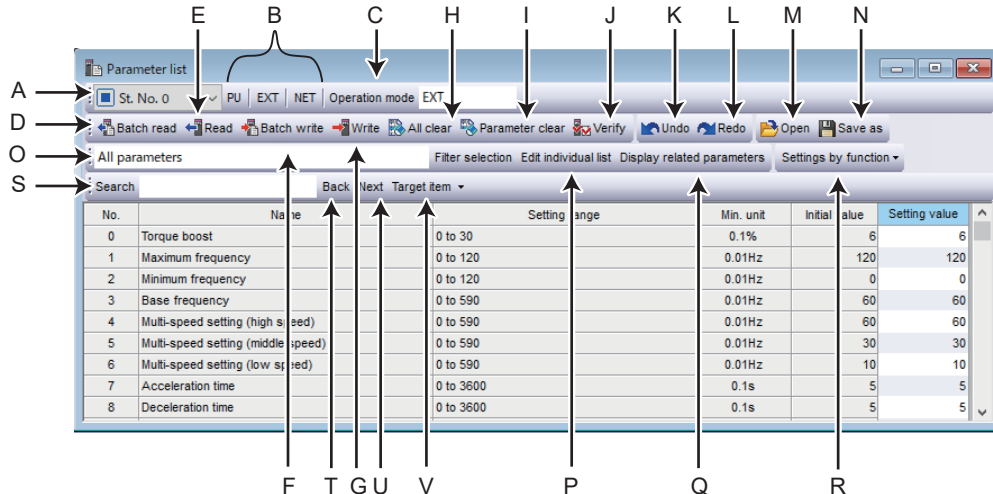


Symbol	Name	Function/description
A	St. No. (Station number)	Select a station to display its I/O terminal monitor data.
B	Pause	Temporarily stop the acquisition of the I/O terminal monitor data.
C	Resume	Resumes the acquisition of the I/O terminal monitor data.
D	Input terminal	All the input terminals are displayed.
E	Input signal	Signal names assigned to the input terminals are displayed.
F	Input status	Input terminal status are displayed.
G	Output terminal	All the output terminals are displayed.
H	Output signal	Signal names assigned to the output terminals are displayed.
I	Output status	Output terminal status are displayed.

2 UNDERSTANDING INVERTER SYSTEM

2.19 Parameter list

To display the "Parameter list", select [Parameter list...] in the [Parameter] menu, or click  on the toolbar. [Batch read], [Read], [Batch write], and [Write] are available for parameters.



Symbol	Name	Function/description
A	St. No. (Station number)	Select a station registered in the project.
B	Operation mode button	Switch between the operation modes of the inverter.
C	Operation mode indication	Displays the operation mode.
D	Batch read	Reads all the parameter setting values of the selected inverter.
E	Read	Reads the selected parameter setting values of the selected inverter.
F	Batch write	Writes all the selected parameter setting values in the setting value column to the selected inverter.
G	Write	Writes all selected parameter setting values to the selected inverter.
H	All clear	Returns all parameters which can be cleared including calibration parameters and terminal function selection parameters to their initial values.
I	Parameter clear	Returns parameters excluding calibration parameters and terminal function selection parameters to their initial values.
J	Verify	Verifies the parameter settings set in FR Configurator2 against initial values, settings in parameter files (*.pr4, *.pr3, *.prm), or settings in the inverter.
K	Undo	Returns the edited parameter setting value to the setting value before editing.
L	Redo	Redoes the setting value changed by "Undo" (up to 10 parameters).
M	Open	Displays the "Open" dialog box for a parameter file (*.pr4, *.pr3, and *.prm) to be opened.
N	Save as	Shows the "Save as" dialog box. Verifies the save location, and saves with the specified [File Name]. The extension for savable parameter information files is *.pr4. The parameter list data can also be saved in the Microsoft Excel file format (*.xls) by using "File Type" in the "Save as" dialog box.
O	Filter selection	Used to select parameters shown in the parameter list.
P	Edit individual list	Used to set the individual list for filtering items.
Q	Display related parameters	Used to display items related to the parameters selected in the parameter list.
R	Settings by function	Perform settings by function: motor, terminal, trace, and position control settings.
S	Search	Searches for the input character string from within the parameter list.
T	Back	Searches for the input character string in the upward direction.
U	Next	Searches for the input character string in the downward direction.
V	Target item	Specifies the column to search.

2 UNDERSTANDING INVERTER SYSTEM

- Parameter list display item

Item	Function/description
No.	Shows the parameter number. Calibration parameters (Pr.902, Pr.903, Pr.904, Pr.905, etc.) will be shown with ().
Name	Shows the parameter name.
Setting range	Shows the setting range of the parameter setting value.
Min. unit	Shows the minimum setting unit of the parameter setting value.
Initial value	Shows the factory default parameter setting values of the inverter.
Setting value	Inputs the value to be written to the inverter. The value different from the initial one is displayed in blue. Selecting [Write] or [Batch write] will write the setting value field data to the inverter.

Remark

- To display the explanation about a parameter on the help window, double-click the parameter in the parameter list.
- When E400 (Pr.77) = "0 (initial setting)", parameter writing from FR Configurator2 in USB connection is only available while the inverter is in the PU mode and stopped.
- Parameter write selection
Whether or not to enable the writing to various parameters can be selected. Use this function to prevent parameter values from being rewritten by misoperation.

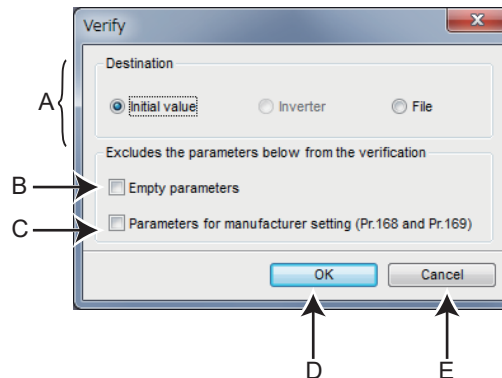
Pr.	Name	Initial value	Setting range	Description
77 E400	Parameter write selection	0	0	Writing is enabled only during stop.
			1	Writing is disabled.
			2	Writing is enabled in any operation mode regardless of the operation status.

- E400 (Pr.77) can be set at any time regardless of the operation mode or operation status.
(Setting through communication is unavailable except for the Ethernet communication between the inverter and FR Configurator2.)
- Some parameters are excepted. For details, refer to the FR-E800 Instruction Manual (Function).

2 UNDERSTANDING INVERTER SYSTEM

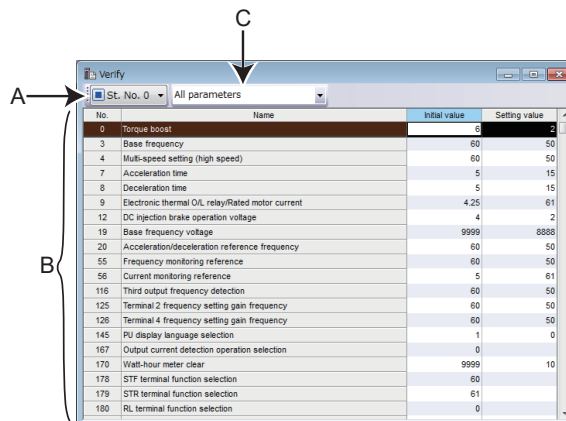
2.19.1 Parameter verification

The "Select destination selection" window can be displayed by selecting [Verify...] from the [Parameter list (Z)] menu bar, or by selecting [Verify] on the toolbar.



Symbol	Name		Function/description
A	Destination	Initial value	Verifies against the initial value.
		Inverter	Verifies against parameter setting values written to the inverter.
		File	Verifies against parameter list setting values saved to a file (*.pr4, *.pr3, and *.prm).
B	Excludes the parameters below from the verification	Empty parameters	Excludes the parameters from verification if they do not have a setting.
C		Parameters for manufacturer setting (E000, E080 (Pr.168), E001, E081 (Pr.169))	Excludes E000, E080 (Pr.168), E001, and E081 (Pr.169) (parameters for manufacturer setting) from verification.
D	OK		Shows the Verify window.
E	Cancel		Closes the Verify destination selection window without performing verification.

The Verify window appears after selecting the destination on the Verify destination window.



Symbol	Name	Function/description
A	St. No. (Station number)	Shows the verified station number.
B	Verify list	Shows parameters whose verified values are mismatched.
C	Filter	Select a filter for filtering the parameters in the verify list.

2 UNDERSTANDING INVERTER SYSTEM

2.19.2 Parameter storage

Click on [Save as] on the toolbar, check the save destination, and save a file with the specified [File Name]. The extension for savable parameter information files is *.pr4.

The parameter list data can also be saved in the Microsoft Excel file format (*.xls) by using "File Type" in the "Save as" dialog box.

Use the "Open" button to open the saved parameter files (*.pr4, *.pr3, and *.prm).

2.20 Settings by function

Parameters related to each function can be set in the individual windows.

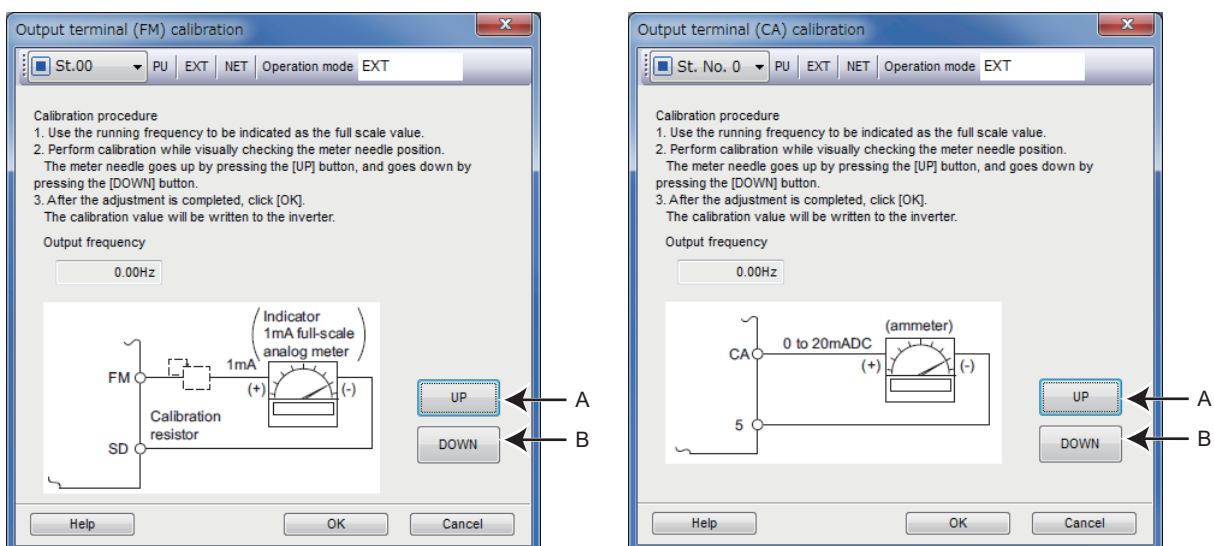
Select [Settings by function] - [Function name] from the [Parameter list (Z)] menu bar, [Settings by function] - [Function name] on the toolbar, or [Parameter] - [Function name] from the project tree to display the window by function.

Remark

Some of the settings by function are not available depending on the inverter model.

2.20.1 Output terminal (FM/CA) calibration

Set parameters related to the output terminal calibration.

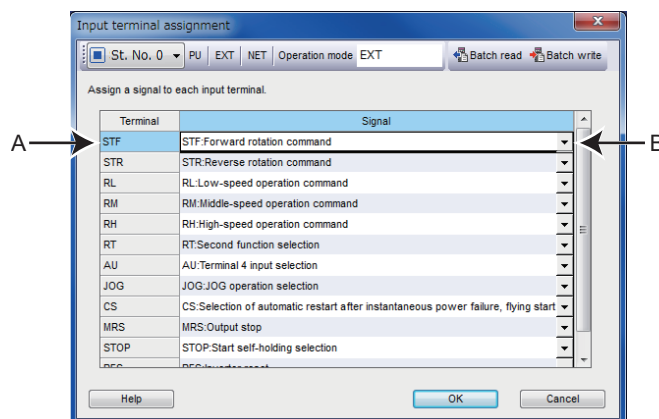


Symbol	Name	Function/description
A	UP button	The meter needle goes up. (Refer to M310 (C0 (Pr.900)).)
B	DOWN button	The meter needle goes down. (Refer to M310 (C0 (Pr.900)).)

2 UNDERSTANDING INVERTER SYSTEM

2.20.2 Input terminal assignment

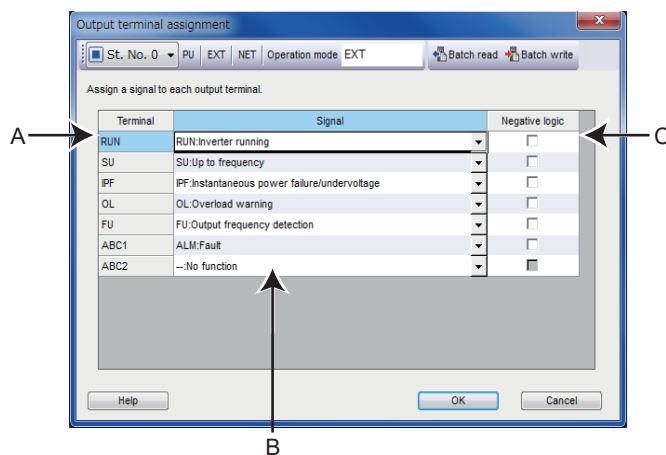
Set parameters related to the input terminal assignment.



Symbol	Name	Function/description
A	Terminal	A terminal name is displayed in this section.
B	Signal	Select the signal to be assigned to the terminal.

2.20.3 Output terminal assignment

Set parameters related to the output terminal assignment.



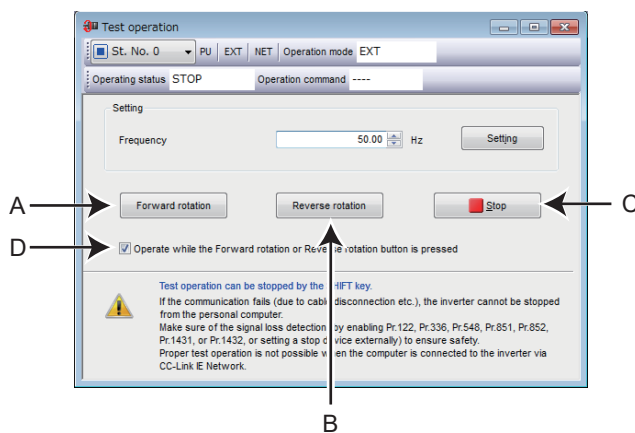
Symbol	Name	Function/description
A	Terminal	A terminal name is displayed in this section.
B	Signal	Select the signal to be assigned to the terminal.
C	Negative logic	Select the checkbox to use negative logic.

2 UNDERSTANDING INVERTER SYSTEM

2.21 Test operation

FR Configurator2 gives a start command to the inverter to start test operation. "Test operation" allows the selected inverter's frequency to be displayed, operation mode to be switched and displayed, forward and reverse operation commands to be sent, setting frequency to be written, and other functions to be done.

Press the [Forward rotation] or [Reverse rotation] button to execute test operation. Press the STOP button to stop operation. Selecting "Operate while the Forward rotation or Reverse rotation button is pressed" will execute test operation only while the [Forward rotation] or [Reverse rotation] button is held down. Simply pressing the [Forward rotation] or [Reverse rotation] button will write the input frequency value to the inverter. After the value is written to the inverter, the test operation will start. Release the [Forward rotation] or [Reverse rotation] button to stop the operation.



Symbol	Name	Function/description
A	Forward rotation	The motor rotates in the forward direction.
B	Reverse rotation	The motor rotates in the reverse direction.
C	Stop	Stops the operation.
D	Operation option	Click on the checkbox to enable test operation only while the [Forward rotation] or [Reverse rotation] button is held down.

Remark

Set the operation mode to "PU mode" for test operation using FR Configurator2 in USB connection. In USB connection, operation using the PU or panel on the inverter is not possible.

Other functions such as fault diagnosis, motor setting, offline auto tuning, and trace function are available. (For details, refer to the Instruction Manual of FR Configurator2.)

Memo

CHAPTER 3 MAINTENANCE SYSTEM DESIGN

It is necessary to design a system for maintenance to prevent failures and accidents with a maintenance-friendly design.

3.1 Preparation for maintenance

- (1) Using products unlikely to fail

In simple terms, this means using highly reliable products. It is recommended to consider the following points.

 - 1) Is the manufacturer of the product reliable?
 - 2) Does it conform to recognized local and/or international standards?
 - 3) Is the design simple?
 - 4) Does it have low failure rate based on performance?
 - 5) Does it have a good reputation in industry?
- (2) Designing a system with good maintainability

For a maintenance-friendly system, it is recommended to consider the following points.

 - 1) Use an inverter with easily available parts and products.
 - 2) Use an inverter that has high maintainability with functions such as self-diagnostics.
 - 3) Use an inverter that allows easy parameter reading, modification, and storage.
 - 4) Design the system so that failures are automatically displayed.
 - 5) Design the system having space for maintenance, inspection, and repair work.
 - 6) Design the system that allows easy replacement of parts and products, and change of wiring.

3.2 Failsafe system which uses the inverter

When a fault is detected by the protective function, the protective function activates and outputs the Fault signal. However, the Fault signal may not be output at an inverter's fault occurrence when the detection circuit or output circuit fails, etc. Although Mitsubishi Electric assures the best quality products, provide an interlock which uses inverter status output signals to prevent accidents such as damage to the machine when the inverter fails for some reason. Also, at the same time consider the system configuration where a failsafe from outside the inverter, without using the inverter, is enabled even if the inverter fails.

(1) Interlock method which uses the inverter status output signals

By combining the inverter output signals to provide an interlock as shown below, an inverter failure can be detected.

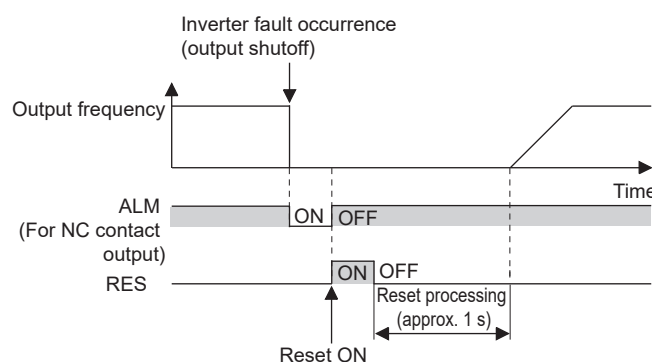
No.	Interlock method	Check method	Used signals
1)	Inverter protective function operation	Operation check of faulty contact. Circuit error detection by negative logic.	Fault (ALM) signal
2)	Inverter operating status	Inverter operation ready signal check.	Inverter operation ready (RY) signal
3)	Inverter running status	Logic check of the start signal and running signal.	Start signal (STF signal, STR signal) Inverter running (RUN) signal
4)	Inverter running status	Logic check of the start signal and output current.	Start signal (STF signal, STR signal) Output current detection (Y12) signal

1) Checking with the inverter fault output signal

When the inverter's protective function is activated and the inverter output is stopped, the Fault (ALM) signal is output. (The ALM signal is assigned to terminals A, B, and C in the initial setting).

With this signal, check that the inverter operates properly.

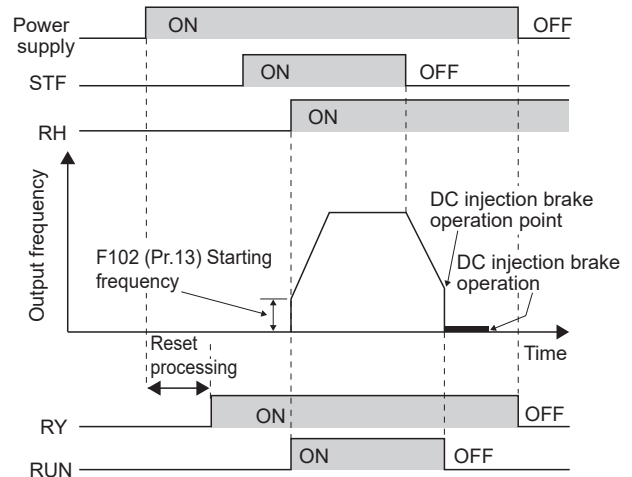
In addition, negative logic can be set. (ON when the inverter is normal, OFF when the fault occurs.)



3 MAINTENANCE SYSTEM DESIGN

2) Checking the inverter operating status by the Inverter operation ready signal

The Inverter operation ready (RY) signal is output when the inverter power is ON and the inverter becomes operative.
Check if the RY signal is output after powering ON the inverter.



3) Checking the inverter operating status by the start signal input to the inverter and the Inverter running signal

The Inverter running (RUN) signal is output when the inverter is running. (The RUN signal is assigned to terminal RUN in the initial setting.)
Check if the RUN signal is output while a start signal (the STF/STR signal for forward/reverse rotation command) is input to the inverter. Even after the start signal is turned OFF, the RUN signal is kept output until the inverter makes the motor to decelerate and to stop. For the logic check, configure a sequence considering the inverter's deceleration time.

4) Checking the motor operating status by the start signal input to the inverter and the Output current detection signal

The Output current detection (Y12) signal is output when the inverter operates and current flows into the motor.
Check if the Y12 signal is output while a start signal (the STF/STR signal for forward/reverse rotation command) is input to the inverter. Adjust the current level at which the Y12 signal is output to around 20% using no load current of the motor as reference with M460 (Pr.150) Output current detection level.
Like the Inverter running (RUN) signal, even after the start signal is turned OFF, the Y12 signal is kept output until the inverter makes the motor decelerate and stop. For the logic check, configure a sequence considering the inverter's deceleration time.

Output signal	Output terminal function selection parameter setting value	
	Positive logic	Negative logic
ALM	99	199
RY	11	111
RUN	0	100
Y12	12	112

• When using signals, refer to the left table and assign the functions to the output terminals.

POINT

- Changing the terminal assignment using output terminal function selection may affect the other functions. Set parameters after confirming the function of each terminal.

3 MAINTENANCE SYSTEM DESIGN

(2) Backup method outside the inverter

Even if the interlock is provided by the inverter status signal, enough failsafe is not ensured depending on the failure status of the inverter itself. For example, if an inverter CPU fails in a system interlocked with the inverter's fault, start, and RUN signals, no Fault signals will be output and the RUN signal will be kept ON because the inverter CPU is down.

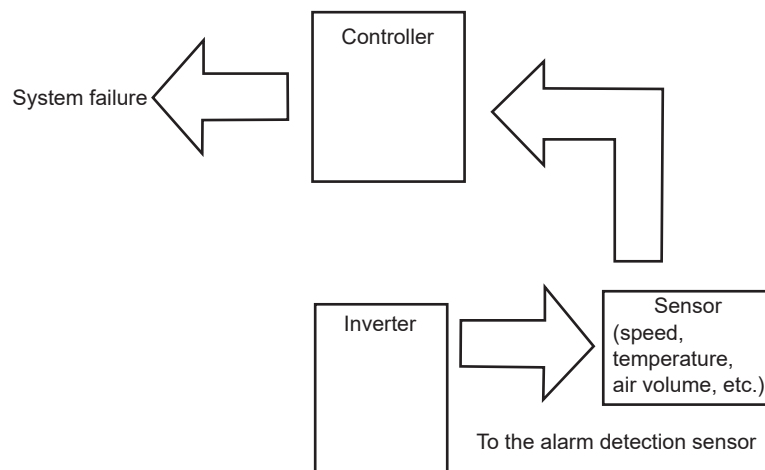
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as performing a check as below according to the level of importance of the system.

1) Start signal and actual operation check

Check the motor running and motor current while the start signal is input to the inverter by comparing the start signal to the inverter and detected speed of the speed detector or detected current of the current detector. Note that the current is flowing through the motor while the motor coasts to stop, even after the inverter's start signal is turned OFF. For the logic check, configure a sequence considering the inverter's deceleration time. In addition, it is recommended to check the three-phase current when using the current detector.

2) Command speed and actual operation check

Check for a gap between the actual speed and commanded speed by comparing the inverter's speed command and the speed detected by the speed detector.



CHAPTER 4 PREVENTIVE MAINTENANCE

Preventive maintenance consists of daily maintenance and periodic maintenance.

4.1 Necessity of preventive maintenance

It is inefficient to repair the production system after failures occur.

The primary goal is to avoid failures and equipment suspension. Preventive maintenance prevents critical failures, as well as leading to fast repair in case of failure.

4.2 Maintenance and inspection

The inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to the adverse effects of the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

4.2.1 Precautions for maintenance and inspection

When accessing the inverter for inspection, the smoothing capacitor voltage remains high for a while after the power supply has been switched OFF. Therefore, wait until the charge lamp turns off and then make sure that the voltage across the main circuit terminals P/+ and N/- of the inverter is not more than 30 VDC using a tester.

4.2.2 Inspection items

(1) Daily inspection

- Basically, check for the following faults during operation.
 - 1) Motor operation fault
 - 2) Improper installation environment
 - 3) Cooling system fault
 - 4) Unusual vibration and noise
 - 5) Abnormal overheat and discoloration

(2) Periodic inspection

- Check the areas inaccessible during operation and requiring periodic inspection.
 - 1) Check for cooling system fault.Clean the air filter, etc.
 - 2) Check the tightening and retighten ...The screws and bolts may become loose due to vibration, temperature changes, etc. Check and tighten them.
 - 3) Check the conductors and insulating materials for corrosion and damage.
 - 4) Measure the insulation resistance.

4 PREVENTIVE MAINTENANCE

5) Check and change the cooling fan and relay.

(Note) Understand the contents of the power supply display indicating that the inverter is running and error (fault) display indicating a trouble on general-purpose inverters. Also, check the electronic thermal O/L relay and the acceleration/deceleration time from the parameter unit, and record the normal setting values.

Refer to the following table for items and judgement criteria of daily and periodic inspections.

Daily and periodic inspection

Area of inspection	Inspection item	Description	Inspection interval		Corrective action at fault occurrence	Check by user
			Daily	Periodic *3		
General	Surrounding environment	Check the surrounding air temperature, humidity, dirt, corrosive gas, oil mist, etc.	○		Improve the environment.	
	Overall unit	Check for unusual vibration and noise.	○		Check fault location and retighten.	
		Check for dirt, oil, and other foreign material.*1	○		Clean.	
	Power supply voltage	Check that the main circuit voltage and control circuit voltage are normal.*2	○		Inspect the power supply.	
Main circuit	General	<ul style="list-style-type: none"> • Check with megger (between main circuit terminals and earth (ground) terminal). • Check for loose screws and bolts. • Check for overheat traces on the parts. • Check for stains. 		<ul style="list-style-type: none"> ○ ○ ○ ○ 	Contact the manufacturer. Retighten. Contact the manufacturer. Clean.	
	Conductors and cables	<ul style="list-style-type: none"> • Check conductors for distortion. • Check cable sheaths for breakage and deterioration (crack, discoloration, etc.). 		<ul style="list-style-type: none"> ○ ○ 	Contact the manufacturer. Contact the manufacturer.	
	Transformer/ Reactor	Check for unusual odor and abnormal increase of whining sound.	○		Stop the equipment and contact the manufacturer.	
	Terminal block	Check for a damage.		○	Stop the equipment and contact the manufacturer.	
	Smoothing aluminum electrolytic capacitor	<ul style="list-style-type: none"> • Check for liquid leakage. • Check for safety valve projection and bulge. • Visual check and judge by the life check of the main circuit capacitor. 		<ul style="list-style-type: none"> ○ ○ ○ 	Contact the manufacturer. Contact the manufacturer.	
	Relay/contacter	Check that the operation is normal and no chattering sound is heard.		○	Contact the manufacturer.	
	Resistor	<ul style="list-style-type: none"> • Check for cracks in the resistor insulator. • Check for a break in the cable. 		<ul style="list-style-type: none"> ○ ○ 	Contact the manufacturer. Contact the manufacturer.	
	Operation check	<ul style="list-style-type: none"> • Check for an output voltage imbalance between phases while operating the inverter alone. • Check that no fault is found in protective and display circuits in a sequence protective operation test. 		<ul style="list-style-type: none"> ○ ○ 	Contact the manufacturer. Locate the fault and check the wiring.	
Control circuit, protection circuit	Component check	Overall		<ul style="list-style-type: none"> ○ ○ 	Stop the equipment and contact the manufacturer. Contact the manufacturer.	
		Aluminum electrolytic capacitor		<ul style="list-style-type: none"> ○ ○ 	Contact the manufacturer.	

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Daily and periodic inspection

Area of inspection	Inspection item	Description	Inspection interval		Corrective action at fault occurrence	Check by user
			Daily	Periodic *3		
Cooling system	Cooling fan	<ul style="list-style-type: none"> • Check for unusual vibration and noise. • Check for loose screws and bolts. • Check for stains. 	○	○	Replace the fan. Fix with the fan cover fixing screws. Clean.	
	Heat sink	<ul style="list-style-type: none"> • Check for clogging. • Check for stains. 		○	Clean. Clean.	
Display	Indication	<ul style="list-style-type: none"> • Check that indications are correct. • Check for stains. 	○	○	Contact the manufacturer. Clean.	
	Meter/counter	Check that readouts are correct.	○		Stop the equipment and contact the manufacturer.	
Load motor	Operation check	Check for vibration and abnormal increase in operation noise.	○		Stop the equipment and contact the manufacturer.	
Waterproof performance, dustproof performance *4	Resin cap	<ul style="list-style-type: none"> • Check for damage. • Check parts such as the gasket for degradation (crack, discoloration, or deformation). 		○	Stop the equipment and contact the manufacturer.	
				○	Stop the equipment and contact the manufacturer.	
	Connector	<ul style="list-style-type: none"> • Check for improper connection. • Check if the cap of an unused connector is removed. 		○	Connect the cable properly.	
				○	Install the caps to the unused connectors.	

*1 Oil component of the heat dissipation grease used inside the inverter may leak out. The oil component, however, is not flammable, corrosive, nor conductive and is not harmful to humans. Wipe off such oil component.

*2 It is recommended to install a voltage monitoring device for checking the voltage of the power supplied to the inverter.

*3 One to two years of periodic inspection cycle is recommended. However, it differs according to the installation environment. Consult us for periodic inspection.

*4 Inspections for the IP67 model.

Remark

Continuous use of a leaked, deformed, or degraded smoothing aluminum electrolytic capacitor (as shown in the table above) may lead to a burst, breakage, or fire. Replace such capacitor without delay.

4.2.3 Checking the inverter and converter modules

(1) Preparation

- Disconnect the external power supply cables (R/L1, S/L2, T/L3) and motor cables (U, V, W).
- Prepare a tester. (For the resistance measurement, use the 100 Ω range.)

(2) Checking method

Change the polarity of the tester alternately at the inverter terminals R/L1, S/L2, T/L3, U, V, W, P/+, and N/- and check the electric continuity.

Remark

- When measuring, measure with a tester between P/+ and N/- and confirm that the smoothing capacitor is discharged.
- At the time of electric discontinuity, the measured value is almost ∞ . When there is an instantaneous electric continuity, due to the smoothing capacitor, the tester may not indicate ∞ . At the time of electric continuity, the measured value is several Ω to several tens of Ω . When all measured values are almost the same (although values may not be constant depending on the tester type), it shows that there are no electrical paths with problems.

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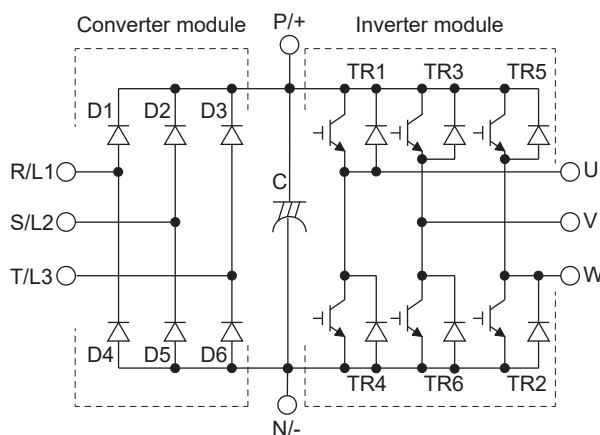
(3) Module device numbers and terminals to be checked

Three-phase 200 V class, three-phase 400 V class, single-phase 200 V class

		Tester polarity		Continuity			Tester polarity		Continuity
		⊕	⊖				⊕	⊖	
Converter module	D1	R/L1	P/+	No	D4	R/L1	N/-	Yes	
		P/+	R/L1	Yes		N/-	R/L1	No	
	D2	S/L2	P/+	No	D5	S/L2	N/-	Yes	
		P/+	S/L2	Yes		N/-	S/L2	No	
	D3	T/L3 ^{*1}	P/+	No	D6	T/L3 ^{*1}	N/-	Yes	
		P/+	T/L3 ^{*1}	Yes		N/-	T/L3 ^{*1}	No	
Inverter module	TR1	U	P/+	No	TR4	U	N/-	Yes	
		P/+	U	Yes		N/-	U	No	
	TR3	V	P/+	No	TR6	V	N/-	Yes	
		P/+	V	Yes		N/-	V	No	
	TR5	W	P/+	No	TR2	W	N/-	Yes	
		P/+	W	Yes		N/-	W	No	

(Assuming that an analog meter is used.)

*1 Terminals T/L3, D3, and D6 are provided only on the three-phase power input model.

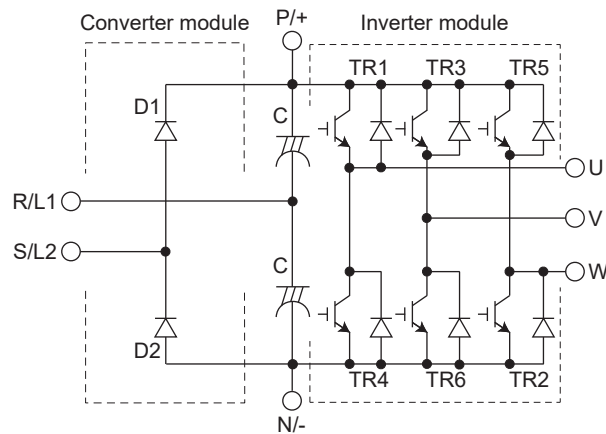


4 PREVENTIVE MAINTENANCE

Single-phase 100 V class

		Tester polarity		Continuity		Tester polarity		Continuity
		⊕	⊖			⊕	⊖	
Converter module	D1	S/L2	P/+	No	—	R/L1	P/+	No
		P/+	S/L2	Yes		P/+	R/L1	No
	D2	S/L2	N/-	Yes		R/L1	N/-	No
		N/-	S/L2	No		N/-	R/L1	No
Inverter module	TR1	U	P/+	No	TR4	U	N/-	Yes
		P/+	U	Yes		N/-	U	No
	TR3	V	P/+	No	TR6	V	N/-	Yes
		P/+	V	Yes		N/-	V	No
	TR5	W	P/+	No	TR2	W	N/-	Yes
		P/+	W	Yes		N/-	W	No

(Assuming that an analog meter is used.)



4.2.4 Cleaning

Always run the inverter in a clean status.

When cleaning the inverter, gently wipe dirty areas with a soft cloth immersed in neutral detergent or ethanol.

Remark

- Do not use solvent, such as acetone, benzene, toluene and alcohol, as these will cause the inverter surface paint to peel off.
- The display, etc. of the operation panel are vulnerable to detergent and alcohol. Therefore, avoid using them for cleaning.

4 PREVENTIVE MAINTENANCE

4.2.5 Replacement of parts

The inverter consists of many electronic parts such as semiconductor devices.

The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or fault of the inverter. For preventive maintenance, the parts must be replaced periodically. Use the life check function as a guidance of parts replacement.

Part name	Estimated lifespan ^{*1}	Replacement method / others
Cooling fan	10 years	Replace (as required)
Main circuit smoothing capacitor	10 years ^{*2}	Replace (as required)
On-board smoothing capacitor	10 years ^{*2}	Replace the board (as required)
ABC/ABC2 ^{*3} relay contact	—	As required
Large resin cap (with gasket) ^{*3*4}	5 years	Replace (as required)
Small resin cap (with gasket) ^{*3*4}	5 years	Replace (as required)
Resin cap (male) (with gasket) ^{*3*4}	10 years	Replace (as required)
Resin cap (female) ^{*3*4}	10 years	Replace (as required)
Gasket of the front cover ^{*4}	10 years	Replace (as required)
Power ON/OFF switch ^{*4}	10 years	Replace (as required)

^{*1} Estimated lifespan for when the yearly average surrounding air temperature is 30°C (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)

^{*2} Output current: 80% of the inverter ND rating

^{*3} For IP67 model only.

^{*4} The life check function is not available for this part. Replace the part when the estimated lifespan has elapsed, or check whether the part needs to be replaced during periodic inspection.

Remark

- For parts replacement, contact the nearest Mitsubishi Electric FA center.

(1) Inverter parts life display

The inverter diagnoses the main circuit capacitor, control circuit capacitor, cooling fan, inrush current limit circuit, inverter module, and relay contacts of terminals A, B, and C, and estimates their lives.

The self-diagnostic warning is output when the life span of each part is near its end. It gives an indication of replacement time.

Guideline for life judgment using the life warning output

Part name	Judgment level
Main circuit capacitor	85% of the initial capacity
Control circuit capacitor	Estimated remaining life 10%
Inrush current limit circuit	Estimated remaining life 10% (Power ON: 100,000 times left)
Cooling fan	Less than the specified speed
Inverter module	Estimated remaining life 15%
ABC/ABC2 relay contact ^{*1}	Estimated remaining life 10%

^{*1} Life check of ABC2 relay contact is applicable only for the IP67 model.

Remark

- Refer to Chapter 8 for details on the life check of the inverter parts.

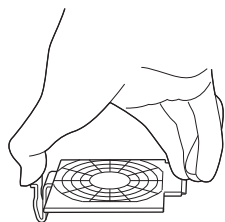
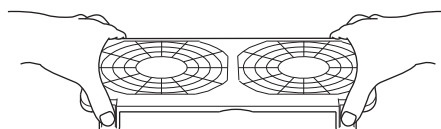
4 PREVENTIVE MAINTENANCE

(2) Replacement procedure of the cooling fan

The replacement interval of the cooling fan used for cooling the parts generating heat such as the main circuit semiconductor is greatly affected by the surrounding air temperature. When unusual noise and/or vibration are noticed during inspection, the cooling fan must be replaced immediately.

- Removal of the fan (standard model, Ethernet model, and safety communication model)

1) Push the hooks from above and remove the fan cover.

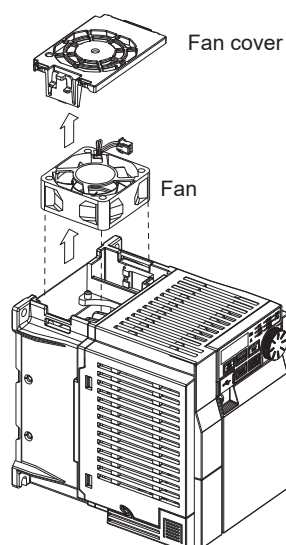


FR-E820-0080(1.5K) to 0330(7.5K)
FR-E840-0040(1.5K) to 0170(7.5K)
FR-E860-0027(1.5K) to 0120(7.5K)
FR-E820S-0080(1.5K), 0110(2.2K)

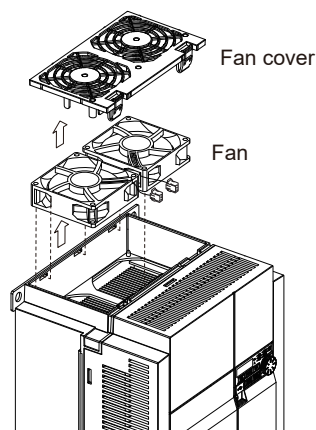
FR-E820-0470(11K) to 0900(22K)
FR-E840-0230(11K) to 0440(22K)

2) Disconnect the fan connectors.

3) Remove the fan.



FR-E820-0080(1.5K) to 0330(7.5K)
FR-E840-0040(1.5K) to 0170(7.5K)
FR-E860-0027(1.5K) to 0120(7.5K)
FR-E820S-0080(1.5K), 0110(2.2K)

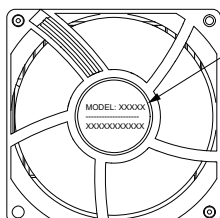


FR-E820-0470(11K) to 0900(22K)
FR-E840-0230(11K) to 0440(22K)

4 PREVENTIVE MAINTENANCE

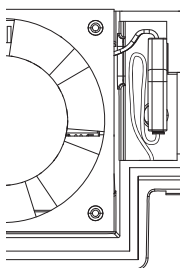
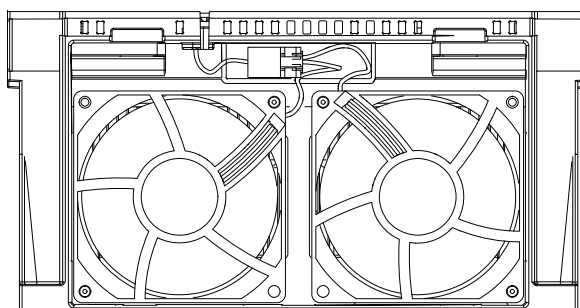
- Reinstallation of the fan (standard model, Ethernet model, and safety communication model)

- 1) Install the fan so that the air outlet side with the rating plate attached faces up. (The manufacturer name, model, and specifications of the fan are described on the rating plate.) Incorrect installation will shorten the life of the inverter or cause a fault. Disconnect the fan connector, and remove the fan itself.



Rating plate (description includes the manufacturer name, model, and specifications)

- 2) Connect the fan connectors.

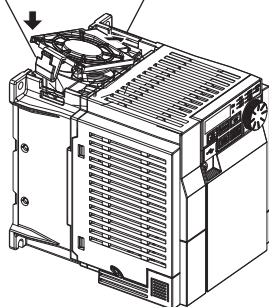


FR-E820-0080(1.5K) to 0330(7.5K)
FR-E840-0040(1.5K) to 0170(7.5K)
FR-E860-0027(1.5K) to 0120(7.5K)
FR-E820S-0080(1.5K), 0110(2.2K)

FR-E820-0470(11K) to 0900(22K)
FR-E840-0230(11K) to 0440(22K)

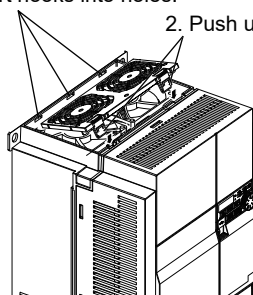
- 3) Install the fan cover.

2. Push until it clicks.
1. Insert the hook into the hole.



FR-E820-0080(1.5K) to 0330(7.5K)
FR-E840-0040(1.5K) to 0170(7.5K)
FR-E860-0027(1.5K) to 0120(7.5K)
FR-E820S-0080(1.5K), 0110(2.2K)

1. Insert hooks into holes.
2. Push until it clicks.

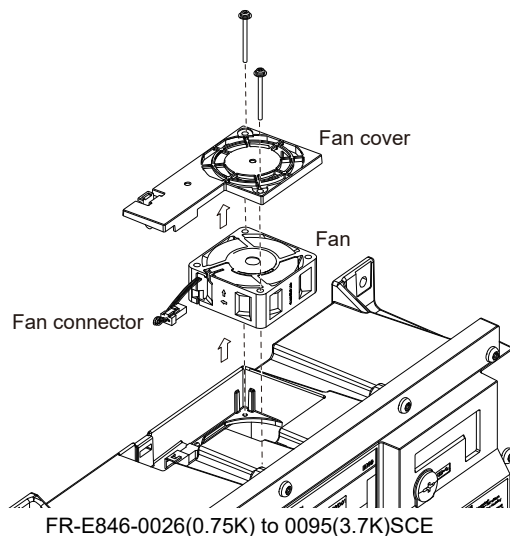


FR-E820-0470(11K) to 0900(22K)
FR-E840-0230(11K) to 0440(22K)

4 PREVENTIVE MAINTENANCE

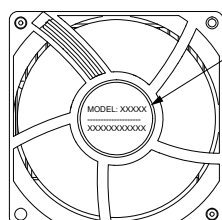
- Removal of the fan (IP67 model)

- 1) Remove the screws to disconnect the fan cover, then disconnect the fan connector and remove the fan itself.



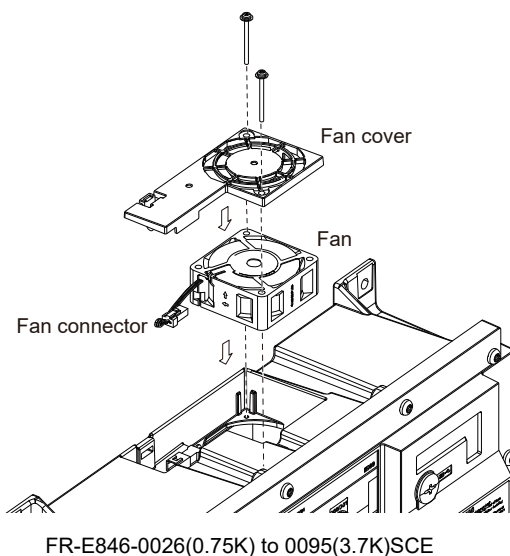
- Reinstallation of the fan (IP67 model)

- 1) Install the fan so that the air outlet side with the rating plate attached faces up. (The manufacturer name, model, and specifications of the fan are described on the rating plate.)
Incorrect installation will shorten the life of the inverter or cause a fault.



Rating plate (description includes the manufacturer name, model, and specifications)

- 2) Connect the fan connector, and reinstall the fan itself.



Remark

Installing the fan in the opposite direction of air flow may shorten the inverter life. Ensure that the cables are not caught when the fan is installed. Switch OFF the power before starting the fan replacement work. To prevent an electric shock accident, power off the inverter and wait for at least 10 minutes as the inverter circuits are charged with voltage even after power OFF.

(3) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the DC section of the main circuit, and an aluminum electrolytic capacitor is used for stabilizing the control circuit power in the control circuit. Adverse effects from ripple currents deteriorate capacitors. Replacement intervals of capacitors vary greatly with surrounding temperatures and operating conditions. Replace them roughly every 10 years when used in normal air-conditioned environments.

Inspecting the product visually:

- Case: Check that the sides and bottom of the capacitor have not ruptured.
- Rubber seal: Check for any noticeable bulging or severe cracks.
- Check for external cracks, discoloration, leakage, etc. It is assumed that the capacitor has reached the end of its life when its capacity has dropped below 80% of its rated capacity.

Remark

The inverter diagnoses the main circuit capacitor and control circuit capacitor by itself and estimates its remaining life.

(4) Relay output terminals

- The contacts of relays deteriorate over time. To prevent faults from occurring, relays must be replaced when they have reached the maximum of switching operations (switching life).
- The control circuit terminal block must be replaced in case of failure of the relay connected to the relay output terminals A, B, and C. (Refer to page 4-12.) (After replacing the control circuit terminal block, set the switch to the correct position in accordance with the control logic of input signals.) (Refer to the FR-E800 Instruction Manual (Connection) or FR-E860 Instruction Manual (Connection).) For the IP67 model, two sets of relay output terminals are provided. If the relay becomes faulty, contact your sales representative.

(5) Resin cap (IP67 model)

- When the resin cap or resin gasket deteriorates with age, IP67 requirements cannot be met. Replace the large/small resin cap after five years of use, and the resin cap (male/female) after 10 years of use.

Part	Model name	Manufacturer	Tightening torque
Large resin cap (with gasket)	A-INSP-M25-65N-P-BK - 1415207	Phoenix Contact GmbH & Co. KG	1.5 N·m
Small resin cap (with gasket)	A-INSP-M16-68N-P-BK - 1045817		1 N·m
Resin cap (male) (with gasket)	P5407601200-000	TE Connectivity	0.7 N·m
Resin cap (female)	T4104000000-00		0.7 N·m

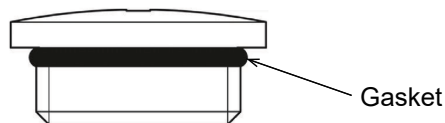
4 PREVENTIVE MAINTENANCE

- Appearance of resin cap

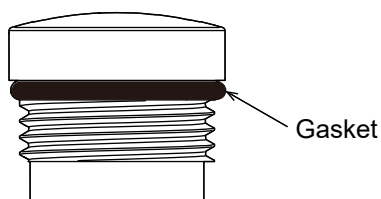
Large resin cap
(A-INSP-M25-65N-P-BK-1415207)



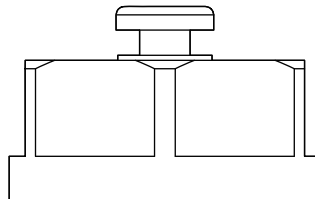
Small resin cap
(A-IN-P-M16-68N-P-BK-1045817)



Resin cap (male)
(P5407601200-000)



Resin cap (female)
(T4104000000-00)



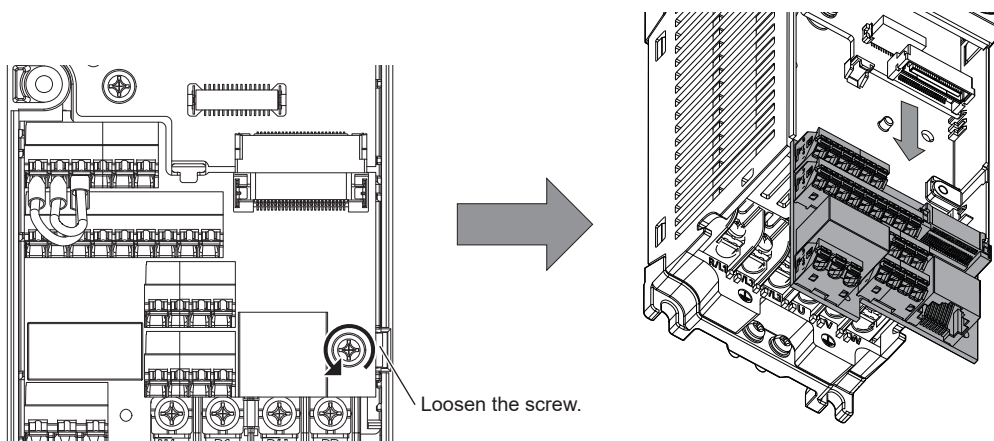
4.2.6 Inverter replacement

This product has a removable control circuit terminal block, which can be replaced with a new one (except for the IP67 model).

(1) Removal and reinstallation

- 1) Loosen the fixing screw of the control circuit terminal block.

Slide down the control circuit terminal block to remove it.



- 2) Be careful not to bend the pins of the inverter's control circuit connector, reinstall the control circuit terminal block and fix it with the mounting screws.

Remark

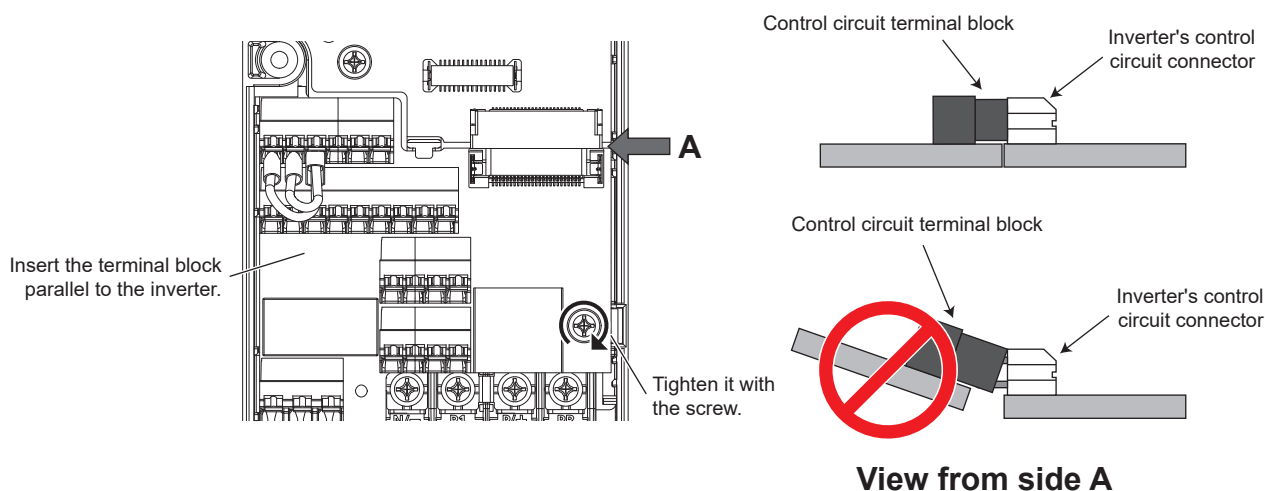
Before starting the replacement, power OFF the inverter, wait for at least 10 minutes to ensure safety.

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(2) Removal and reinstallation precautions

The following are the precautions to remove or reinstall the control circuit terminal block. Observe the following precautions and handle the inverter properly to avoid malfunctions or failures.

- To remove or reinstall the control circuit terminal block, keep it upright so that it is parallel with the inverter.
- Check that the terminal block is parallel to the inverter and the pins on the inverter control circuit connector are not bent. After checking proper connection, tighten the screw to fix the terminal block.



Remark

- Do not tilt the terminal block while tightening the screws or removing it from the product. (Otherwise, a stress applied to the control circuit terminal block or the control circuit connector may cause damage to them.)
- After replacing the control circuit terminal block, set the switch to the correct position in accordance with the control logic of input signals.
- When the control circuit terminal block is not connected to the inverter properly, a board combination fault (E.CMB) occurs.

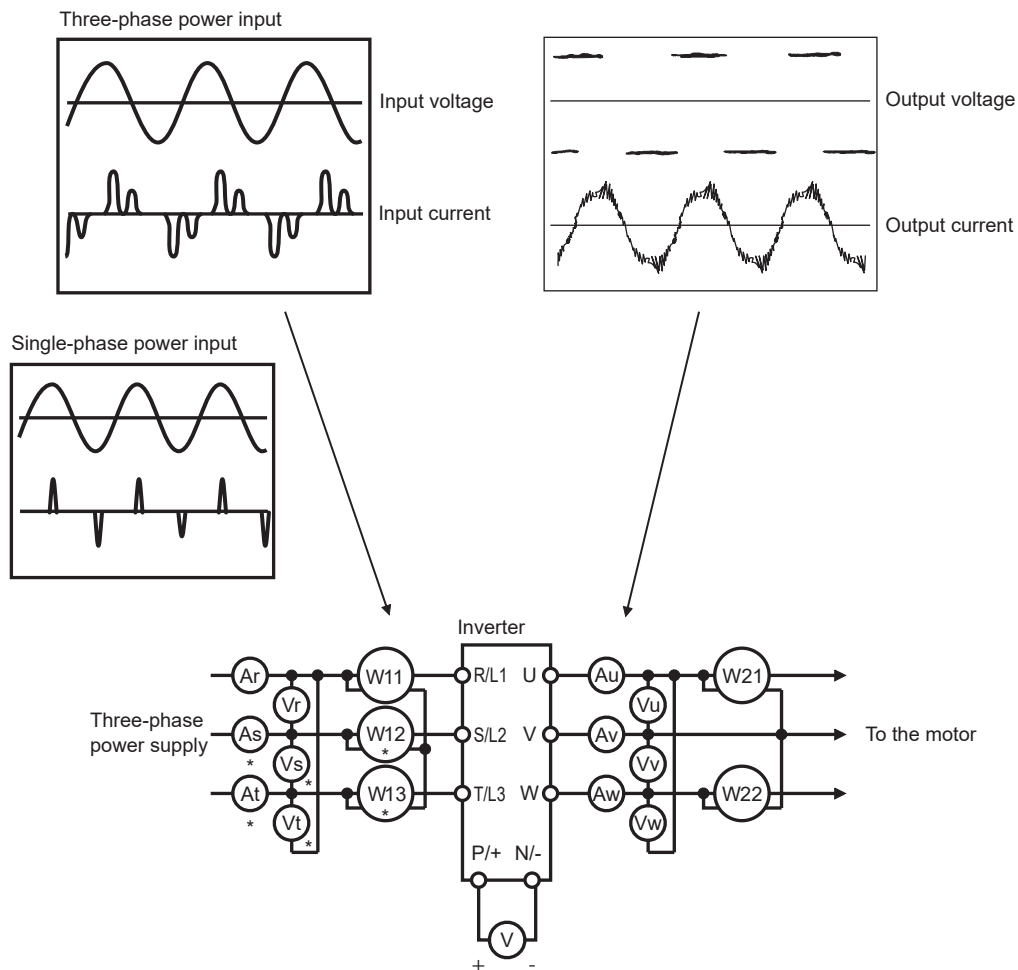
4 PREVENTIVE MAINTENANCE

4.2.7 Measurement of main circuit voltages, currents, and powers (measuring points and instruments)

Since the voltages and currents on the inverter power supply and output sides include harmonics, measurement data depends on the instruments used and circuits measured. When instruments for commercial frequency are used for measurement, measure the following circuits with the instruments given on the next page.

Remark

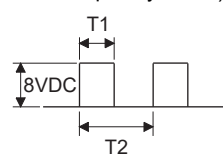
- When installing meters etc. on the inverter output side
When the inverter-to-motor wiring length is long, especially in the 400/575 V class, small-capacity models, the meters and CTs may generate heat due to line-to-line leakage current. Therefore, choose the equipment which has enough capacity for the current rating.
To measure and display the output voltage and output current of the inverter, it is recommended that the terminal AM and FM output functions of the inverter are used.



* At, As, Vt, Vs, W12, W13 are only for the three-phase power input specification models.

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Measuring points and instruments

Item	Measuring point	Measuring instrument	Remarks (reference measured value)	
Input voltage V1	Between R/L1 and S/L2, S/L2 and T/L3, and T/L3 and R/L1 ^{*3}	Digital power meter (designed for inverter)	Commercial power Within permissible AC voltage fluctuation	
Input current I1	R/L1, S/L2, T/L3 line current ^{*3}			
Input power P1	At R/L1, S/L2, and T/L3, and between R/L1 and S/L2, S/L2 and T/L3, and T/L3 and R/L1 ^{*3}		P1 = W11 + W12 + W13 (3-wattmeter method)	
Input power factor Pf1	Calculate after measuring input voltage, input current and input power. [Three-phase power supply] [Single-phase power supply] $Pf1 = \frac{P1}{\sqrt{3}V_1 \times I_1} \times 100\% \quad Pf1 = \frac{P1}{V_1 \times I_1} \times 100\%$			
Output voltage V2	Between U and V, V and W, and W and U	Digital power meter (designed for inverter) ^{*1}	Difference between the phases must be within 1% of the maximum output voltage.	
Output current I2	Line current at U, V, and W		Difference between the phases must be within 10%.	
Output power P2	At U, V, and W, and between U and V, and V and W	Digital power meter (designed for inverter)	P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)	
Output power factor Pf2	Calculate in similar manner to the input power factor. $Pf2 = \frac{P2}{\sqrt{3}V_2 \times I_2} \times 100\%$			
Converter output	Between P/+ and N/-	Digital multimeter or some other tester	1.35 × V1	
Frequency setting signal	2, and between 4(+) and 5	Digital multimeter or some other tester, or moving-coil type instrument (internal resistance 50 kΩ or more)	0 to 10 VDC, 4 to 20 mA	Terminal 5 is a common terminal.
Power supply for a frequency setting potentiometer	Between 10(+) and 5		5.2 VDC	
Frequency meter signal	[E800] Between AM(+) and 5		Approximately 10 VDC at maximum frequency (without frequency meter)	
	[E800] Between FM(+) and SD		Approximately 5 VDC at maximum frequency (without frequency meter)	Terminal SD is a common terminal.
			 Pulse width T1: Adjust with C0 (Pr.900). Pulse cycle T2: Set with Pr.55 (for frequency monitor only).	
Start terminal Multi-speed selection terminal Reset terminal Output stop terminal	[E800] Between terminal SD and each of terminal STF, STR, RH, RM, RL, RES, and MRS(+) (for sink logic) [E800-E] Between DI0 and SD, and DI1 and SD (for sink logic)		Voltage when terminal is open: 20 to 30 VDC. Voltage when signal is ON: 1 V or less.	
Relay output (fault output) terminal	Between A and C Between B and C	Digital multimeter or some other tester	Continuity check ^{*2} Fault: discontinuity across B and C (continuity across A and C), normal: continuity across B and C (discontinuity across A and C)	
Relay output 2 terminal ^{*4}	Between A2 and C2 Between B2 and C2		Continuity check ^{*2} Being output: discontinuity across B2 and C2 (continuity across A2 and C2), not being output: continuity across B2 and C2 (discontinuity across A2 and C2)	

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- *1 Use an FFT to measure the output voltage accurately. A digital multimeter or general measuring instrument cannot measure accurately.
- *2 When the setting of M405 (Pr.192) ABC terminal function selection or M406 (Pr.197) ABC2 terminal function selection is the positive logic.
- *3 Terminal T/L3 is provided only on the three-phase power input model.
- *4 IP67 model only.

CHAPTER 5 BREAKDOWN MAINTENANCE

Troubles can be caused by failures or accidents even though preventive maintenance is performed. If the inverter becomes faulty by any unexpected reason and the production system stops, breakdown maintenance is required.

5.1 Protective functions

5.1.1 Purposes and types of protective functions

When the inverter detects a fault, depending on the nature of the fault, the operation panel displays an error message or warning, or a protective function is activated to shut off the inverter output.

- When any fault occurs, take an appropriate corrective action, then reset the inverter, and resume the operation. Restarting the operation without a reset may break or damage the inverter.
- When a protective function is activated, note the following points.

Item	Description
Fault output signal	Opening the magnetic contactor (MC) provided on the input side of the inverter at a fault occurrence shuts off the control circuit power to the inverter, therefore, the fault output will not be retained.
Fault or alarm indication	When a protective function is activated, the operation panel displays a fault indication.
Operation restart method	While a protective function is activated, the inverter output is kept shutoff. Reset the inverter to restart the operation.

- Inverter fault or alarm indications are categorized as follows.

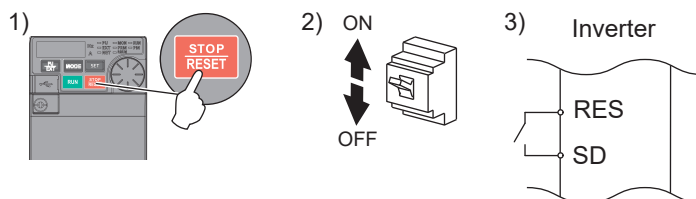
Displayed item	Description
Error message	A message regarding operational fault or setting fault on the operation panel is displayed. The inverter output is not shut off.
Warning	The inverter output is not shut off even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.
Alarm	The inverter output is not shut off. An Alarm (LF) signal can also be output with a parameter setting.
Fault	When a protective function is activated, the inverter output is shut off and a Fault (ALM) signal is output.

5.1.2 Reset method for the protective functions

Reset the inverter by performing any of the following operations. Note that the accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the inverter.

The inverter recovers about 1 second after the reset is released.

- 1) On the operation panel, press the STOP/RESET key to reset the inverter. (This operation is valid only when the protective function for a fault is activated.)
- 2) Switch the power OFF once, then switch it ON again.
- 3) Turn ON the Reset (RES) signal for 0.1 second or more. (If the RES signal is kept ON, "Err" appears (blinks) to indicate that the inverter is in a reset status.)



- OFF status of the start signal must be confirmed before resetting the inverter fault. Resetting an inverter fault with the start signal ON restarts the motor suddenly.

5.1.3 Protective function activation mechanism

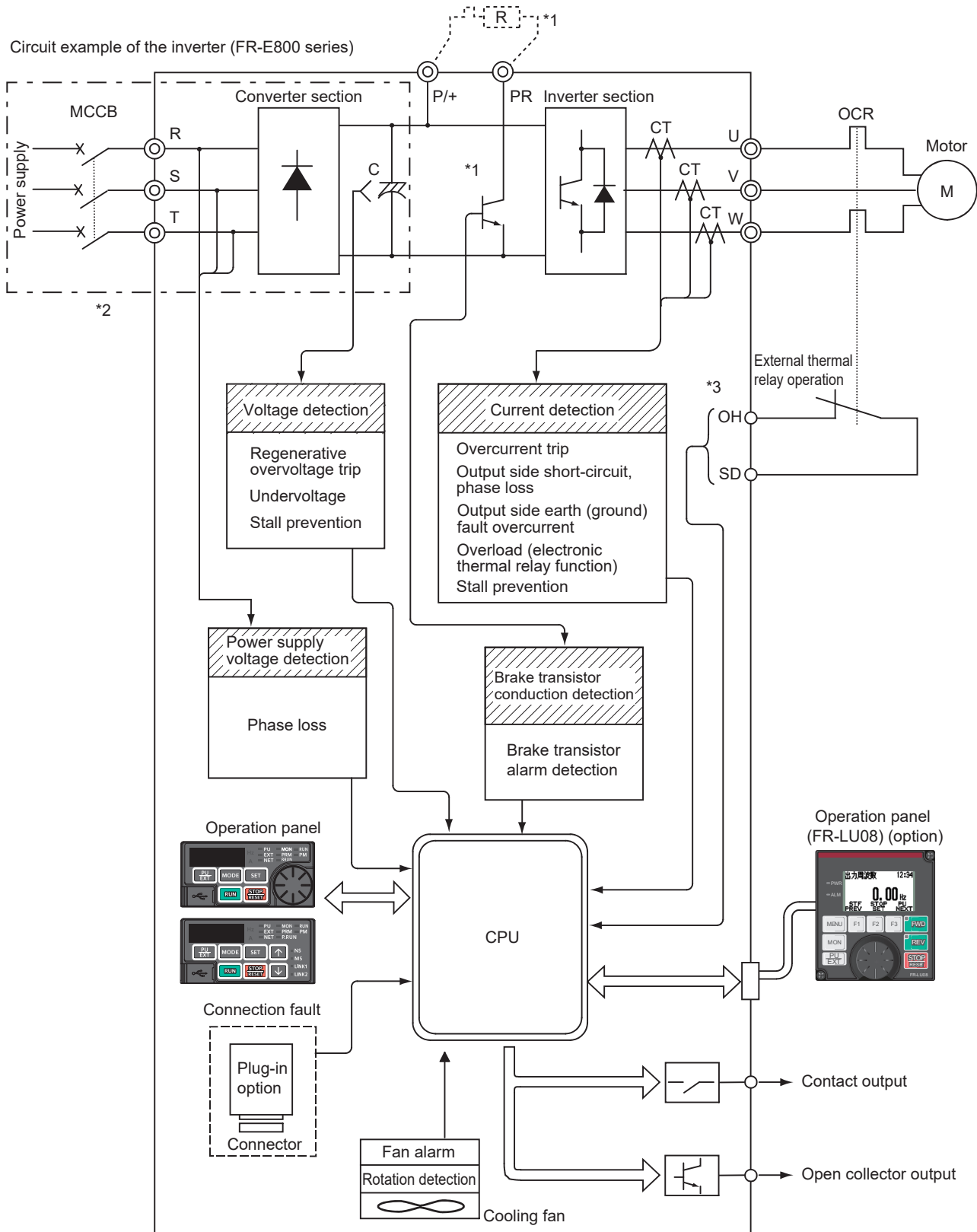
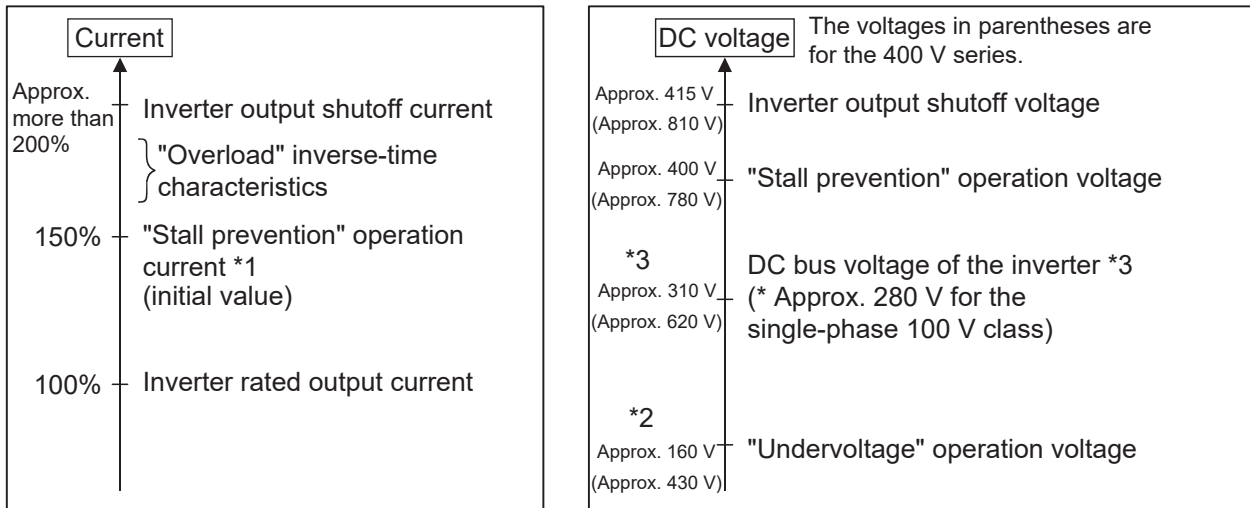


Fig. 5.1 Circuit diagram of protective functions

5.1.4 Protective function activation levels

The following shows the levels at which protective functions operate based on current and voltage detection.

(For the FR-E800 series)



*1 When the operation current level is changed at the ND rating, the changed current (%) will be used.

*2 The equivalent AC input voltage is approx. 115 VAC (approx. 230 VAC for the 400 V class and approx. 58 VAC for the 100 V class).

*3 The DC bus voltage of the inverter will be approximately $\sqrt{2}$ times of the normal input voltage (twice of the input voltage for the 100 V class). The bus voltage is approx. 311 VDC at an input voltage of 220 VAC for the three-phase 200 V class (283 VDC at 100 VAC for the single-phase 100 V class, 622 VDC at 440 VAC for the three-phase 400 V class, and 813 VDC at 575 VAC for the three-phase 575 V class). However, it may vary depending on the input power supply waveform.

☒ Good to know for checking an inverter

Regenerative overvoltage trip (E.OV1 to E.OV3) occurs only when the regenerative power from the motor is high, but in rare cases it may occur due to overvoltage while the motor is stopped. This phenomenon occurs when the smooth capacitor is charged by the surge voltage from the power supply side and the output shutoff voltage level is reached. The cause is the opening and closing of the power factor regulation capacitor in the power supply system (high or low voltage).

As a countermeasure, insert an AC reactor (power factor improving reactor) at the inverter input side.

5.2 Troubleshooting using the demonstration machine

Use the demonstration machine to troubleshoot.

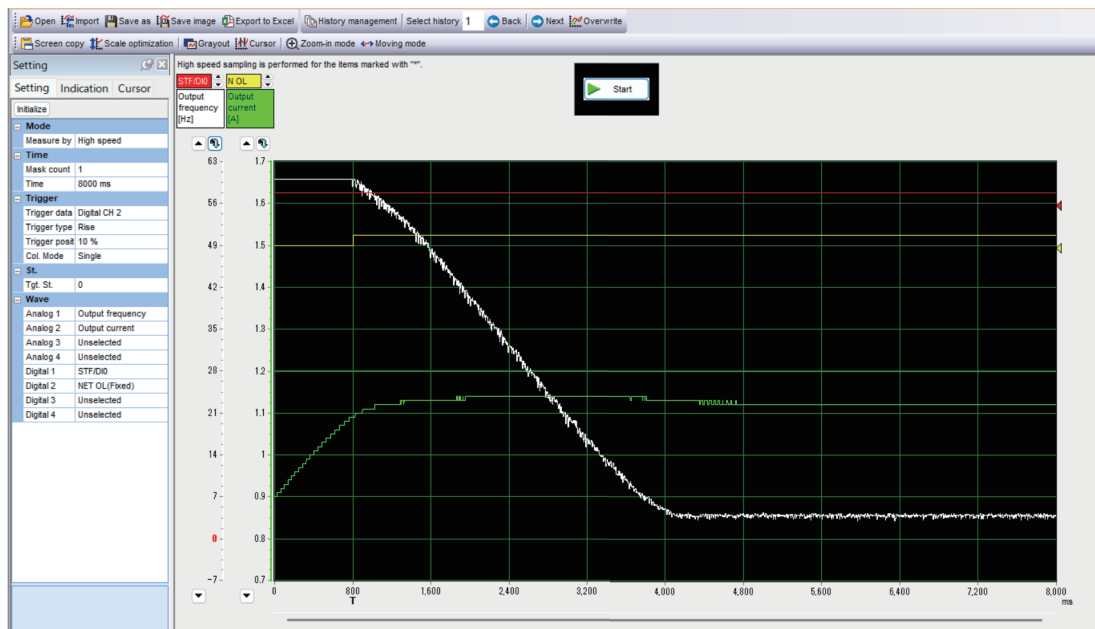
Follow the instructions to verify the issue and correct the problem.

5.2.1 Stall prevention (overcurrent) (OLC display) [Training]

Change H500 (Pr.22) (Stall prevention operation level) from the initial value 150% to 75 to 80%, and turn ON STF and high speed RH. After 60 Hz is displayed, turn ON the load and turn the load setting potentiometer from 0% to 150%. Confirm that the OLC display appears and the motor decelerates to stop.

(1) Corrective action

1) Use FR Configurator2 to check the output current value.



2) Check that the stall prevention (overcurrent) (OLC display) occurs when the value is higher than the current value that is set in H500 (P.22).

(Check that output current is equal to the rated current (1.5 A) × stall prevention operation level that is set (%).)

Task 1 | Change H500 (Pr.22) (Stall prevention operation level) and obtain the threshold for OLC display.

Task 2 | Adjust the potentiometer of the load setting, and obtain the setting value that triggers the stall prevention (overcurrent) (OLC display).

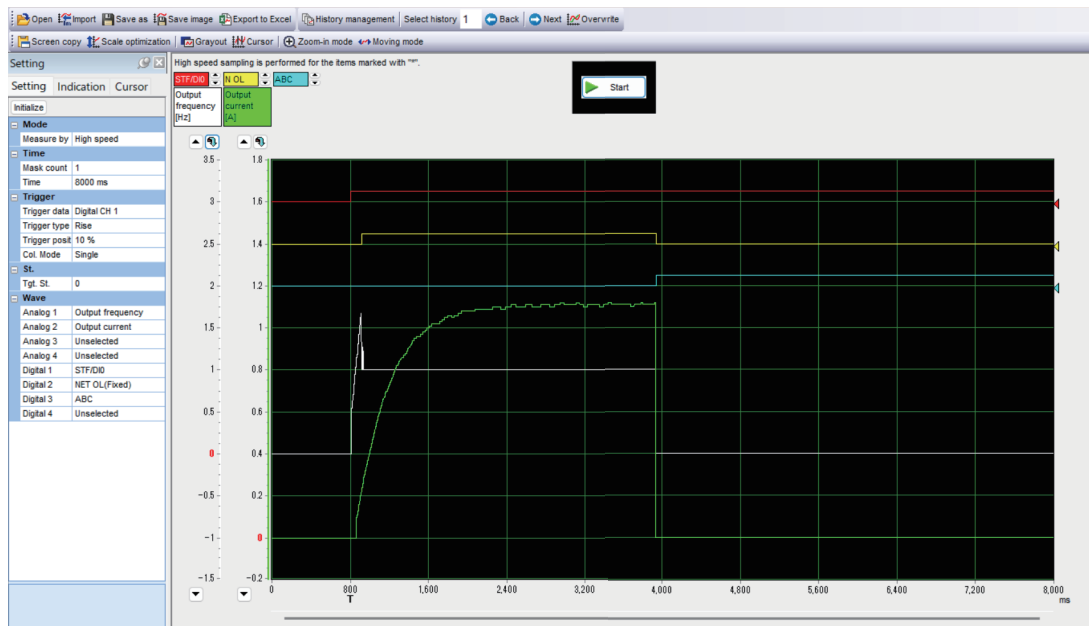
5.2.2 Stall prevention stop (E.OLT display) [Training]

Check that the stall prevention stop (E.OLT display) occurs.

Change H500 (Pr.22) (Stall prevention operation level) from the initial value 150% to 70%, and turn ON STF and high speed RH. Check that E.OLT is displayed in 3 or 4 seconds.

(1) Corrective action

1) Use FR Configurator2 to check the output current value.



2) Check that the stall prevention stop (E.OLT display) occurs at the output current value lower than usual.

Task 1 Change H500 (Pr.22) (Stall prevention operation level) and obtain the setting value at which the stall prevention stop (overcurrent) (E.OLT display) occurs.

●●●At the end of the training●●●

Reset H500 (Pr.22) (Stall prevention operation level) to the initial value 150%.

5 BREAKDOWN MAINTENANCE

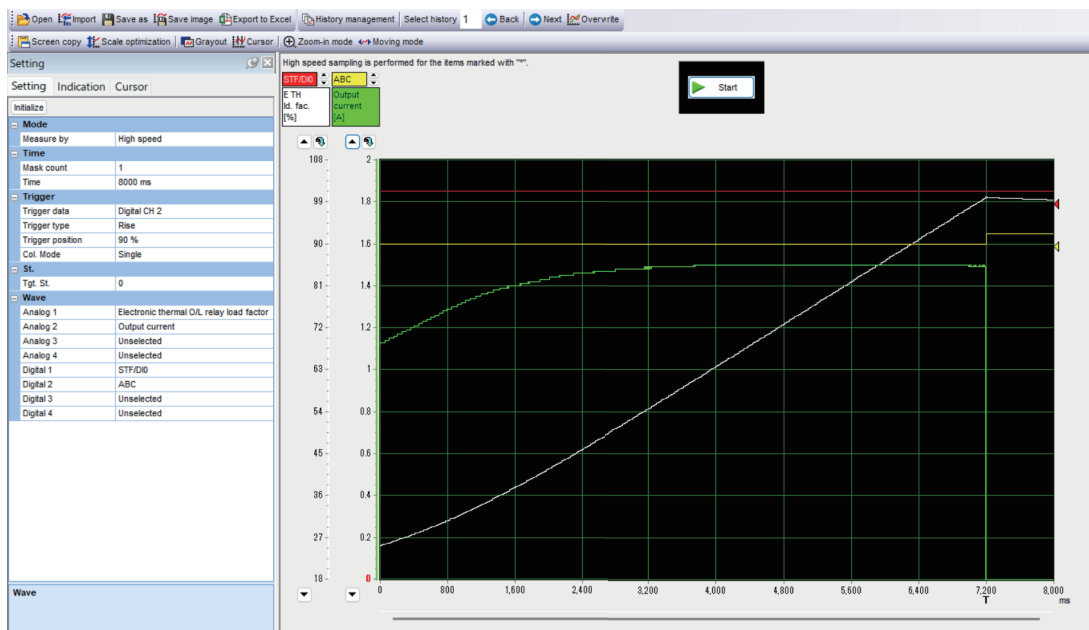
5.2.3 Electronic thermal O/L relay pre-alarm (TH display) and motor overload trip (electronic thermal O/L relay) (E.THM display) [Training]

Change H000 (Pr.9) (Electronic thermal O/L relay) from "1.16" (setting value of the electronic thermal O/L relay for the demonstration machine) to "0.5". Turn ON STF and high speed RH, and turn the potentiometer of the load setting to the right after 60 Hz is displayed. Run the inverter with the load ON at load torque 150%. Check that TH is displayed in approximately 6 seconds and E.THM is displayed in approximately 7 seconds, and that the motor is coasting.

(1) Corrective action

- 1) Use FR Configurator2 to measure the output current value when the electronic thermal O/L relay pre-alarm (TH display) and the motor overload trip (Electronic thermal O/L relay) (E.THM display) occurred.

Set the trigger position to 90%.



Task 1 Change H000 (Pr.9) (Electronic thermal O/L relay) and compare the output current values and timings when E.THM is displayed.

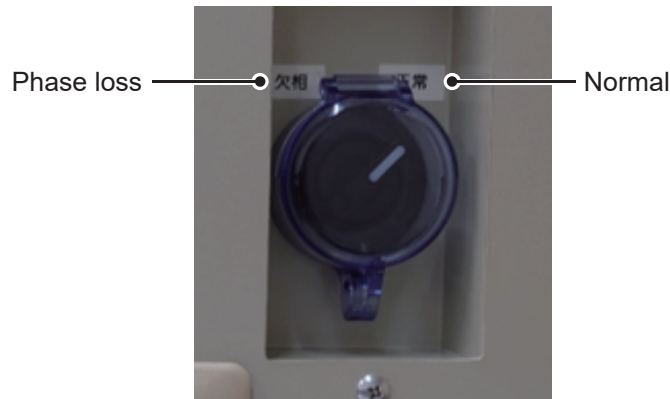
●●● At the end of the training ●●●

Reset H000 (Pr.9) (Electronic thermal O/L relay) to "1.16" (setting value of the electronic thermal O/L relay for the demonstration machine).

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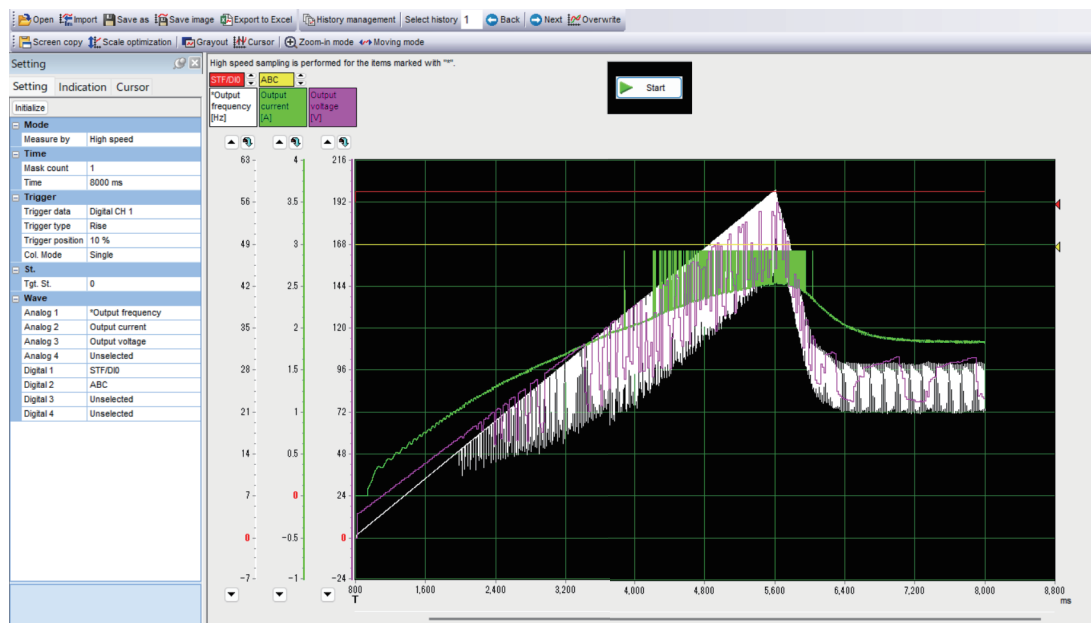
5.2.4 Output phase loss (E.LF display) [Training]

Check that E.LF is displayed in a few seconds due to the U phase loss after switching the phase loss generation switch to the motor phase loss side and turning ON STF and high speed RH. (The switch is found on the right side of the demonstration machine.)



(1) Corrective action

- 1) Use FR Configurator2 to check the output voltage and output current, and to compare them with the normal values.



- 2) Switch the phase loss generation switch on the right side of the demonstration machine to the normal side.

5.3 Appendices for training (Confirmation of error descriptions and others)

Following 5.2 Troubleshooting using the demonstration machine in the previous section, this section provides descriptions of simple errors.

Check the error details by following "Error setting", "Error description", and "Error handling procedure" in this order.

5.3.1 Error setting

- (1) **Prevention of reverse rotation <When the prevention of reverse rotation is valid>**
Change D020 (Pr.78) (Reverse rotation prevention selection) from the initial value "0" to "1" (reverse rotation disabled), and turn ON STR. Check that the [RUN] indicator on the inverter operation panel blinks and the motor does not rotate in the reverse direction.
- (2) **Maximum frequency setting**
Change H400 (Pr.1) (Maximum frequency) from 120 Hz to 55 Hz, and turn ON STF and high speed RH. Then, check that 55 Hz is displayed although the high speed RH is set to 60 Hz, and that the frequency cannot exceed 55 Hz.
- (3) **E.OHT display <External thermal relay operation>**
After turning ON the MRS switch once, change T709 (Pr.183) (MRS terminal function selection) from "24" (output stop) to "7" (external thermal relay input) and turn OFF the MRS switch (keep terminals MRS and SD open). Check that E.OHT is displayed.
- (4) **E.CDO display <Output current detection value exceeded>**
Change M464 (Pr.167) (Output current detection operation selection) from "0" to "1", M460 (Pr.150) (Output current detection level) from "150" to "40", and turn ON STF and high speed RH. Check that E.CDO is displayed at startup.
- (5) **E.USB display <USB communication fault>**
Change N041 (Pr.548) (USB communication check time interval) from "9999" to "1", and after writing the setting change, reset the inverter or cycle the power. Select the PU operation mode with FR Configurator2 being online, then check that E.USB is displayed when disconnecting USB cable. (* This setting will be enabled after writing the setting change then resetting the inverter or cycling the power.)
- (6) **E.RET display <Retry count excess>**
Change H302 (Pr.68) (Retry waiting time) from "1" to "5" seconds and change H301 (Pr.67) (Number of retries at fault occurrence) from "0" to "3" times. Change H000 (Pr.9) (Electronic thermal O/L relay) to "0.1".
Check that E.THM is displayed in 1 second when STF and high speed RH are turned ON and that E.RET is displayed by performing three retries after the automatic reset without fault output.
- (7) **MT display <Maintenance signal output>**
Change E711 (Pr.504) (Maintenance timer warning output set time) from "9999" to "0" and check that MT is displayed.

(8) PS display <PU stop>

During operation in the External operation mode, press the STOP/RESET key on the operation panel and check that PS is displayed.

5.3.2 Error description

(1) The motor does not rotate.

The motor does not rotate when STR is turned ON.

(2) The frequency does not reach the set value.

When STF and high speed RH are ON, 55 Hz is displayed. * High speed RH of 60 Hz is required.

(3) E.OHT display <External thermal relay operation>

E.OHT is displayed.

(4) E.CDO display <Output current detection value exceeded>

When STF and high speed RH are ON, E.CDO is displayed at startup.

(5) E.USB display <USB communication fault>

E.USB is displayed.

(6) E.RET display <Retry count excess>

When STF and high speed RH are turned ON, E.THM is displayed. However, E.RET is displayed when three retries are performed after the automatic reset without fault output.

(7) MT display <Maintenance signal output>

MT is displayed.

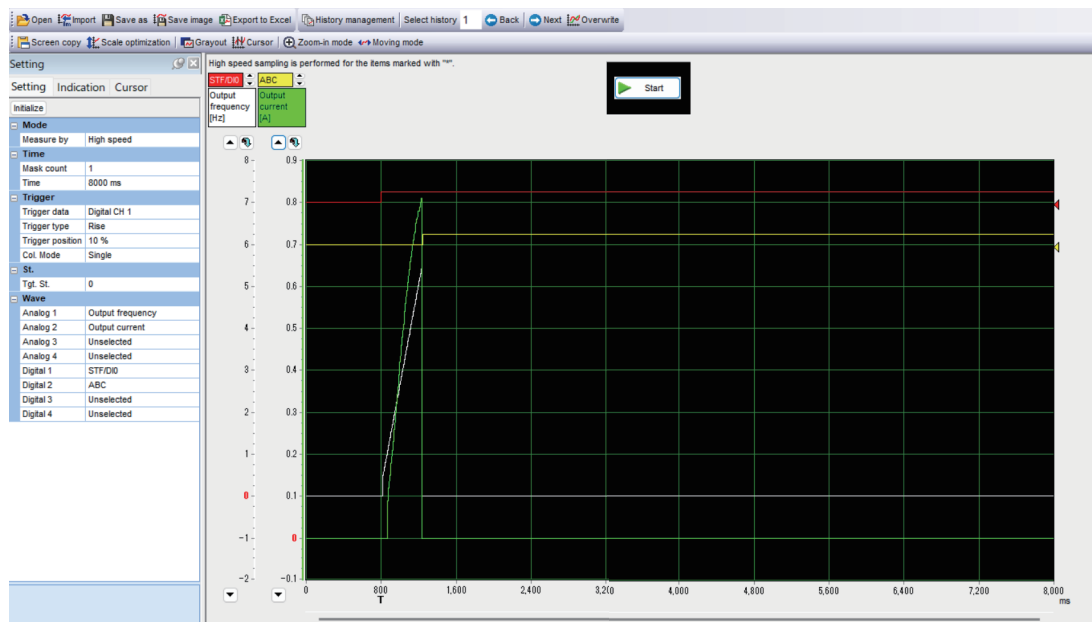
(8) PS display <PU stop>

PS is displayed.

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5.3.3 Error handling procedure

- (1) **Prevention of reverse rotation <When the prevention of reverse rotation is valid>**
Check that ON signals of STR and high speed RH are input using FR Configurator2. Change D020 (Pr.78) (Reverse rotation prevention selection) to the initial value "0".
- (2) **Maximum frequency setting**
Check that the output frequency does not match the command using FR Configurator2. Change H400 (Pr.1) (Maximum frequency) to 120 Hz.
- (3) **E.OHT display <External thermal relay operation>**
Change T709 (Pr.183) (MRS terminal function selection) to "24" (output stop).
- (4) **E.CDO display <Output current detection value exceeded>**
 - 1) Use FR Configurator2 to check the output current when the output current detection value is exceeded.



- 2) Change M464 (Pr.167) (Output current detection operation selection) to the initial value "0" (continuous operation when output current detection value exceeded).
- 3) Change M460 (Pr.150) (Output current detection level) to the initial value 150%.

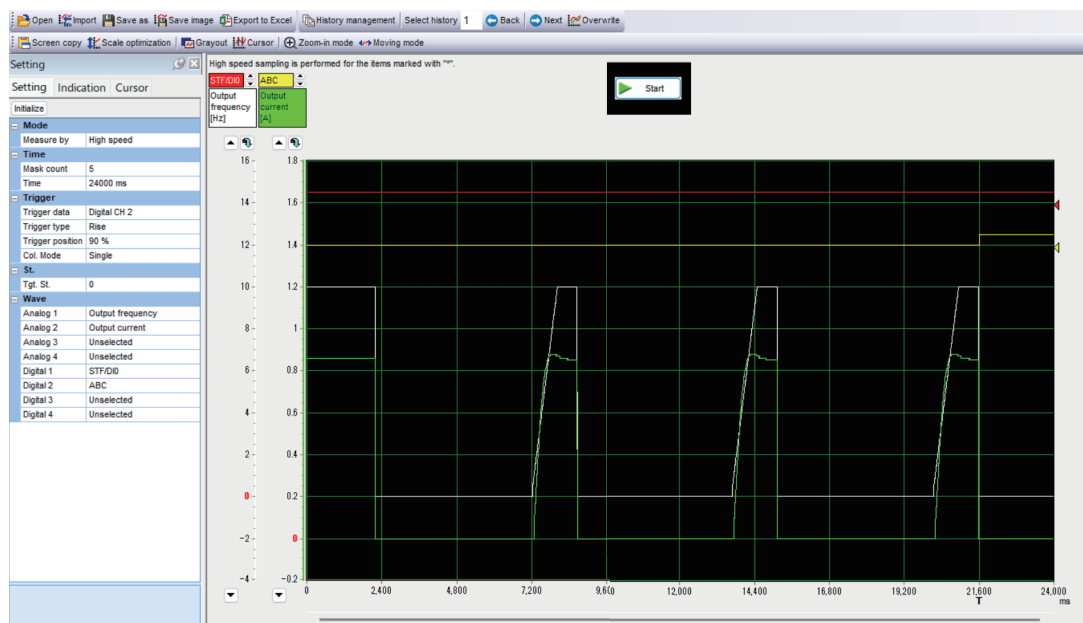
5 BREAKDOWN MAINTENANCE

(5) E.USB display <USB communication fault>

Change N041 (Pr.548) (USB communication check time interval) to "9999", and after writing the setting change, reset the inverter or cycle the power. Reconnect the USB cable. (* This setting will be enabled after writing the setting change then resetting the inverter or cycling the power.)

(6) E.RET display <Retry count excess>

- 1) Use FR Configurator2 to measure the graph from when the electronic thermal O/L relay (E.THM display) occurs to when retries are performed for three times in five seconds. Set the trigger position to 90%.



- 2) Check that the graph that is measured on 1), H302 (Pr.68) (Retry waiting time), and H301 (Pr.67) (Number of retries at fault occurrence) are consistent.
- 3) Change H301 (Pr.67) (Number of retries at fault occurrence) to the initial value "0", H302 (Pr.68) (Retry waiting time) to one second, and H000 (Pr.9) (Electronic thermal O/L relay) to 1.16 A (setting value of the electronic thermal O/L relay for the demonstration machine).

(7) MT display <Maintenance signal output>

On simultaneous monitoring of FR Configurator2, check the actual operation time of No. 19. Change E711 (Pr.504) (Maintenance timer warning output set time) to "9999".

(8) PS display <PU stop>

Turn OFF the start signal, and then press the PU/EXT key to clear the error.

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5.4 Error code list

• Error message

A message regarding operational fault or setting fault on the operation panel is displayed. The inverter output is not shut off.

Operation panel indication	Name	Description
<i>Hold</i>	HOLD	Operation panel lock Operation lock is set. Operation other than pressing the STOP/RESET key is disabled.
<i>LoCd</i>	LOCD	Password locked Password function is active. Display and setting of parameters are restricted.
<i>Er1</i> to <i>Er4</i>	Er1 to Er4	Parameter write error Appears when an error occurs during parameter writing.
<i>Err.</i>	Err.	Error <ul style="list-style-type: none"> The RES signal is turned ON. This error may occur when the voltage at the input side of the inverter drops.

• Warning

The inverter output is not shut off even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.

Operation panel indication	Name	Data code	Description
<i>olC</i>	OLC	1 (H01)	When the output current of the inverter increases, the stall prevention (overcurrent) function is activated.
<i>olV</i>	OLV	2 (H02)	<ul style="list-style-type: none"> When the output voltage of the inverter increases, the stall prevention (overvoltage) function is activated. The regeneration avoidance function is activated due to excessive regenerative power of the motor.
<i>rb</i>	RB	3 (H03)	Appears if the actual regenerative brake duty reaches or exceeds 85% of the reference regenerative brake duty (100%) determined by the settings of E300 (Pr.30) Regenerative function selection and G107 (Pr.70) Special regenerative brake duty. If the regenerative brake duty reaches 100%, a regenerative overvoltage (E.OV[]) occurs.
<i>TH</i>	TH	4 (H04)	Appears if the cumulative value of the electronic thermal O/L relay reaches or exceeds 85% of the preset level of H000 (Pr.9) Electronic thermal O/L relay.
<i>PS</i>	PS	6 (H06)	<ul style="list-style-type: none"> The motor is stopped using the STOP/RESET key in the mode other than the PU operation mode. The motor is stopped by the emergency stop function.
<i>MT</i>	MT	8 (H08)	Appears when the inverter's cumulative energization time reaches or exceeds the parameter set value.
<i>SL</i>	SL	9 (H09)	Output if the speed limit level is exceeded during torque control.
<i>CF</i>	CF	10 (H0A)	Appears when the operation continues while an error is occurring in the communication line or communication option (when N013 (Pr.502) = "6").
<i>SA</i>	SA	12 (H0C)	Appears when safety stop function is activated (during output shutoff).
<i>LdF</i>	LDF	26 (H1A)	Appears when the load is deviated from the detection width set in H531 (Pr.1488) Upper limit warning detection width or H532 (Pr.1489) Lower limit warning detection width.
<i>EHR</i>	EHR	28 (H1C)	Appears when Ethernet communication is interrupted by physical factors while N643 (Pr.1431) Ethernet signal loss detection function selection = "1 to 3".
<i>dIP</i>	DIP	32 (H20)	Appears when duplicate IP address is detected.
<i>IP</i>	IP	38 (H26)	Appears when the IP address or the subnet mask is out of the specified range.
<i>SE</i>	SE	48 (H30)	Appears when a start command is input while the condition to start operation is not satisfied in the motor setting (C100 (Pr.71), C200 (Pr.450), C101 (Pr.80), C201 (Pr.453), C102 (Pr.81), or C202 (Pr.454)) for the control method selected in G200 (Pr.800) or G300 (Pr.451).
<i>Cor</i>	Cor	50 (H32)	Appears when the corrosion level of the control circuit board becomes "3" (E709 (Pr.198) = "3"). (Available only for the FR-E8[]-[]-60 (with coating).)

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Operation panel indication	Name	Data code	Description
UV	UV	Undervoltage	—
LP	LP	Stroke limit warning	20 (H14)
HP1	HP1	Home position return setting error	21 (H15)
HP2	HP2	Home position return uncompleted	22 (H16)
ED	ED	Emergency drive in operation	24 (H18)

- Alarm

The inverter output is not shut off. The Alarm (LF) signal can be output depending on the parameter setting.

Operation panel indication	Name	Description
Fn	FN	Fan alarm

- Fault

When a protective function is activated, the inverter output is shut off and a Fault (ALM) signal is output.

The data code is used for checking the fault detail via communication or with H103 (Pr.997) Fault initiation.

Data code 16 to 199

Operation panel indication	Name	Data code	Description
E.O.C1	E.OC1	Overcurrent trip during acceleration	16 (H10)
E.O.C2	E.OC2	Overcurrent trip during constant speed	17 (H11)
E.O.C3	E.OC3	Overcurrent trip during deceleration or stop	18 (H12)
E.O.V1	E.OV1	Regenerative overvoltage trip during acceleration	32 (H20)
E.O.V2	E.OV2	Regenerative overvoltage trip during constant speed	33 (H21)
E.O.V3	E.OV3	Regenerative overvoltage trip during deceleration or stop	34 (H22)
E.T.HT	E.THT	Inverter overload trip (electronic thermal relay function) ^{*1}	48 (H30)
E.T.HN	E.THM	Motor overload trip (electronic thermal relay function) ^{*1}	49 (H31)

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Operation panel indication	Name	Data code	Description
<i>E.F. n</i>	E.FIN	Heat sink overheat 64 (H40)	When the heat sink overheats, the temperature sensor is activated, and the inverter output is stopped.
<i>E.UvF</i>	E.UVT	Undervoltage 81 (H51)	When a PM motor is used, the protective function is activated in the following case: a fault such as power failure or voltage drop occurs, the converter voltage drops to cause the motor to coast, and restarting and coasting are repeated by the automatic restart after instantaneous power failure function.
<i>E. l F</i>	E.ILF	Input phase loss* ³ 82 (H52)	When H201 (Pr.872) Input phase loss protection selection = "1" (function enabled) and one of the three-phase power input is lost, the inverter output is shut off. (Available only for the three-phase power supply input.)
<i>E.oLT</i>	E.OLT	Stall prevention stop 96 (H60)	If the output frequency has fallen to 0.5 Hz by stall prevention operation and remains for 3 seconds, a fault (E.OLT) appears and the inverter is shut off.
<i>E.Sof</i>	E.SOT	Loss of synchronism detection 97 (H61)	The inverter output is shut off when the motor operation is not synchronized. (This function is only available under PM sensorless vector control.)
<i>E.LUP</i>	E.LUP	Upper limit fault detection* ³ 98 (H62)	The inverter output is shut off when the load exceeds the upper limit fault detection range.
<i>E.Ldn</i>	E.LDN	Lower limit fault detection* ³ 99 (H63)	The inverter output is shut off when the load falls below the lower limit fault detection range.
<i>E.bE</i>	E.BE	Brake transistor alarm detection 112 (H70)	The inverter output is shut off if a fault due to damage of the brake transistor and such occurs in the brake circuit. In such a case, the power supply to the inverter must be shut off immediately.
<i>E.GF</i>	E.GF	Output side earth (ground) fault overcurrent 128 (H80)	The inverter output is shut off if an earth (ground) fault overcurrent flows due to an earth (ground) fault that occurred on the inverter's output side (load side).
<i>E.l F</i>	E.LF	Output phase loss 129 (H81)	The inverter output is shut off if one of the three phases (U, V, W) on the inverter's output side (load side) is lost.
<i>E.oHT</i>	E.OHT	External thermal relay operation* ² * ³ 144 (H90)	The inverter output is shut off if the external thermal relay provided for motor overheat protection or the internally mounted thermal relay in the motor, etc. switches ON (contacts open). (This protective function is available for the standard model and the Ethernet model.)
<i>E.PTC</i>	E.PTC	PTC thermistor operation* ³ 145 (H91)	The inverter output is shut off if resistance of the PTC thermistor connected between terminal 2 and terminal 10 is equal to or higher than the H020 (Pr.561) PTC thermistor protection level setting for a continuous time equal to or longer than the setting value in H021 (Pr.1016) PTC thermistor protection detection time.
<i>E.oPr</i>	E.OPT	Option fault 160 (HA0)	<ul style="list-style-type: none"> • Appears when torque command by the plug-in option is selected using D400 (Pr.804) Torque command source selection and no plug-in option is mounted. • Appears when the switch for manufacturer setting of the plug-in option is changed. • Appears when a communication option is connected while E410 (Pr.296) Password lock level = "0 or 100".
<i>E.oP 1</i>	E.OP1	Communication option fault 161 (HA1)	The inverter output is shut off if a communication line error occurs in the communication option.
<i>E. 16</i>	E.16	User definition error by the PLC function* ³	The protective function is activated by setting "16 to 20" in the special register SD1214 for the PLC function. The inverter output is shut off when the protective function is activated. The protective function is activated when the PLC function is enabled.
<i>E. 17</i>	E.17		
<i>E. 18</i>	E.18		
<i>E. 19</i>	E.19		
<i>E. 20</i>	E.20		
<i>E.PE6</i>	E.PE6	Internal storage device fault 172 (HAC)	This protective function is activated by an inverter reset if writing data fails due to power-OFF or a data fault occurs in the storage device during parameter operations* ⁴ .
<i>E.PE</i>	E.PE	Parameter storage device fault (control circuit board) 176 (HB0)	The inverter output is shut off if a fault occurs in the parameter stored. (EEPROM failure)

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Operation panel indication	Name	Data code	Description
<i>E.PUE</i>	E.PUE	PU disconnection	177 (HB1) <ul style="list-style-type: none"> The inverter output is shut off if communication between the inverter and PU is suspended, e.g. the cable is disconnected from the PU connector, when the disconnected PU detection function is valid in E101 (Pr.75) Reset selection/disconnected PU detection/PU stop selection. The inverter output is shut off if communication errors occurred consecutively for more than permissible number of retries when N025 (Pr.121 PU communication retry count ≠ "9999" during the RS-485 communication via the PU connector. The inverter output is shut off if communication is broken within the period of time set in N026 (Pr.122) PU communication check time interval during the RS-485 communication via the PU connector. (This protective function is available for the standard model.)
<i>E.rET</i>	E.RET	Retry count excess ^{*3}	178 (HB2) The inverter output is shut off if the operation cannot be resumed properly within the number of retries set in H301 (Pr.67) Number of retries at fault occurrence.
<i>E.PE2</i>	E.PE2	Parameter storage device fault (main circuit board)	179 (HB3) The inverter output is shut off if a fault occurs in the inverter model information.
<i>E.CPU</i>	E.CPU	CPU fault	192 (HC0) The inverter output is shut off if the communication fault of the built-in CPU occurs.
<i>E.Cdo</i>	E.CDO	Abnormal output current detection ^{*3}	196 (HC4) The inverter output is shut off if the output current exceeds the M460 (Pr.150) Output current detection level setting.
<i>E.IOH</i>	E.IOH	Inrush current limit circuit fault	197 (HC5) The inverter output is shut off when the resistor of the inrush current limit circuit is overheated. The inrush current limit circuit is faulty.
<i>E.A. E</i>	E.AIE	Analog input fault	199 (HC7) The inverter output is shut off when a 30 mA or higher current or a 7.5 V or higher voltage is input to terminal 2 while the current input is selected by T000 (Pr.73) Analog input selection, or to terminal 4 while the current input is selected by T001 (Pr.267) Terminal 4 input selection.

Data code 200 or more

Operation panel indication	Name	Data code	Description
<i>E.USB</i>	E.USB	USB communication fault	200 (HC8) The inverter output is shut off when the communication is cut off for the time set in N041 (Pr.548) USB communication check time interval.
<i>E.SAF</i>	E.SAF	Safety circuit fault	201 (HC9) [Standard model and Ethernet model] <ul style="list-style-type: none"> The inverter output is shut off when a safety circuit fault occurs. The inverter output is shut off if the either of the wire between S1 and PC or S2 and PC becomes non-conductive while using the safety stop function. When the safety stop function is not used, the inverter output is shut off when the shorting wire between terminals S1 and PC or across S2 and PC is disconnected. [Safety communication model] When a fault related to functional safety occurs, the inverter output is shut off by the protective function.
<i>E.OS</i>	E.OS	Overspeed occurrence ^{*3}	208 (HD0) The inverter output is shut off when the motor speed exceeds the H800 (Pr.374) Overspeed detection level under encoder feedback control, Real sensorless vector control, Vector control, and PM sensorless vector control.
<i>E.OSd</i>	E.OSD	Speed deviation excess detection	209 (HD1) When H416 (Pr.285) Speed deviation excess detection frequency is set during Vector control or PM sensorless vector control, if the motor speed is increased or decreased by factors such as influence of the load and cannot be controlled in accordance with the speed command value, the deceleration check function (H881 (Pr.690)) is activated to stop the inverter output.
<i>E.ECT</i>	E.ECT	Signal loss detection ^{*3*6}	210 (HD2) The inverter output is shut off when the encoder signal is shut off under orientation control, encoder feedback control, or Vector control.
<i>E.OD</i>	E.OD	Excessive position fault ^{*3*6}	211 (HD3) The inverter output is shut off when the difference between the position command and position feedback exceeds the setting of B008 (Pr.427) Excessive level error during position control.

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Operation panel indication	Name	Data code	Description
<i>E.nb 1</i>	E.MB1	213 (HD5)	The inverter output is stopped when a sequence error occurs during use of the brake sequence function (A100 to A107 (Pr.278 to Pr.285)).
<i>E.nb 2</i>	E.MB2	214 (HD6)	
<i>E.nb 3</i>	E.MB3	215 (HD7)	
<i>E.nb 4</i>	E.MB4	216 (HD8)	
<i>E.nb 5</i>	E.MB5	217 (HD9)	
<i>E.nb 6</i>	E.MB6	218 (HDA)	
<i>E.nb 7</i>	E.MB7	219 (HDB)	
<i>E.oA</i>	E.OA	221 (HDD)	The acceleration error (E.OA) occurs and the inverter output is shut off when the acceleration rate of the motor rotation speed has exceeded the faulty acceleration rate detection level (H801 (Pr.375)).
<i>E. AH</i>	E.IAH	225 (HE1)	The inverter output is shut off when the inverter internal temperature reaches the specified value or higher. (IP66/67 model only)
<i>E.P. d</i>	E.PID	230 (HE6)	The inverter output is shut off if the measured value exceeds the PID upper limit or PID lower limit parameter setting, or the absolute deviation value exceeds the PID deviation parameter setting during PID control.
<i>E.EHr</i>	E.EHR	231 (HE7)	<ul style="list-style-type: none"> • Appears when Ethernet communication is interrupted by physical factors while N643 (Pr.1431) Ethernet signal loss detection function selection = "3" or N648 (Pr.1457) Extended setting for Ethernet signal loss detection function selection = "3". • The inverter output is shut off if Ethernet communication is broken for the time set in N644 (Pr.1432) Ethernet communication check time interval or longer for all devices with IP addresses in the range specified for Ethernet command source selection (N670 to N675 (Pr.1449 to Pr.1454)). • When the CC-Link IE Field Network Basic is used, the inverter output is shut off in the following cases: the data addressed to the own station is not received for the predetermined timeout period or longer, or the status bit of the cyclic transmission addressed to the own station turns OFF (when the master inverter gives a command to stop the cyclic transmission). • When BACnet/IP is used, the inverter output will be shut off after the time period set in N644 (Pr.1432) after power is supplied to the inverter if an IP address of any other inverter falls within the Ethernet IP address range set for command source selection. (This protective function is available for the Ethernet model and the safety communication model.)
<i>E.Cnb</i>	E.CMB	232 (HE8)	Appears when the combination of the circuit board and the inverter is not appropriate or when the circuit board is not connected to the inverter.
<i>E. 1</i>	E.1	241 (HF1)	<ul style="list-style-type: none"> • The inverter output is shut off when a contact fault or the like of the connector occurs between the inverter and the plug-in option. • Appears when the switch for manufacturer setting of the plug-in option is changed.
<i>E. 5</i>	E.5	245 (HF5)	The inverter output is shut off if the communication fault of the built-in CPU occurs.
<i>E. 6</i>	E.6	246 (HF6)	
<i>E. 7</i>	E.7	247 (HF7)	
<i>E. 10</i>	E.10	250 (HFA)	The inverter output is shut off if the inverter detects an output current fault such as an earth (ground) fault that occurred on the inverter's output side (load side).
<i>E. 11</i>	E.11	251 (HFB)	The speed may not decelerate during low speed operation if the rotation direction of the speed command and the estimated speed differ when the rotation is changing from forward to reverse or from reverse to forward during torque control under Real sensorless vector control. The inverter output is shut off when overload occurs due to the un-switched rotation direction.
<i>E. 13</i>	E.13	253 (HFD)	Appears when the internal circuit is faulty.

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- Others

The fault history and the operation status of the inverter are displayed. It is not a fault.

Operation panel indication	Name	Description
	Fault history	The operation panel stores the fault indications which appear when a protective function is activated to display the fault record for the past 10 faults.
	No fault history	Appears when no fault records are stored. (Appears when the fault history is cleared after the protective function has been activated.)
	24 V external power supply operation	When the FR-E8DS is mounted, the indication blinks while the main circuit power supply is OFF and the 24 V power is supplied externally.
	Backup in progress	Backup operation is in progress to back up inverter parameters and the data used in the PLC function.
	Restoration in progress	Restore operation is in progress to restore the backup data stored in the computer in the inverter.

*1 Resetting the inverter initializes the internal cumulative heat value of the electronic thermal relay function.

*2 A protective function leading to the External thermal relay operation fault is enabled only when the OH signal is assigned to an input terminal by using T700 to T704, T709, or T711, T751 to T755 (Pr.178 to Pr.189) (Input terminal function selection).

*3 This protective function is not available in the initial status.

*4 For example, when Parameter clear, All parameter clear, Parameter copy, or offline auto tuning is performed in the inverter, or when parameter batch write is performed in FR Configurator2.

*5 Differs according to ratings. The rating can be changed using E301 (Pr.570) Multiple rating setting.

Three-phase input:

170% for LD rating, 230% for ND rating (initial setting) (FR-E820-0175(3.7K) or lower, FR-E840-0095(3.7K) or lower, FR-E860-0061(3.7K) or lower, FR-E846-0095(3.7K) or lower), and 235% for ND rating (initial value) (FR-E820-0240(5.5K) or higher, FR-E840-0120(5.5K) or higher, FR-E860-0090(5.5K) or higher)

Single-phase input:

280% for ND rating (FR-E820S-0015(0.2K) or lower) and 230% for ND rating (FR-E820S-0030(0.4K) or higher)

*6 Appears when a vector control compatible option is installed.

For details, refer to the FR-E800 Instruction Manual (Maintenance) or use the faults history function of FR Configurator2.

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5.5 Check first when you have a trouble

If the cause is still unknown after every check, it is recommended to initialize the parameters, set the required parameter values and check again.

5.5.1 Motor does not start.

Check point	Possible cause	Countermeasure
Main circuit	An appropriate power supply voltage is not applied. (The operation panel display is not operating.)	Power on a molded case circuit breaker (MCCB), an earth leakage circuit breaker (ELB), or a magnetic contactor (MC).
		Check for the decreased input voltage, input phase loss, and wiring.
		If only the control power is ON when using a separate power source for the control circuit, turn ON the main circuit power.
Main circuit	The motor is not connected properly.	Check the wiring between the inverter and the motor. If the electronic bypass function is active, check the wiring of the magnetic contactor (MC) between the inverter and the motor.
	The jumper across P/+ to P1 is disconnected. A DC reactor (FR-HEL) is not connected.	Securely fit a jumper across P/+ and P1. When using a DC reactor (FR-HEL), remove the jumper across P/+ to P1, and then connect the DC reactor.
Input signal	A start signal is not input.	Check the start command source, and input a start signal.
	Both the forward and reverse rotation start signals (STF and STR) are input simultaneously.	Turn ON either one of the signals. When the STF and STR signals are turned ON simultaneously in the initial setting, a stop command is given.
	Frequency command is zero. (The [RUN] LED indicator on the operation panel is blinking.)	Check the frequency command source and input a frequency command.
	The Terminal 4 input selection (AU) signal is not ON when terminal 4 is used for frequency setting. (The [RUN] indicator on the operation panel is blinking.)	Turn ON the AU signal. Turning ON the AU signal activates terminal 4 input.
	The Output stop (MRS) signal or the Inverter reset (RES) signal is ON. (The [RUN] LED indicator on the operation panel is blinking.)	Turn the MRS or RES signal OFF. The inverter starts the operation with a given start command and a frequency command after turning OFF the MRS or RES signal. Before turning OFF, ensure the safety.
	The switch setting for selecting sink logic or source logic is incorrect. (The [FWD] or [REV] LED indicator on the operation panel is blinking.)	Check that the control logic switch is set correctly. If it is not set correctly, the input signal is not recognized.
	The wiring of the encoder is incorrect. (Under encoder feedback control or vector control)	Check the wiring of the encoder.
	The voltage/current input switch is not correctly set for the analog input signal (0 to 5 V, 0 to 10 V, or 4 to 20 mA). (The [RUN] LED indicator on the operation panel is blinking.)	Set T000 (Pr.73) Analog input selection, T001 (Pr.267) Terminal 4 input selection, and the voltage/current input switch correctly, then input an analog signal in accordance with the setting.
	The STOP/RESET key was pressed. (The operation panel indication is "PS".)	During the External operation mode, check the method of restarting after the operation is stopped using the STOP/RESET key on the PU.
	During position control, the Pre-excitation (LX) signal is not input.	Assign the LX signal to an input terminal and turn ON the signal.
	During position control, the Position control sudden stop (X87) signal is input.	Turn OFF the X87 signal. Check the B190 (Pr.1292) Position control terminal input selection setting.
	During position control, the Forward stroke end (LSP) signal or the Reverse stroke end (LSN) signal is assigned to the input terminal, but the signal is not input.	Turn ON the LSP/LSN signal. Check the B190 (Pr.1292) Position control terminal input selection setting.
	Two-wire or three-wire type connection is incorrect.	Check the connection. Use the Start self-holding selection (STP (STOP)) signal when the three-wire type is used.

Check point	Possible cause	Countermeasure
Parameter setting	Under V/F control, G000 (Pr.0) Torque boost setting is not appropriate.	Increase the G000 (Pr.0) setting by 0.5% increments while observing the rotation of a motor. If that makes no difference, decrease the setting.
	D020 (Pr.78) Reverse rotation prevention selection is set.	Check the D020 (Pr.78) setting. Set D020 (Pr.78) when you want to limit the motor rotation to only one direction.
	The D000 (Pr.79) Operation mode selection setting is incorrect.	Select the operation mode suitable for the input methods of the start command and frequency command.
	The bias and gain (the calibration parameter C2 to C7) settings are not appropriate.	Check the bias and gain (the calibration parameter C2 to C7) settings.
	The F102 (Pr.13) Starting frequency setting is greater than the set frequency.	Set the frequency higher than the one set in F102 (Pr.13). The inverter does not start if the frequency setting signal has a value lower than that of F102 (Pr.13).
	Zero is set in frequency settings (such as for multi-speed operation). Especially, H400 (Pr.1) Maximum frequency is zero.	Set the frequency command according to the application. Set H400 (Pr.1) higher than the actual frequency used.
	D200 (Pr.15) Jog frequency is lower than F102 (Pr.13) Starting frequency for JOG operation.	The D200 (Pr.15) setting should be equal to or higher than the F102 (Pr.13) setting.
	The C141 (Pr.359) Encoder rotation direction setting is incorrect under encoder feedback control or under vector control.	When the [RUN] indicator on the operation panel is blinking slowly (1.4-second cycle) while the forward rotation command is given, set C141 (Pr.359) = "1".
	Operation mode and a writing device do not correspond.	Check D000 (Pr.79) Operation mode selection, D010 (Pr.338) Communication operation command source, D011 (Pr.339) Communication speed command source, D012 (Pr.550) NET mode operation command source selection, and D013 (Pr.551) PU mode operation command source selection, and select an operation mode suitable for the purpose.
	The start signal operation selection is set by G106 (Pr.250) Stop selection.	Check the G106 (Pr.250) setting and the connection of the STF and STR signals.
	The motor has decelerated to a stop when the power failure time deceleration-to-stop function is selected.	When power is restored, ensure the safety, and turn OFF the start signal once, then turn ON again to restart. When A730 (Pr.261) Power failure stop selection = "2", the motor automatically restarts after the power is restored.
	Auto tuning is being performed.	When offline auto tuning ends, press the STOP/RESET key on the operation panel during PU operation. For the External operation, turn OFF the start signal (STF or STR). This operation resets the offline auto tuning, and the PU's monitor display returns to the normal indication. (Without this operation, next operation cannot be started.)
	The automatic restart after instantaneous power failure function or power failure stop function has been activated. (Performing overload operation by the single-phase power input model or during input phase loss may cause voltage insufficiency, and that may result in detection of power failure.)	Set H201 (Pr.872) Input phase loss protection selection = "1" (input phase loss protection active). Disable the automatic restart after instantaneous power failure function and power failure stop function. Reduce the load. Increase the acceleration time if the function was activated during acceleration.
	The motor test operation is selected under Vector control or PM sensorless vector control.	Check the G200 (Pr.800) Control method selection setting.
Load	Load is too heavy.	Reduce the load.
	The shaft is locked.	Inspect the machine (motor).
Others	During position control, point table position control based on the absolute position does not operate.	Perform home position return.

5.5.2 Motor or machine is making abnormal acoustic noise

Check point	Possible cause	Countermeasure
Input signal	Disturbance due to EMI when the frequency or torque command is given through analog input terminal 2 or 4.	Take countermeasures against EMI.
Parameter setting		Increase the T002 (Pr.74) Input filter time constant setting if steady operation cannot be performed due to EMI or the like.
Parameter setting	No carrier frequency noises (metallic noises) are generated.	In the initial setting, E601 (Pr.240) Soft-PWM operation selection is enabled to change motor noise to an unoffending complex tone. Therefore, no carrier frequency noises (metallic noises) are generated. Set E601 (Pr.240) = "0" to disable this function.
	The motor noise increases due to activation of the carrier frequency automatic reduction function when the motor is driven overloaded.	Reduce the load. Disable the automatic reduction function by setting E602 (Pr.260) PWM frequency automatic switchover = "0". (As the load remains excessive, overload may cause a protective function E.THT.)
	Resonance occurs. (Output frequency)	Set H420 (Pr.31) to H425 (Pr.36), and H429 (Pr.552) (frequency jump). When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped.
	Resonance occurs. (Carrier frequency)	Change the E600 (Pr.72) PWM frequency selection setting. Changing the PWM carrier frequency produces an effect on avoiding the resonance frequency of a mechanical system or a motor.
	Auto tuning is not performed under Advanced magnetic flux vector control, Real sensorless vector control, or Vector control.	Perform offline auto tuning.
	Gain adjustment during PID control is insufficient.	To stabilize the measured value, change the proportional band (A613 (Pr.129)) to a larger value, the integral time (A614 (Pr.130)) to a slightly longer time, and the differential time (A615 (Pr.134)) to a slightly shorter time. Check the calibration of set point and measured value.
	The gain is too high under Real sensorless vector control, Vector control, or PM sensorless vector control.	During speed control, check the setting of G211 (Pr.820) Speed control P gain. During torque control, check the setting of G213 (Pr.824) Torque control P gain.
Others	During position control, the position control gain is too high.	Check the B003 (Pr.422) Position control gain setting.
	Mechanical looseness	Adjust machine/equipment so that there is no mechanical looseness.
	Contact the motor manufacturer.	
Motor	Operating with output phase loss	Check the motor wiring.

5.5.3 Inverter generates abnormal noise

Check point	Possible cause	Countermeasure
Fan	The fan cover was not correctly installed when a cooling fan was replaced.	Install the fan cover correctly.

5.5.4 Motor generates heat abnormally

Check point	Possible cause	Countermeasure
Motor	The motor fan is not working. (Dust is accumulated.)	Clean the motor fan. Improve the environment.
	Phase to phase insulation of the motor is insufficient.	Check the insulation of the motor.
Main circuit	The inverter output voltage (U, V, W) are unbalanced.	Check the output voltage of the inverter. Check the insulation of the motor.
Parameter setting	The C100 (Pr.71) Applied motor setting is incorrect.	Check the C100 (Pr.71) Applied motor setting.
—	Motor current is too large	Refer to "Motor current is too large" (page 5-24).

5.5.5 Motor rotates in the opposite direction

Check point	Possible cause	Countermeasure
Main circuit	The phase sequence of output terminals U, V and W is incorrect.	Connect the output side terminals (terminals U, V, and W) correctly.
Input signal	The start signals (STF and STR signals) are connected improperly.	Check the connection. (STF: forward rotation, STR: reverse rotation)
	The polarity of the frequency command is negative during the polarity reversible operation set by T000 (Pr.73) Analog input selection.	Check the polarity of the frequency command.
Input signal, parameter setting	The torque command is negative during torque control under Vector control.	Check the torque command value.
	During position control, the sign of the position command is incorrect.	Check the sign settings in B123 (Pr.1225) to B147 (Pr.1249) for positioning sub-functions.

5.5.6 Speed greatly differs from the setting

Check point	Possible cause	Countermeasure
Input signal	The frequency setting signal is incorrect.	Measure the input signal level.
	The input signal lines are affected by external EMI.	Take countermeasures against EMI, such as using shielded wires for input signal lines.
Parameter setting	H400 (Pr.1) Maximum frequency, H401 (Pr.2) Minimum frequency, H402 (Pr.18) High speed maximum frequency, and the calibration parameter T200 (C2 (Pr.902)) to T403 (C7 (Pr.905)) settings are not appropriate.	Check the settings of H400 (Pr.1), H401 (Pr.2), and H402 (Pr.18). Check the calibration parameter T200 (C2 (Pr.902)) to T403 (C7 (Pr.905)) settings.
	H420 (Pr.31) to H425 (Pr.36) (frequency jump) settings are not appropriate.	Narrow down the range of frequency jump.
	During position control, the maximum speed setting in any of D301 (Pr.4) to D303 (Pr.6) and D304 (Pr.24) to D307 (Pr.27) is incorrect.	Check the maximum speed settings of D301 (Pr.4) to D303 (Pr.6) and D304 (Pr.24) to D307 (Pr.27).
Load		Reduce the load.
Parameter setting	The stall prevention (torque limit) function is activated due to a heavy load.	Set H500 (Pr.22) Stall prevention operation level (Torque limit level) higher according to the load. (If H500 (Pr.22) is set too high, an overcurrent trip (E.OC[]) is likely to occur.)
Motor		Check the capacities of the inverter and the motor.

5.5.7 Acceleration/deceleration is not smooth

Check point	Possible cause	Countermeasure
Parameter setting	The acceleration/deceleration time is too short.	Increase the acceleration/deceleration time.
	The torque boost (G000 (Pr.0), G010 (Pr.46)) setting is not appropriate under V/F control, so the stall prevention function is activated.	Increase/decrease the G000 (Pr.0) Torque boost setting value by 0.5% increments so that stall prevention does not occur.
	The base frequency does not match the motor characteristics.	Under V/F control, set G001 (Pr.3) Base frequency and G011 (Pr.47) Second V/F (base frequency).
		Under Vector control, set C105 (Pr.84) Rated motor frequency.
	Regeneration avoidance operation is performed.	If the frequency becomes unstable during regeneration avoidance operation, decrease the setting of G124 (Pr.886) Regeneration avoidance voltage gain.
Load		Reduce the load.
Parameter setting	The stall prevention (torque limit) function is activated due to a heavy load.	Set H500 (Pr.22) Stall prevention operation level (Torque limit level) higher according to the load. (If H500 (Pr.22) is set too high, an overcurrent trip (E.OC[]) is likely to occur.)
Motor		Check the capacities of the inverter and the motor.

5.5.8 Speed varies during operation

Check point	Possible cause	Countermeasure
Load	The load varies during an operation.	Select Advanced magnetic flux vector control, Real sensorless vector control, Vector control, or encoder feedback control.
Input signal	The frequency setting signal is varying.	Check the frequency setting signal.
	The frequency setting signal is affected by EMI.	Set filter to the analog input terminal using T002 (Pr.74) Input filter time constant, T003 (Pr.822) Speed setting filter 1. Take countermeasures against EMI, such as using shielded wires for input signal lines.
	A malfunction is occurring due to the undesirable current generated when the transistor output unit is connected.	Use terminal PC (terminal SD when source logic) as a common terminal to prevent a malfunction caused by undesirable current.
	An input signal is chattering.	Take countermeasures to suppress chattering. Use relay contacts with high contact reliability. When the chattering is caused by noises, take measures against noises. Design a ladder program to prevent chattering.
	The feedback signal from the encoder is affected by EMI.	Run the encoder cable away from any EMI source such as the main circuit and power supply voltage. Earth (ground) the shield of the encoder cable to the enclosure using a metal P-clip or U-clip.
Parameter setting	Fluctuation of power supply voltage is too large.	Under V/F control, change the G002 (Pr.19) Base frequency voltage setting (approximately by 3%).
	The C101 (Pr.80) Motor capacity and C102 (Pr.81) Number of motor poles settings are not appropriate for the motor capacity under Advanced magnetic flux vector control, Real sensorless vector control, Vector control, or PM sensorless vector control.	Check the settings of C101 (Pr.80) and C102 (Pr.81).
	The wiring length exceeds 30 m when Advanced magnetic flux vector control, Real sensorless vector control, Vector control, or PM sensorless vector control is selected.	Perform offline auto tuning.
	Under V/F control, wiring is too long and a voltage drop occurs.	In the low-speed range, adjust the G000 (Pr.0) Torque boost setting by 0.5% increments. Change the control method to Advanced magnetic flux vector control or Real sensorless vector control.
	Hunting occurs by the generated vibration, for example, when structural rigidity of the load is insufficient.	Disable automatic control functions, such as the energy saving operation, fast-response current limit operation, torque limit, regeneration avoidance function, Advanced magnetic flux vector control, Real sensorless vector control, Vector control, encoder feedback control, droop control, stall prevention, online auto tuning, and orientation control. For PID control, set smaller values to A613 (Pr.129) PID proportional band and A614 (Pr.130) PID integral time. Lower the control gain to increase the stability.
		Change the E600 (Pr.72) PWM frequency selection setting.

5.5.9 Operation mode is not changed properly

Check point	Possible cause	Countermeasure
Input signal	The start signal (STF or STR) is ON.	Check that the STF and STR signals are OFF. When either is ON, the operation mode cannot be changed.
Parameter setting	The D000 (Pr.79) Operation mode selection setting is not appropriate.	When the D000 (Pr.79) is set to "0 (initial value)", the operation mode is the External operation mode at power ON. To switch to the PU operation mode, press the PU/EXT key on the operation panel. At other settings (1 to 4, 6, 7), the operation mode is limited accordingly.
	Operation mode and a writing device do not correspond.	Check D000 (Pr.79) Operation mode selection, D010 (Pr.338) Communication operation command source, D011 (Pr.339) Communication speed command source, D012 (Pr.550) NET mode operation command source selection, and D013 (Pr.551) PU mode operation command source selection, and select an operation mode suitable for the purpose.

5.5.10 Operation panel display is not operating

Check point	Possible cause	Countermeasure
Main circuit Control circuit	The power is not input.	Input the power.
Front cover	The operation panel is not properly connected to the inverter.	Check if the inverter front cover is installed securely.

5.5.11 Motor current is too large

Check point	Possible cause	Countermeasure
Parameter setting	The torque boost (G000 (Pr.0), G010 (Pr.46)) setting is not appropriate under V/F control, so the stall prevention function is activated.	Increase/decrease the G000 (Pr.0) Torque boost setting value by 0.5% increments so that stall prevention does not occur.
	The V/F pattern is not appropriate when V/F control is performed. (G001 (Pr.3), G003 (Pr.14), G002 (Pr.19))	Set the rated frequency of the motor to G001 (Pr.3) Base frequency. Use G002 (Pr.19) Base frequency voltage to set the base voltage (for example, rated motor voltage).
		Change the G003 (Pr.14) Load pattern selection setting according to the load characteristic.
	The stall prevention (torque limit) function is activated due to a heavy load.	Reduce the load.
		Set H500 (Pr.22) Stall prevention operation level (Torque limit level) higher according to the load. (If H500 (Pr.22) is set too high, an overcurrent trip (E.OC[]) is likely to occur.)
	Offline auto tuning is not performed under Advanced magnetic flux vector control, Real sensorless vector control, or Vector control.	Check the capacities of the inverter and the motor.
	When PM sensorless vector control is selected for an IPM motor other than the MM-GKR or E-MA, offline auto tuning is not performed.	Perform offline auto tuning.
		Performing the offline auto tuning for a PM motor

5.5.12 Speed does not accelerate

Check point	Possible cause	Countermeasure
Input signal	The start command or frequency command is chattering.	Check if the start command and the frequency command are correct.
	The wiring length is too long for the analog frequency command, causing a voltage (current) drop.	Perform the bias and gain calibration for the analog input.
	The input signal lines are affected by external EMI.	Take countermeasures against EMI, such as using shielded wires for input signal lines.
Parameter setting	H400 (Pr.1) Maximum frequency, H401 (Pr.2) Minimum frequency, H402 (Pr.18) High speed maximum frequency, and the calibration parameter T200 (C2 (Pr.902)) to T403 (C7 (Pr.905)) settings are not appropriate.	Check the settings of H400 (Pr.1) and H401 (Pr.2). To operate at 120 Hz or higher, set H402 (Pr.18) High speed maximum frequency.
		Check the calibration parameter T200 (C2 (Pr.902)) to T403 (C7 (Pr.905)) settings.
	The maximum voltage (current) input value is not set during the External operation. (T022 (Pr.125), T042 (Pr.126), H402 (Pr.18))	Check the settings of T022 (Pr.125) Terminal 2 frequency setting gain frequency and T042 (Pr.126) Terminal 4 frequency setting gain frequency. To operate at 120 Hz or higher, set H402 (Pr.18).
	The torque boost (G000 (Pr.0), G010 (Pr.46)) setting is not appropriate under V/F control, so the stall prevention function is activated.	Increase/decrease the G000 (Pr.0) Torque boost setting value by 0.5% increments so that stall prevention does not occur.
	The V/F pattern is not appropriate when V/F control is performed. (Pr.3, Pr.14, Pr.19)	Set the rated frequency of the motor to G001 (Pr.3) Base frequency. Use G002 (Pr.19) Base frequency voltage to set the base voltage (for example, rated motor voltage).
		Change the G003 (Pr.14) Load pattern selection setting according to the load characteristic.

Check point	Possible cause	Countermeasure
Parameter setting	The stall prevention (torque limit) function is activated due to a heavy load.	Reduce the load.
		Set H500 (Pr.22) Stall prevention operation level (Torque limit level) higher according to the load. (If H500 (Pr.22) is set too high, an overcurrent trip (E.OC[]) is likely to occur.)
	Auto tuning is not performed under Advanced magnetic flux vector control, Real sensorless vector control, or Vector control.	Check the capacities of the inverter and the motor.
Main circuit	During PID control, the output frequency is automatically controlled so that the measured value equals the set point.	Perform offline auto tuning.
Main circuit	A brake resistor is connected across terminals P/+ and P1 or across P1 and PR by mistake.	Connect an optional brake resistor across terminals P/+ and PR.

5.5.13 Unable to write parameter setting

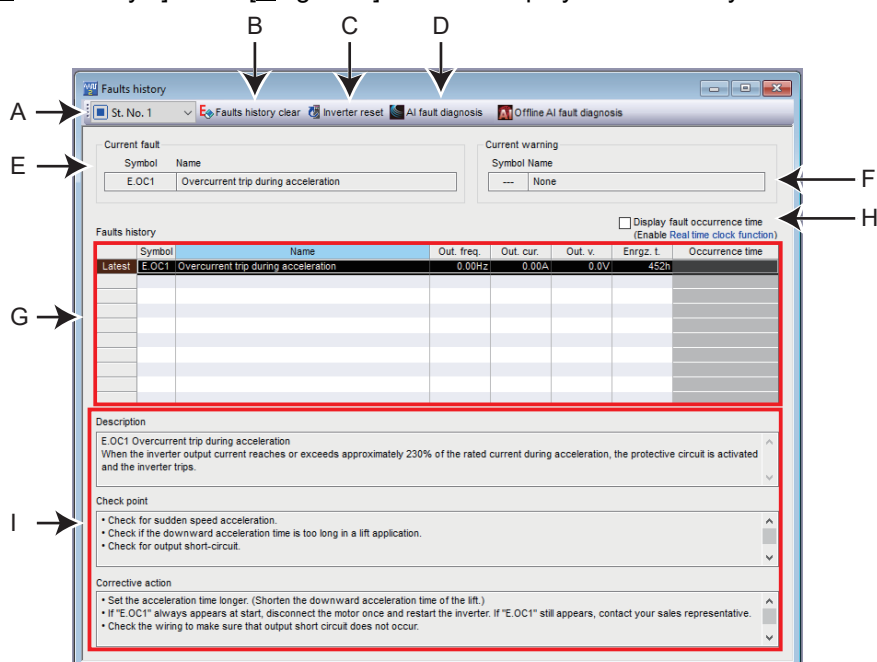
Check point	Possible cause	Countermeasure
Input signal	Operation is being performed (the STF or STR signal is ON).	Stop the operation. When E400 (Pr.77) Parameter write selection = "0 (initial value)", writing is enabled only during a stop.
Parameter setting	Parameter setting was attempted in External operation mode.	Choose the PU operation mode. Or, set E400 (Pr.77) Parameter write selection = "2" to enable parameter writing regardless of the operation mode.
	Parameter write is disabled by the E400 (Pr.77) Parameter write selection setting.	Check the E400 (Pr.77) setting.
	The key lock mode is enabled by the E200 (Pr.161) Frequency setting/key lock operation selection setting.	Check the E200 (Pr.161) setting.
	Operation mode and a writing device do not correspond.	Check D000 (Pr.79), D010 (Pr.338), D011 (Pr.339), D012 (Pr.550), and D013 (Pr.551), and select an operation mode suitable for the purpose.

5.5.14 Unable to establish Ethernet communication

Check point	Possible cause	Countermeasure
Wiring	The Ethernet cable has a break.	Check that the Ethernet cable is connected to the Ethernet connector properly and the Ethernet cable is not damaged.
	Excessive electrical noise is present around the inverter.	When excessive noise occurs around the inverter, change the communication setting of the master. (The noise may be reduced by setting a shorter timeout period or increasing the number of retries in the communication setting of the master.)
	The FR-A8NC is installed when CC-Link IE TSN or CC-Link IE Field Network Basic is used for communication.	Remove the FR-A8NC.
Parameter setting	Communication protocols that cannot be used together are selected.	Check the settings of N630 (Pr.1427) to N633 (Pr.1430). (Refer to the FR-E800 Instruction Manual (Communication).)
	The N644 (Pr.1432) setting is too small when CC-Link IE Field Network Basic, MODBUS/TCP, BACnet/IP, or EtherNet/IP is selected.	Set a larger value in N644 (Pr.1432).
	When the CC-Link IE Field Network Basic is used, the timeout period set in the master is shorter than the period during which the inverter does not receive the data addressed to the own station.	When the CC-Link IE Field Network Basic is used, set a timeout period longer than the period during which the inverter does not receive the data addressed to the own station.
	When the CC-Link IE Field Network Basic is used, the status bit of the cyclic transmission addressed to the own station is OFF.	When the CC-Link IE Field Network Basic is used, turn ON the status bit of the cyclic transmission addressed to the own station.
	When CC-Link IE Field Network Basic, MODBUS/TCP, BACnet/IP, or EtherNet/IP is used, IP addresses of other inverters are included in the Ethernet IP address range set for command source selection.	When CC-Link IE Field Network Basic, MODBUS/TCP, BACnet/IP, or EtherNet/IP is used, do not include IP addresses of other inverters in the Ethernet IP address range set for command source selection.

5.6 Faults history function

Select [Faults history...] in the [Diagnosis] menu to display "faults history" in the sub-window.



Symbol	Name	Function/description
A	St. No. (Station number)	Select a station for which fault history is to be displayed.
B	Faults history clear	Clears the selected station's faults history.
C	Inverter reset	Resets the selected station's inverter.
D	AI fault diagnosis	Used to find probable causes of faults using AI technology. (For details, refer to page 5-27.)
E	Current fault	Shows the current fault. If E.SAF occurs in the FR-E800-SCE or FR-E806-SCE, the fault detail code is displayed. When the fault detail code cannot be obtained, "----" will be displayed. When the fault detail code is not defined, "Unknown code" will be displayed.
F	Current warning	Shows the current warning.
G	Faults history	Shows a list of the faults history read from the inverter. The output frequency, output current, output voltage, and energization time at the time of fault occurrence are displayed by each fault record. The time of fault occurrence is also displayed when the "Display fault occurrence time" checkbox is checked.
H	Display fault occurrence time	Determines whether to display the time of fault occurrence. (Available for the product having the real time clock function.)
I	Fault details	Shows explanations of selected fault details, check points, and corrective actions.

- When "Ethernet" is selected for "PC-side port", "TCP" for "Protocol", and "GOT" for "Through", clicking the [Inverter reset] button for any inverter switches all the connected inverters to offline. Switch the connection status to online to establish the communication with the inverter again.

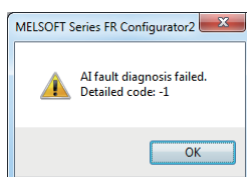
5.7 AI fault diagnosis

The AI fault diagnosis function is available for the following models under the following conditions.

Applicable model	FR-E800(-E/-SCE), FR-E806-SCE	
Condition	Control method	Any method
	Control mode	Speed control only
Applicable fault	Overcurrent trip: E.OC1 to E.OC3, overvoltage trip: E.OV1 to E.OV3, inverter overload trip (electronic thermal relay function): E.THT, motor overload trip (electronic thermal relay function): E.THM, loss of synchronism detection: E.SOT, overspeed occurrence: E.OS, stall prevention stop: E.OLT	

The AI fault diagnosis function is used to suggest probable causes of faults using AI technology. Select [AI fault diagnosis] in the [Faults history (Z)] menu while the fault history window is displayed front, or select [AI fault diagnosis] on the toolbar to display the AI fault diagnosis window as a sub window.

- When the following dialog box appears with the message "AI fault diagnosis failed. Detailed code: -1", update the operating system using Windows Update. After the update, install FR Configurator2 again.

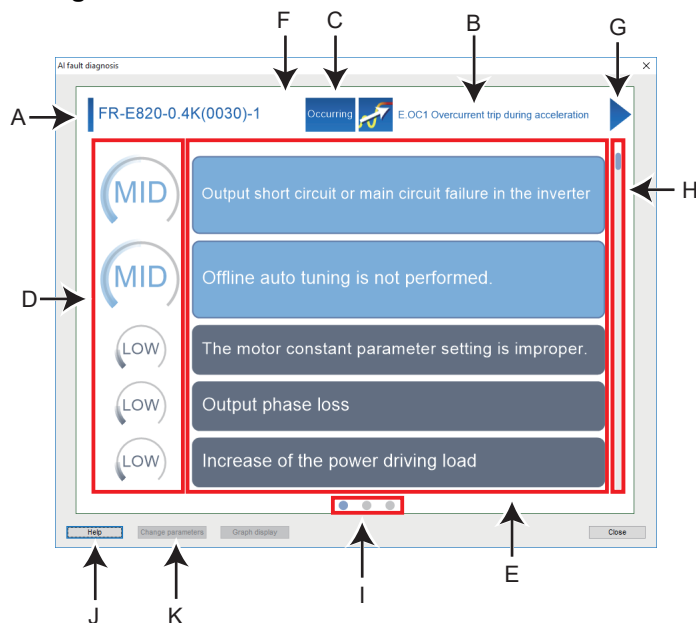


- The AI fault diagnosis function can be used for up to three faults while a fault occurs, and up to two faults while no fault occurs.
- The AI fault diagnosis function is not available for faults initiated by setting H103 (Pr.997).
- To enable the AI fault diagnosis function, AI diagnosis data are stored in the computer that contains the files for diagnosis.
- The trace function is not available during AI fault diagnosis.
- The AI fault diagnosis function is not available for faults that occurred during emergency drive operation.

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5.7.1 AI fault diagnosis

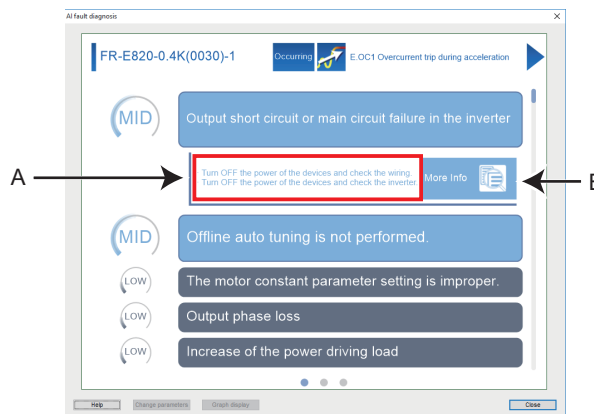
(1) AI fault diagnosis result screen



Symbol	Name	Function/description
A	Model	Shows the model of the inverter of the selected station number.
B	Fault name	Shows the name of fault.
C	Fault No.	Shows the fault record number.
D	Probability	Shows the probability (high, mid, and low) of each cause.
E	Cause	Shows probable causes of the fault. When a cause is selected, details of corrective action to be taken and the [Details] button appear. (Refer to page 5-29.)
F	Next fault (left arrow key)	Shows probable causes of the subsequent fault. Not applicable when no subsequent fault exists.
G	Previous fault (right arrow key)	Shows probable causes of the previous fault. Not applicable when no previous fault exists.
H	Scroll bar (up/down key)	Used for scrolling up/down when there are many probable fault causes.
I	Page indicator	Shows the current page and the total number of pages.
J	Help	Displays the help window.
K	Change parameters	Shows parameters changed after the startup. (Refer to page 5-30.)

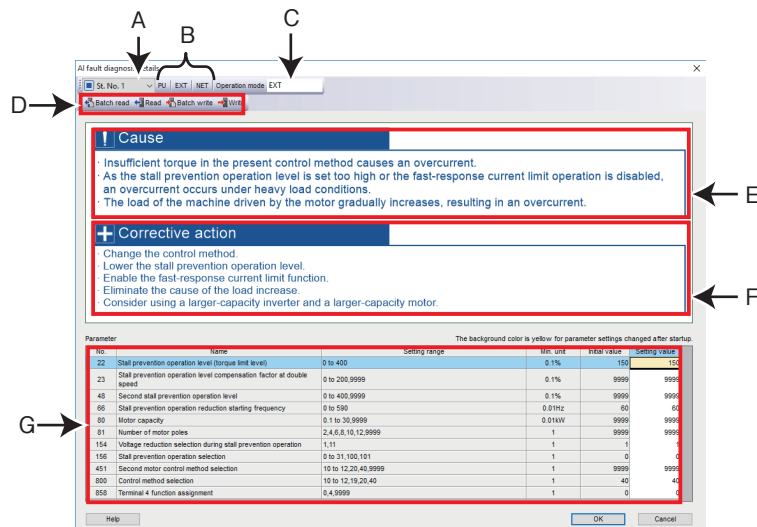
5 BREAKDOWN MAINTENANCE

(2) AI fault diagnosis result screen (cause selection)



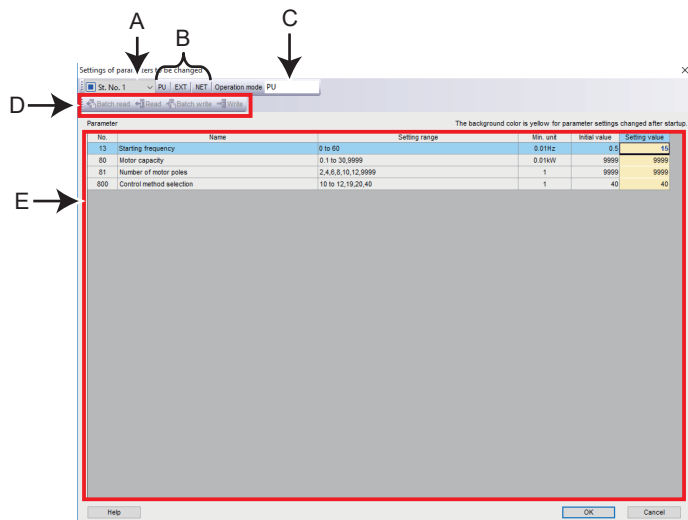
Symbol	Name	Function/description
A	Corrective action	Corrective actions are suggested.
B	More Info (space key)	Shows a window for details of the parameters related to the cause. (Refer to page 5-29.)

(3) AI fault diagnosis result screen (details of the AI fault diagnosis)



Symbol	Name	Function/description
A	St. No. (Station number)	Select a station registered in the project.
B	Operation mode button	Switch between the operation modes of the inverter.
C	Operation mode indication	Displays the operation mode.
D	Batch read	Reads all the parameter setting values of the selected inverter.
	Read	Reads the selected parameter setting values of the selected inverter.
	Batch write	Writes all the selected parameter setting values in the setting value column to the selected inverter.
	Write	Writes all selected parameter setting values to the selected inverter.
E	Cause	Shows probable causes of the fault.
F	Corrective action	Corrective actions are suggested.
G	No.	Shows the parameter number.
	Name	Shows the parameter name.
	Setting range	Shows the setting range of the parameter setting value.
	Min. unit	Shows the minimum setting unit of the parameter setting value.
	Initial value	Shows the factory default parameter setting values of the inverter.
	Setting value	Inputs the value to be written to the inverter. The yellow background color shows that the value has been changed after the startup.

(4) AI fault diagnosis result screen (settings of parameters to be changed)

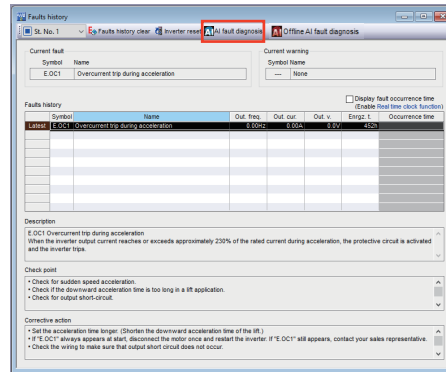


Symbol	Name	Function/description
A	St. No. (Station number)	Select a station registered in the project.
B	Operation mode button	Switch between the operation modes of the inverter.
C	Operation mode indication	Displays the operation mode.
D	Batch read	Reads all the parameter setting values of the selected inverter.
	Read	Reads the selected parameter setting values of the selected inverter.
	Batch write	Writes all the selected parameter setting values in the setting value column to the selected inverter.
	Write	Writes all selected parameter setting values to the selected inverter.
E	No.	Shows the parameter number.
	Name	Shows the parameter name.
	Setting range	Shows the setting range of the parameter setting value.
	Min. unit	Shows the minimum setting unit of the parameter setting value.
	Initial value	Shows the factory default parameter setting values of the inverter.
	Setting value	Inputs the value to be written to the inverter. The yellow background color shows that the value has been changed after the startup.

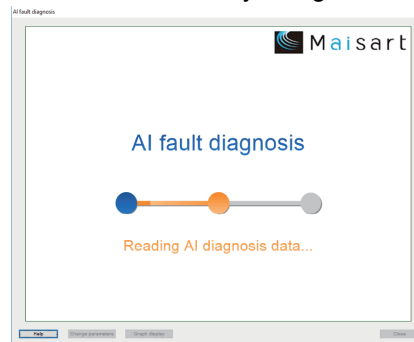
5 BREAKDOWN MAINTENANCE

5.7.2 Procedure for finding probable causes by AI fault diagnosis

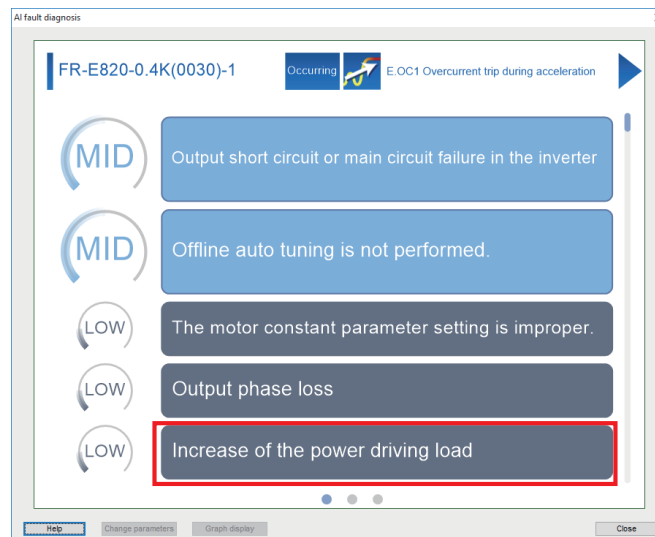
- 1) Select [Faults history...] in the [Diagnosis].
- 2) The fault history window is displayed.
- 3) Display the fault history window front and select [AI fault diagnosis] in the [Faults history (Z)] menu. Alternatively, select [AI fault diagnosis] on the taskbar in the fault history window.



- 4) The AI fault diagnosis function is activated to find probable causes and display corrective actions for the fault in the fault history using AI technology.



- 5) Select one of the probable causes suggested in the result screen to check corrective actions to be taken.



5 BREAKDOWN MAINTENANCE

6) When the probable cause is related to parameter settings, click [More Info].

Increase of the power driving load

- Change the control method.
- Lower the stall prevention operation level.
- Enable the fast-response current limit function.
- Eliminate the cause of the load increase.
- Consider using a larger-capacity inverter and a larger-capacity motor.

More Info



7) Click [Batch read] to display current parameter settings of the inverter.

AI fault diagnosis details

St No. 1 PU EXT NET Operation mode: EXT

Batch read Batch write

! Cause

- Insufficient torque in the present control method causes an overcurrent.
- As the stall prevention operation level is set too high or the fast-response current limit operation is disabled, an overcurrent occurs under heavy load conditions.
- The load of the machine driven by the motor gradually increases, resulting in an overcurrent.

+ Corrective action

- Change the control method.
- Lower the stall prevention operation level.
- Enable the fast-response current limit function.
- Eliminate the cause of the load increase.
- Consider using a larger-capacity inverter and a larger-capacity motor.

Parameter

No.	Name	Setting range	Min. unit	Initial value	Setting value
22	Stall prevention operation level (torque limit level)	0 to 400	0.1%	150	150
23	Stall prevention operation level compensation factor at double speed	0 to 200.9999	0.1%	9999	9999
48	Second stall prevention operation level	0 to 400.9999	0.1%	9999	9999
66	Stall prevention operation reduction starting frequency	0 to 590	0.01Hz	60	60
80	Motor capacity	0.1 to 30.9999	0.01kW	9999	9999
81	Number of motor poles	2,4,6,8,10,12,9999	1	9999	9999
154	Voltage reduction selection during stall prevention operation	1,11	1	0	1
156	Stall prevention operation selection	0 to 31,100,101	1	0	0
451	Second motor control method selection	10 to 12,20,40,9999	1	9999	9999
800	Control method selection	10 to 12,19,20,40	1	40	40
858	Terminal 4 function assignment	0,4,9999	1	0	0

Help OK Cancel

8) Check the corrective actions and change parameter settings as required. After the change, click [Batch write] to write the setting values to the inverters.

AI fault diagnosis details

St No. 1 PU EXT NET Operation mode: EXT

Batch read Batch write

! Cause

- Insufficient torque in the present control method causes an overcurrent.
- As the stall prevention operation level is set too high or the fast-response current limit operation is disabled, an overcurrent occurs under heavy load conditions.
- The load of the machine driven by the motor gradually increases, resulting in an overcurrent.

+ Corrective action

- Change the control method.
- Lower the stall prevention operation level.
- Enable the fast-response current limit function.
- Eliminate the cause of the load increase.
- Consider using a larger-capacity inverter and a larger-capacity motor.

Parameter

No.	Name	Setting range	Min. unit	Initial value	Setting value
22	Stall prevention operation level (torque limit level)	0 to 400	0.1%	150	150
23	Stall prevention operation level compensation factor at double speed	0 to 200.9999	0.1%	9999	9999
48	Second stall prevention operation level	0 to 400.9999	0.1%	9999	9999
66	Stall prevention operation reduction starting frequency	0 to 590	0.01Hz	60	60
80	Motor capacity	0.1 to 30.9999	0.01kW	9999	9999
81	Number of motor poles	2,4,6,8,10,12,9999	1	9999	9999
154	Voltage reduction selection during stall prevention operation	1,11	1	0	1
156	Stall prevention operation selection	0 to 31,100,101	1	0	0
451	Second motor control method selection	10 to 12,20,40,9999	1	9999	9999
800	Control method selection	10 to 12,19,20,40	1	40	40
858	Terminal 4 function assignment	0,4,9999	1	0	0

Help OK Cancel

CHAPTER 6 CORRECTIVE MAINTENANCE

Reduce the deterioration of equipment and facilitate maintenance work to increase maintainability of the production system.

6.1 Improving the maintainability of equipment

(1) Improvement to reduce deterioration of equipment

- 1) Review the surrounding environment and install an air conditioning system or a ventilation system as necessary to prevent abnormal deterioration of equipment.
- 2) Take countermeasures against dust, moisture, and vibration to prevent abnormal deterioration of equipment.
- 3) Replace the device that may deteriorate rapidly with the durable one.

(2) Improvement to facilitate repair

- 1) Improve the configuration of equipment.
- 2) Provide space for repair.
- 3) Use products that can be easily repaired.

(3) Using products unlikely to fail

- 1) Use products with low failure rate and high reliability.

Memo

CHAPTER 7 REVIEW OF INSTALLATION ENVIRONMENT

7.1 Power supply of inverter (harmonics and instantaneous power failure)

This section explains the influence of harmonics generated from the inverter on the power supply and its system to which an inverter is connected. Determine the level of influence on the peripheral devices according to the amount of harmonics generated from the inverter to consider concrete countermeasures against harmonics.

This section also explains the influence of voltage fluctuations such as an instantaneous power failure and voltage drop on the inverter is explained. It is important to understand the operation of the inverter and motor well.

POINT

1. Differences between harmonics and noise
2. Inflow path and the size of harmonic current
3. Harmonic suppression guidelines and handling methods
4. Operation of the inverter and motor at an instantaneous power failure (including an instantaneous voltage drop)

7.1.1 Harmonics

A harmonic has a frequency that is an integral multiple of the fundamental wave (generally the power supply frequency). The composition of a single fundamental wave and multiple harmonics is called a distorted wave. (Refer to Fig. 7.2.)

A distorted wave typically includes harmonics in a high-frequency range (kHz to MHz order).

However, in a power distribution system, harmonics are usually up to 40th to 50th degrees (to 3 kHz).

Harmonics have different problems from those of high-frequency that usually assume an irregular form. For example, noise and electromagnetic interference from the computer (refer to Section 7.2) are local problems which are closely related to hard devices, and the influences and measures are different from those of harmonics in electrical power network. This must be defined first.

$$i = i_o + \sum_{n=1}^{\infty} i_n \cdot \sin(2\pi fnt + \psi_n) \dots\dots\dots (7.1)$$

$n = 1, 2, 3, \dots$
 $f = \text{Fundamental frequency}$

7 REVIEW OF INSTALLATION ENVIRONMENT

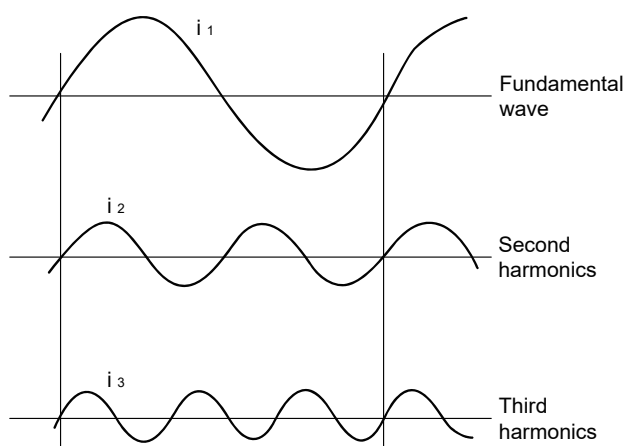


Fig. 7.1 Fundamental wave and harmonics

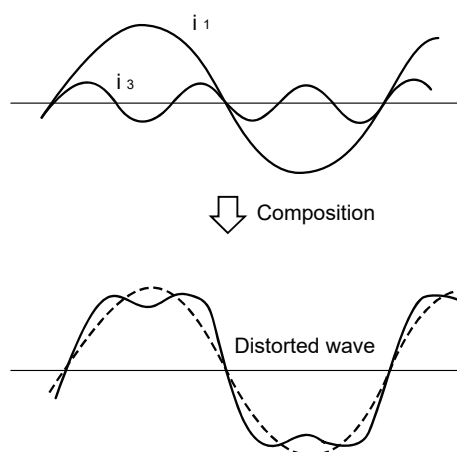


Fig. 7.2 Distorted wave

Table 7.1 Differences between harmonics and noise

Item	Harmonics	Noise
Frequency	Normally 40th to 50th degrees or less (3 kHz or less)	High frequency (several 10 kHz to MHz order)
Source	Converter section	Inverter section
Cause	Rectifier circuit commutation	Transistor switching
Environment	To-electric channel, power impedance	To-space, distance, wiring path
Quantitative understanding	Theoretical calculation possible.	Due to random occurrence, quantitative grasping is difficult.
Generated amount	Nearly proportional to the load capacity	Changes with the current variation ratio. (Gets larger as switching speed increases.)
Affected equipment immunity	Specified by standards per equipment.	Different depending on maker's equipment specifications.
Countermeasure	Provide a reactor (L).	Increase distance (ℓ).

7.1.2 Characteristics of rectifier circuit and generated harmonics

Harmonics are generated by a rectifier, an AC power adjuster, etc. The converter circuit of a general-purpose inverter consists of a rectifier circuit, and generates a large amount of harmonic current. There are various types of rectifier circuits depending on the main circuit method. The three-phase bridge method is most widely adopted in the general-purpose inverter.

The ordinal number "n" of the generated harmonic current is theoretically equal to $PK \pm 1$ (P = number of pulses, $K = 1, 2, 3, \dots$). The general-purpose inverter using the three-phase bridge method ($P = 6$, as 6-pulse converter is used) generates $6K \pm 1$ st (5, 7, 11, 13th.....) harmonic current. The magnitude of the harmonic current (harmonic content) is $1/n$, and as the ordinal number of harmonic current increases, the generated amount decreases. The inverter using the single-phase power supply input generates $4K \pm 1$ st (3, 5, 7, 9th.....) harmonic current.

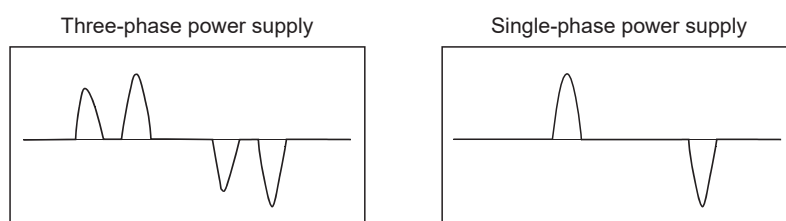


Fig. 7.3 Inverter input current waveform (harmonic current)

7.1.3 Split-flow path of harmonic current

When harmonic current is a problem in the power distribution system, the power supply of the harmonic current is not a general commercial power supply but the source of harmonics (the converter section for the general-purpose inverter). The commercial power supply (low and high voltage power transformer) becomes a load on harmonics. Therefore, as shown in the example of Fig. 7.4, the harmonic current " I_n " generated from the inverter ($I_n = I_2 + I_3 + I_4 + \dots$ (n stands for the ordinal number)) splits and flows in proportion to the power transformer impedance ($\dot{Z}_L = R_L + j_nX_L$) and the devices connected in parallel with it (in the example of Fig. 7.4, the motor B and the capacitor), in other words the reciprocal ratio $1/Z$ between the motor B impedance ($\dot{Z}_M = R_M + j_nX_M$) and the capacitor impedance ($\dot{Z}_C = j_nX_r - jX_c / n$). Since the frequency of harmonics is higher than that of the power supply, the impedance of the capacitor decreases and thus the harmonic current tends to flow into the capacitor. As a result, the capacitor may be overheated or damaged.

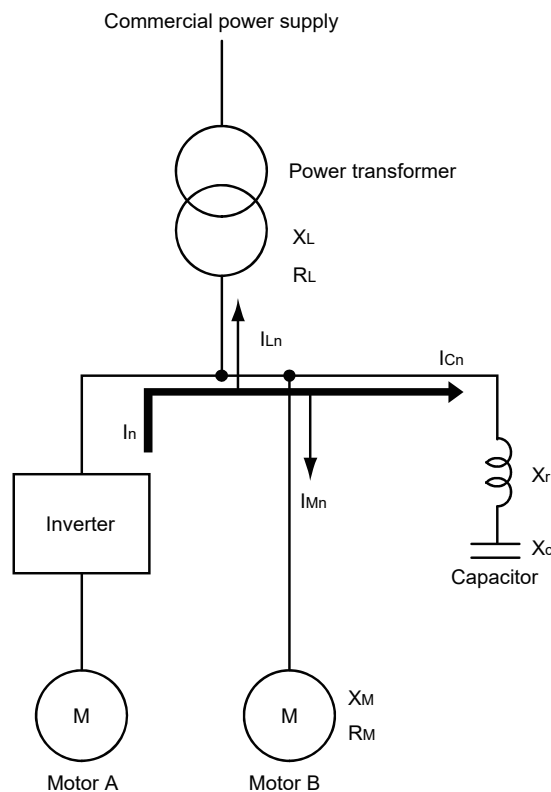


Fig. 7.4 Power distribution system

☒ Good to know for checking an inverter

- Current tends to flow into the smaller impedance, and the harmonics may increase when there are capacitive impedance elements (such as a power factor correction capacitor).

Therefore, in harmonic problems, 1) Since the impedance at the power supply side $\dot{Z}_s$ is represented by the short-circuit capacity of the power supply system, the larger the power supply capacity is, the less the influence of other elements is. 2) Inductive loads can be ignored since they represent high impedance to harmonics. 3) Only capacitive loads such as a power factor correction capacitor should be considered.

7.1.4 Harmonic suppression guidelines

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The Harmonic Suppression Guidelines were established to protect other consumers from these outgoing harmonic currents.

The three-phase 200 V input specifications 3.7 kW or lower were previously covered by "the Harmonic Suppression Guidelines for Household Appliances and General-purpose Products" and other models were covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage". However, the transistorized inverter has been excluded from the target products covered by "the Harmonic Suppression Guidelines for Household Appliances and General-purpose Products" in January 2004 and "the Harmonic Suppression Guideline for Household Appliances and General-purpose Products" was repealed on September 6, 2004. All capacities and all models of general-purpose inverters used by specific consumers (consumers who receive high voltage) are covered by the "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage".

"Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage"

These guidelines set forth the maximum harmonic currents outgoing from a high-voltage or especially high-voltage receiving consumer who will install, add or renew harmonic generating equipment. If any of the maximum values is exceeded, certain measures must be taken.

However, we ask the users who are not covered by the guideline to connect a DC reactor or an AC reactor as usual.

For compliance with the "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage"

Input power	Applicable capacity	Countermeasures
Three-phase 200 V	All capacities	Make a judgment based on the "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage" issued by the Japanese Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry) in September 1994 and take countermeasures if necessary. For how to calculate the power supply harmonics, refer to the following.
Three-phase 400 V		References •"Harmonic Suppression Measures of the General-purpose Inverter" January 2004 JEMA The Japan Electrical Manufacturers' Association •"Calculation Method of Harmonic Current of the General-purpose Inverter Used by Specific Consumers" JEM-TR201 (Revised in December 2003): The Japan Electrical Manufacturers' Association

For compliance with the "Harmonic Suppression Guideline of the General-purpose Inverter (Input Current of 20A or Less) for Consumers Other Than Specific Consumers" published by JEMA

Input power	Applicable capacity	Countermeasures
Three-phase 200 V	3.7 kW or lower	Connect the AC reactor or DC reactor recommended in the catalog or the Instruction Manual. References •"Harmonic Suppression Guideline of the General-purpose Inverter (Input Current of 20A or Less)" JEM-TR226 (Established in December 2003): The Japan Electrical Manufacturers' Association

Follow the procedure below to examine the necessity of the harmonic suppression techniques along the "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage".

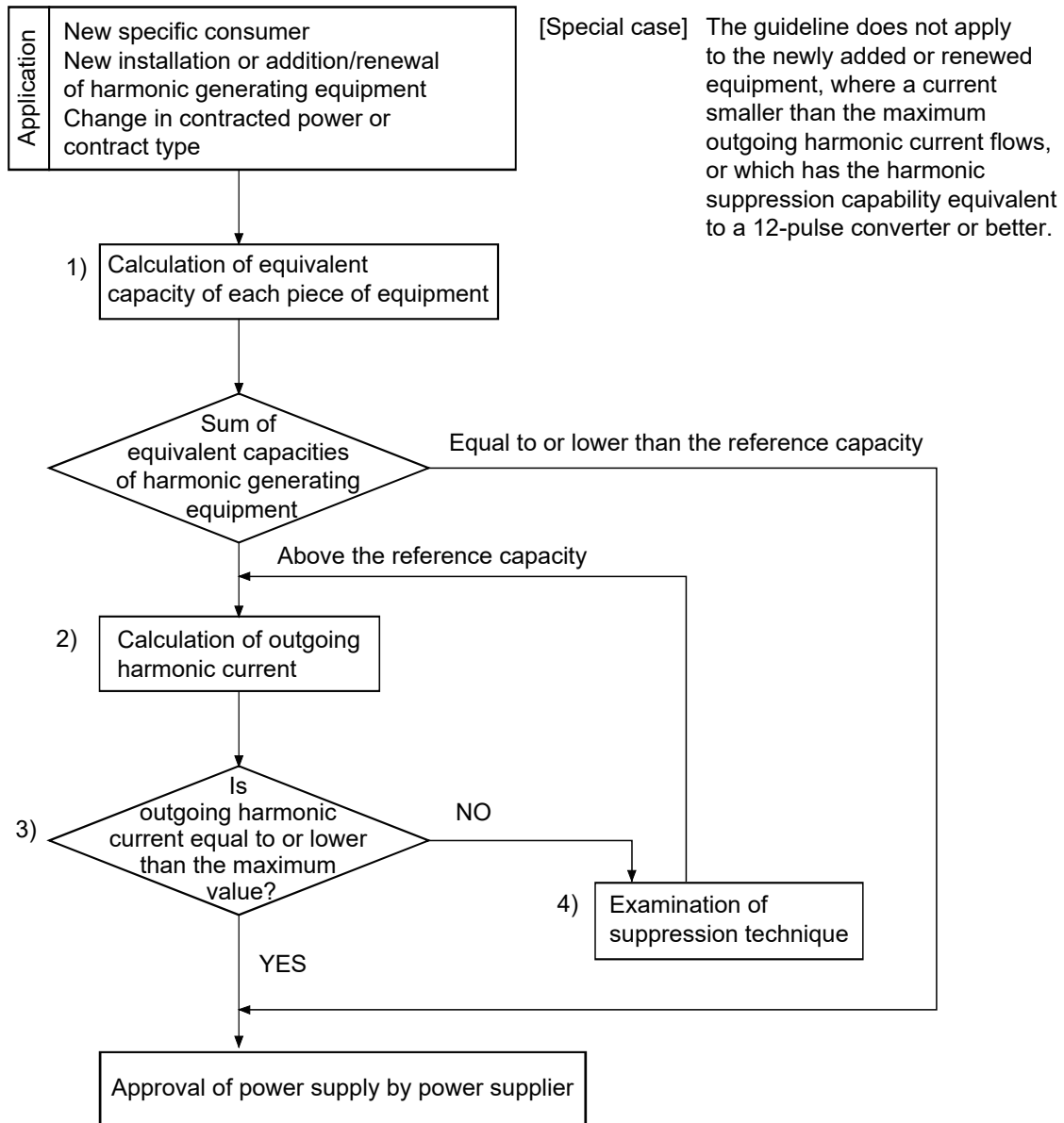


Fig. 7.5 Harmonics examination flowchart

7.1.5 Overview of harmonic suppression measures

The following table lists the basis and characteristics overview of the methods to suppress and absorb harmonics.

No.	Item	Description	Effect, etc.
1)	Reactor for inverter (FR-HAL, FR-HEL)	Connect an AC reactor on the AC side (power supply side) of the inverter or/and a DC reactor on the DC side of the inverter to increase the circuit impedance and suppress the harmonic current.	Harmonic current is suppressed to approximately half.
2)	High power factor converter (FR-HC2)	The converter switches the converter section ON/OFF to reshape an input current waveform into a sine wave, greatly suppressing harmonics. Connect it to the DC area of an inverter.	Harmonic current is suppressed to almost zero.
3)	Installation of power factor improving capacitor	The power factor improving capacitor has a small impedance for high frequency components and can absorb the harmonic current when used with a reactor connected in series. This capacitor can be installed in either of the high or low voltage side.	The absorbing effect is greater in the low voltage side.
4)	Transformer multi-phase operation	When two or more transformers are used, connecting them with a phase angle difference of 30° as in combinations of Y to Δ and Δ to Δ will cause a timing shift that suppresses peak current, resulting in an effect equivalent to 12 pulses.	Even if the capacities of the combinations of Y to Δ and Δ to Δ are different, the effect equivalent to 12 pulses is expected for the smaller one. Thus, harmonic current can be suppressed to approximately half.
5)	AC filter	As in a power factor improving capacitor, a capacitor and reactor connected in series are used together to reduce the impedance for a specific frequency (ordinal number). The harmonic current is absorbed greatly.	Current is greatly suppressed. (The guideline requirements can be satisfied.)
6)	Active filter	This filter detects the current in a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress the harmonic current at the detection point.	Current is greatly suppressed. (The guideline requirements can be satisfied.) Since this filter corrects the whole waveform, a power factor can be improved.

* The countermeasures above are effective in the following order:

- For suppression effect: 6) → 2) → 5) → 4) → 3) → 1)
- For cost: 1) → 2) → 3) → 4) → 5) → 6)

7.1.6 Influence to inverter at instantaneous power failure

When an instantaneous power failure occurs, the power supply voltage of the control circuit for the inverter is shut off. To prevent malfunction of control due to this power failure, activate the instantaneous power failure protection to stop the inverter output and keep the output stopped. The protective operation differs depending on the instantaneous power failure time. The FR-A800 series is used as an example here.

(1) Inverter operation depending on the instantaneous power failure time

- (a) When the instantaneous power failure time is within 15 ms
Since the protective function is not activated, operation can continue normally.

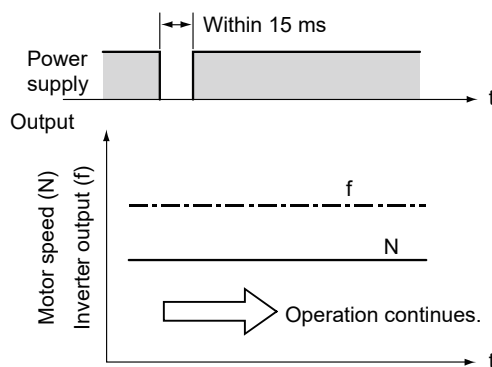


Fig. 7.6 Instantaneous power failure for 15 ms or less

- (b) When the instantaneous power failure time is over 15 ms and under 100 ms
The protective function is activated and the inverter output is stopped. (The motor coasts to a stop.)

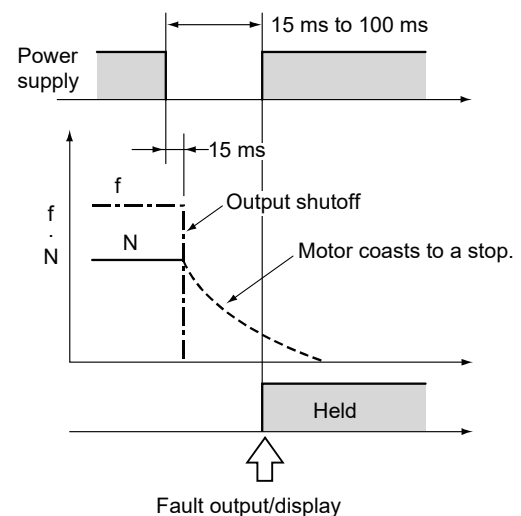


Fig. 7.7 Instantaneous power failure for more than 15 ms and less than 100 ms

- (c) Power failure for 100 ms or more
The protective function is reset automatically at the power restoration and the inverter can be restarted.

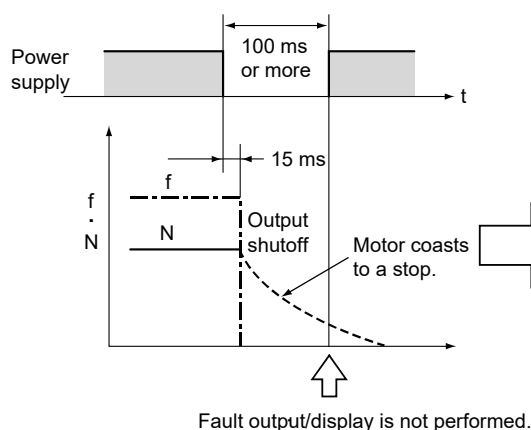


Fig. 7.8 Instantaneous power failure for 100 ms or more

[Note]

When the start signal (STF, STR) is ON, the inverter restarts at the power restoration. If the motor is coasting at this time, the overvoltage or overcurrent protection may be activated, which may cause a trip. To restart automatically at power restoration, use the automatic restart after instantaneous power failure function.

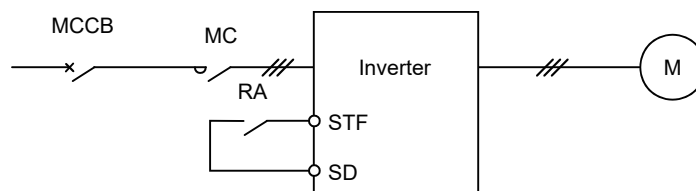
(The FR-A800 series inverters have this function as standard. However, the function is not selected at the factory shipment. Thus, set the parameter A702 (Pr.57) to "0".)

* For the FR-E800 series, the inverter operation does not differ due to the difference in the instantaneous power failure time as described above. The output of the FR-E800 series will be shut off when the converter output voltage falls below a certain value due to an instantaneous power failure.

7 REVIEW OF INSTALLATION ENVIRONMENT

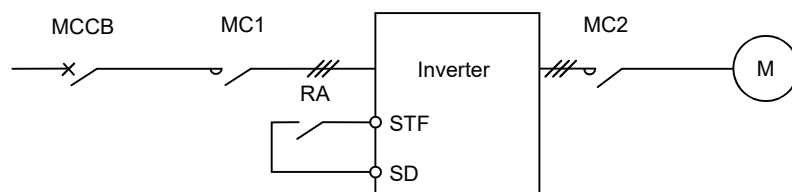
7.1.7 Inverter peripheral circuit and inverter operation at instantaneous power failure

(1) For a magnetic contactor (MC) at the inverter's input line



When the instantaneous power failure time is short and both the magnetic contactor MC and relay RA do not trip (start signal STF remains ON), the operation is as described in 7.1.6. When only the magnetic contactor MC trips, the motor coasts to a stop. Therefore, when restarting the inverter after a power restoration, turn on MC again or use the instantaneous power failure function after the motor coasts to a stop (coasting interlock timer is necessary).

(2) For magnetic contactors (MC) at both the inverter's input line and the output line



When the instantaneous power failure time is short and both the magnetic contactor MC1 and relay RA do not trip (start signal STF remains ON), the operation is as described in 7.1.6.

When only the magnetic contactor MC1 trips, the motor coasts to a stop. Therefore, when restarting the inverter after a power restoration, turn on MC1 again or use the instantaneous power failure function after the motor coasts to a stop (coasting interlock timer is necessary).

When only the magnetic contactor MC2 trips, the motor coasts to a stop. However, the inverter continues to output depending on the instantaneous power failure time, or only the inverter restarts after resetting at the power restoration. Therefore, when MC2 is turned on again, the motor starts directly with the inverter output frequency, and this may cause an inverter trip due to overcurrent.

☒ Good to know for checking an inverter

- 1) Even though an instantaneous power failure occurs at the receiving end, an instantaneous power failure is unlikely to occur (completely) at the low voltage side inverter input terminal (R, S, T) and voltage drops instantaneously. (Undervoltage protection operations)
 - 2) An inverter has the instantaneous power failure protective function and the undervoltage protection. The protective function is activated when the DC circuit voltage of the inverter is under a certain value for a certain time. Therefore, when the power supply drops instantaneously, the protective function may be activated for an inverter whose load output (kW) is large, and the operation may continue for an inverter whose load output is small.
 - 3) On the other hand, the magnetic contactors or relays may not trip due to an instantaneous voltage drop, if once it is turned on. In general, it trips when the voltage is equal to or lower than 30% to 50% of coil rating.
-

7 REVIEW OF INSTALLATION ENVIRONMENT

(3) Automatic restart after instantaneous power failure control

The inverter can be restarted without stopping the motor operation in the following situations:

- When an instantaneous power failure occurs during inverter operation
- When the motor is coasting at start

CAUTION This function operates properly only when one motor is connected to the inverter. Using multiple motors disrupts proper operation of the function.

(a) Operation of automatic restart after instantaneous power failure

- 1) When an instantaneous power failure occurs during operation, the motor starts coasting.
- 2) After a power restoration, applying the DC voltage from the inverter to the coasting motor carries the DC to the motor. (Refer to Fig. 7.9 (A).)

This DC includes the ripple cycle proportional to the motor speed.

- 3) Input the signal from the current detector to the CPU and count the ripple cycle to determine the motor speed.
- 4) The inverter outputs with the frequency according to the motor speed. (Refer to Fig. 7.9 (B).) After that, restart the inverter operation while increasing the output voltage gradually to reduce the starting current of the motor.

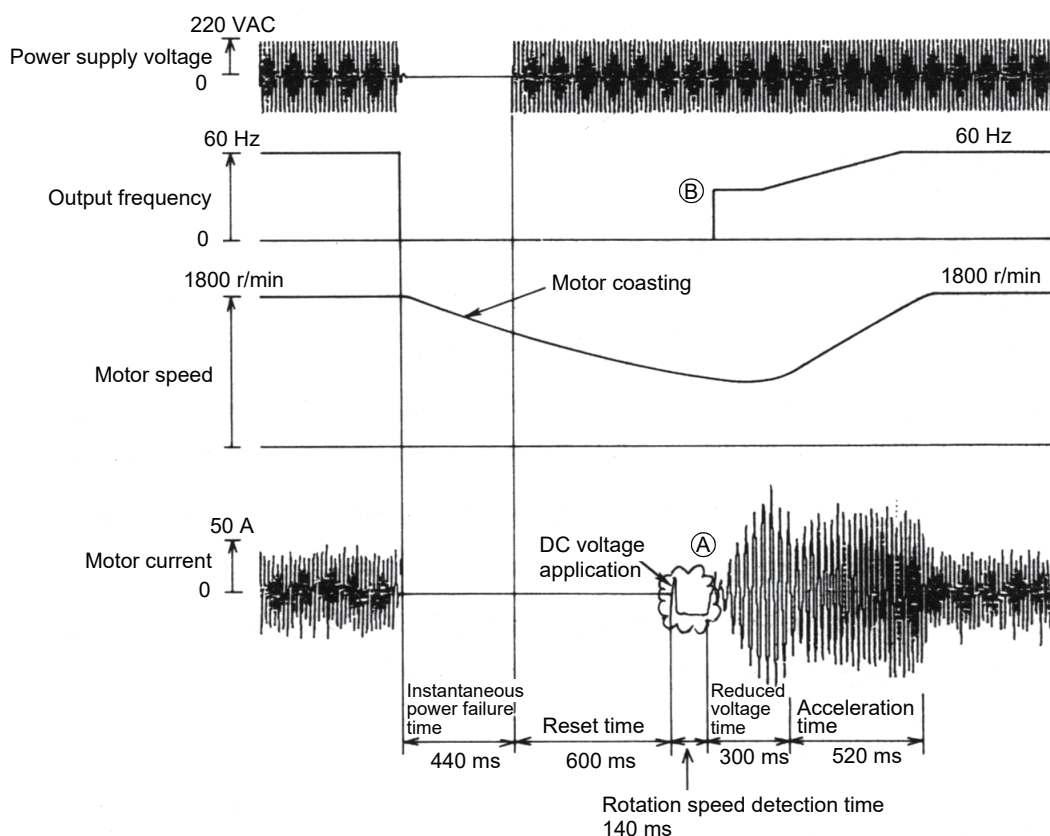


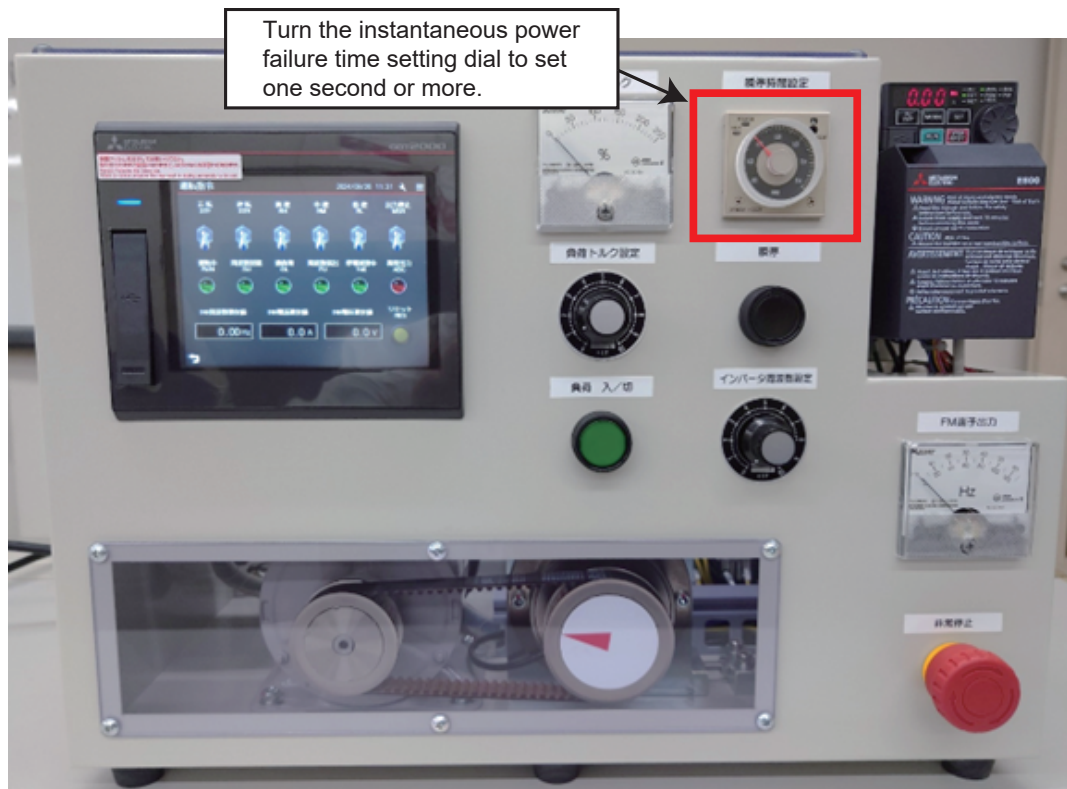
Fig. 7.9 Example of automatic restart after instantaneous power failure operation

7.1.8 Restart operation with frequency search [Training]

First, change A702 (Pr.57) Restart coasting time from "9999" to "0".

Check that "0" is set in A700 (Pr.162) (restart operation with frequency search).

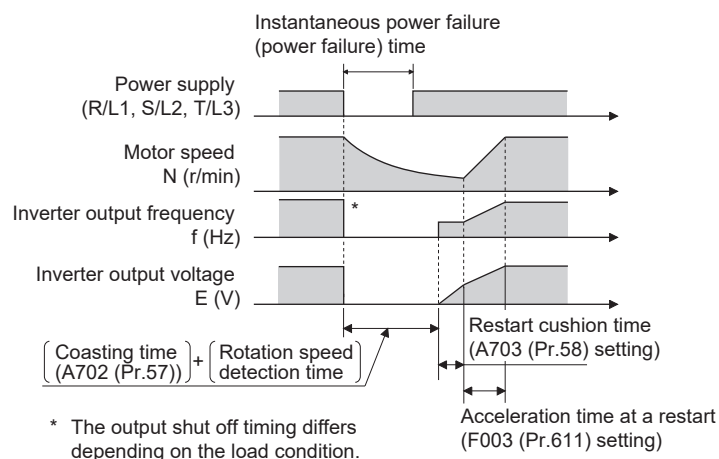
Set STF (ON) and high-speed RH (ON) to display 60 Hz. Set the instantaneous power failure stop time to one second or more, and press the instantaneous power failure button.



(1) Restart operation with frequency search (A700 (Pr.162) = "0")

At a power restoration, the encoder detects the motor speed so that the inverter can restart smoothly.

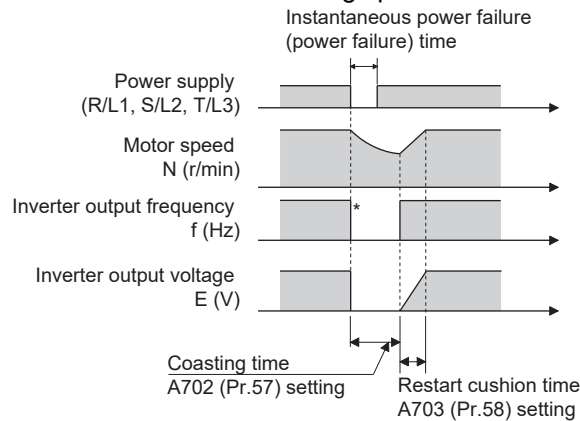
- 1) Press the instantaneous power failure button while the motor is rotating.
- 2) At a power restoration, the encoder detects the motor speed so that the inverter can restart smoothly.



(2) Restart operation without frequency search (A700 (Pr.162) ="1")

Reduced voltage start is used for the restart operation. In this method, the voltage is raised gradually while keeping the output frequency level at the level before an instantaneous power failure, regardless of the motor's coasting speed.

- 1) Change the A700 (Pr.162) setting from "0" (restart operation with frequency search) to "1".
- 2) Start the motor rotation and press the instantaneous power failure button.
- 3) Reduced voltage start is used for the restart operation. In this method, the voltage is raised gradually while keeping the output frequency level at the level before an instantaneous power failure, regardless of the motor's coasting speed.



* The output shut off timing differs depending on the load condition.

●●● **At the end of the training** ●●●

- Restore the setting of A700 (Pr.162) to "0".
- Restore the setting of A702 (Pr.57) to "9999".
- * If the load is heavy, restarting may fail during training.

7.1.9 Power failure time deceleration-to-stop function

This is a function to decelerate the motor to a stop when an instantaneous power failure or undervoltage occurs.

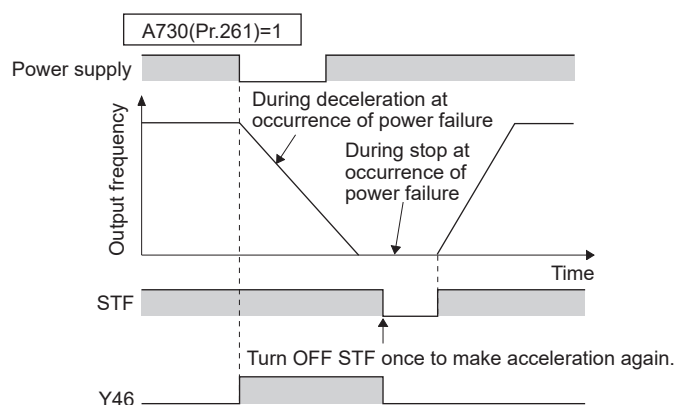
(1) Setting the power failure time deceleration-to-stop function (A730 (Pr.261))

Change A730 (Pr.261) (Power failure stop selection) from the initial value "0" to "1" to check the deceleration-to-stop function. It prevents restarting at a power restoration.

Pr.	Name	Initial value	Setting range	Description
261 A730	Power failure stop selection	0	0	The inverter output is shut off at an undervoltage or when a power failure occurs.
			1	The inverter decelerates the motor to a stop at an undervoltage or when a power failure occurs.
			2	The inverter decelerates the motor to a stop at an undervoltage or when a power failure occurs. The inverter re-accelerates the motor if the power restores during the deceleration.

Power failure stop function (A730 (Pr.261) = "1")

Even if power is restored during deceleration triggered by a power failure, deceleration stop is continued after which the inverter stays stopped. To restart operation, turn the start signal OFF then ON again.



Check points

* With this setting, the motor will not coast at power failure. It will decelerate to a stop.

- 1) Change the A730 (Pr.261) setting from "0" to "1".
- 2) Start the motor rotation and press the instantaneous power failure button.
- 3) In the demonstration machine, the Y46 lamp turns ON during the power failure deceleration. While Y46 is ON, the inverter will not restart the operation after the deceleration stop due to the power failure stop function.
- 4) Turn OFF the start switch (STF/STR) once, and then turn it ON after Y46 is turned OFF to restart the operation.

Precautions

- If the automatic restart after instantaneous power failure is selected (A702 (Pr.57) Restart coasting time $\neq$ "9999") while the power failure time deceleration-to-stop function is set enabled (A730 (Pr.261) = "1"), the power failure time deceleration-to-stop function is disabled.
- When the power failure time deceleration-to-stop function is enabled (A730 (Pr.261) = "1"), the inverter does not start even if the power is turned ON or inverter reset is performed with the start signal (STF/STR) ON.

●●●At the end of the training●●●

Restore the setting of A730 (Pr.261) (Power failure stop selection) to the initial value "0".

☒ Good to know for checking an inverter

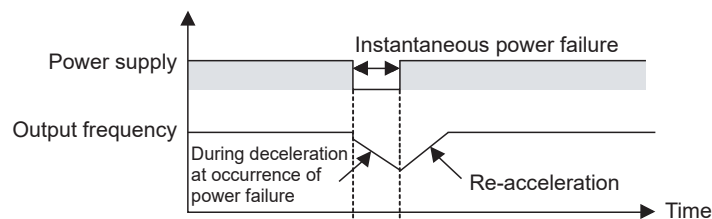
For the power failure time deceleration-to-stop function (A730 (Pr.261)), re-acceleration can be selected as well when power is restored during power failure deceleration.

Continuous operation function at instantaneous power failure (A730 (Pr.261) = "2")

When an instantaneous power failure is detected, the operation is continued by using the regenerative power generated by decelerating the motor. After the power restoration, the motor is accelerated until it reaches the command frequency and continues to operate.

When the load inertia is small, a trip may occur due to an undervoltage since the regenerative power from the motor is not provided.

In this case, use the automatic restart after instantaneous power failure.



7.2 Noise

As electronic devices are widely used, troubles due to the noise tend to increase.

Since an inverter generates the noise in accordance with the operating principle, it may affect adjacent devices.

The influence rate varies depending on circumstances such as the inverter control method, noise capacity of the adjacent device, wiring status, installation interval, and earthing (grounding) method. However, when installing the following devices around the inverter, it is recommended to take the countermeasures described hereafter according to the circumstances.

[Devices for which considering countermeasures against noise is required]

Sensors (such as proximity switches), video cameras (such as ITVs and image scanners), wireless communications devices (including AM radios), sound equipment (such as microphones, videos, and audio equipment), CRT display devices, and medical devices

[Devices for which considering countermeasures against noise is recommended]

Instruments and internal telephones

7.2.1 Principles of noise generation

The inverter controls output voltage waveform by switching the DC voltage in a high speed.

Precipitous rising and falling of the output waveform contain many high frequency components.

These high frequency components are the source of the noise.

The noise generated in such a case and the harmonics described in Section 7.1 may be confused because both of them may affect other electronic devices. However, harmonics are typically 40th to 50th (2.4 to 3 kHz), and noise is several 10 kHz or more.

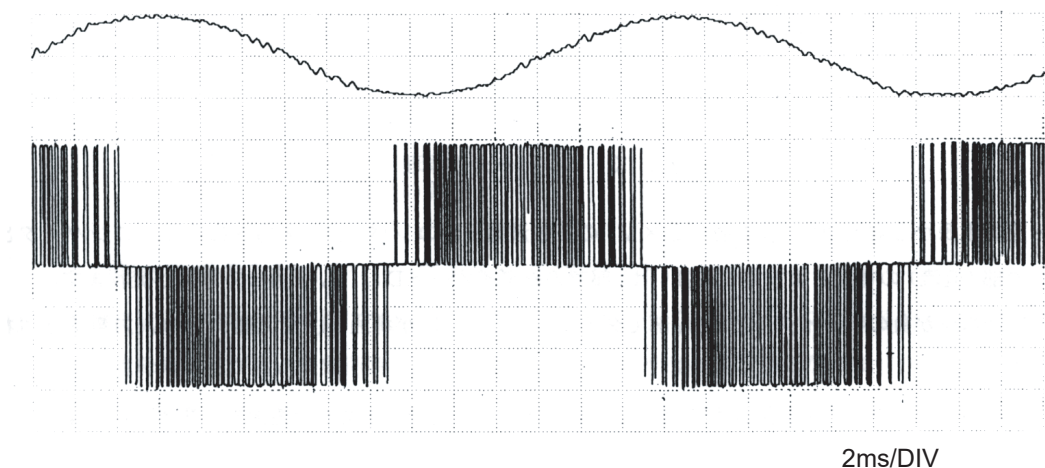


Fig. 7.10 Actual measurement example of output current and voltage waveform of the inverter FR-A800 series
(When carrier frequency is 2 kHz)

7.2.2 Types of noise and propagation path

The inverter-generated noise is largely classified into those radiated by the cables connected to the inverter and inverter main circuits (I/O), those electromagnetically and electrostatically induced to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.

Fig. 7.11 shows the types of noise, and Fig. 7.12 shows the path of noise.

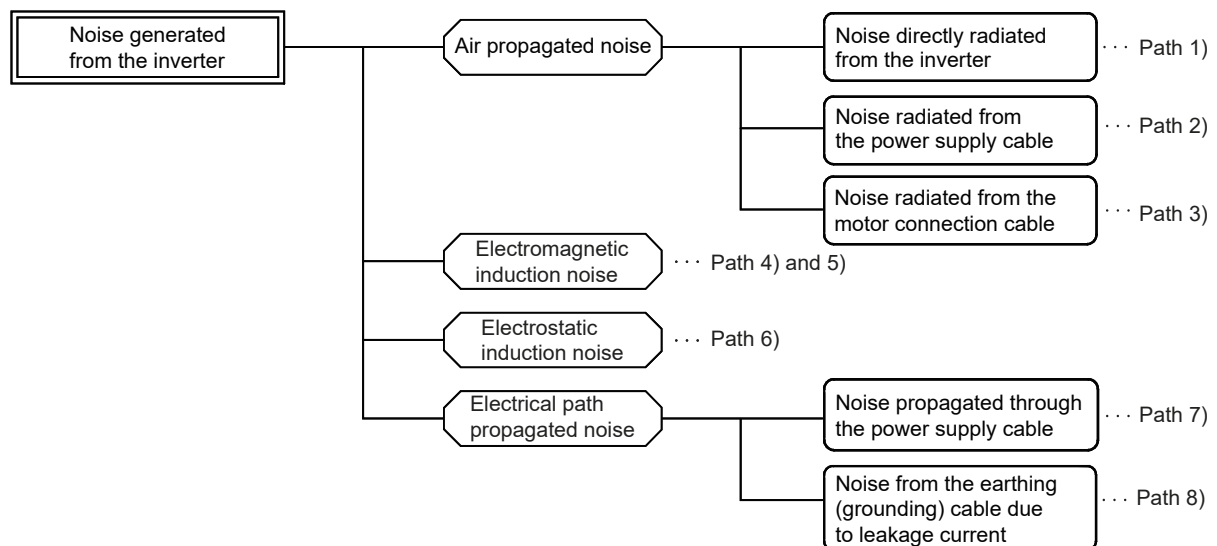


Fig. 7.11 Types of noise

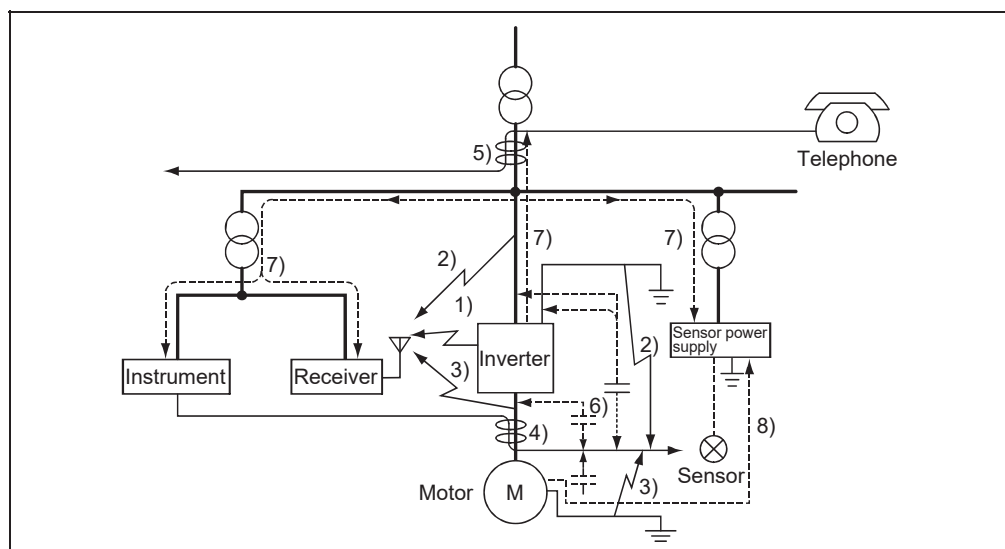


Fig. 7.12 Path of noise

Each noise level tends to be decreased as the frequency band rises. In general, it does not matter in the frequency band of 30 MHz or more.

Therefore, it does not affect much the televisions or FM radios that use frequency of 30 MHz or more with some exceptions. However, it affects low frequency band (0.5 to 10 MHz) radios such as AM radios.

Accordingly, it is rational to consider the countermeasures with regard to the frequency band of the noise.

(1) Air propagated noise: Path 1) to 3)

The noise generated by an inverter is radiated and transmitted into the air following the three paths as shown in Fig. 7.13.

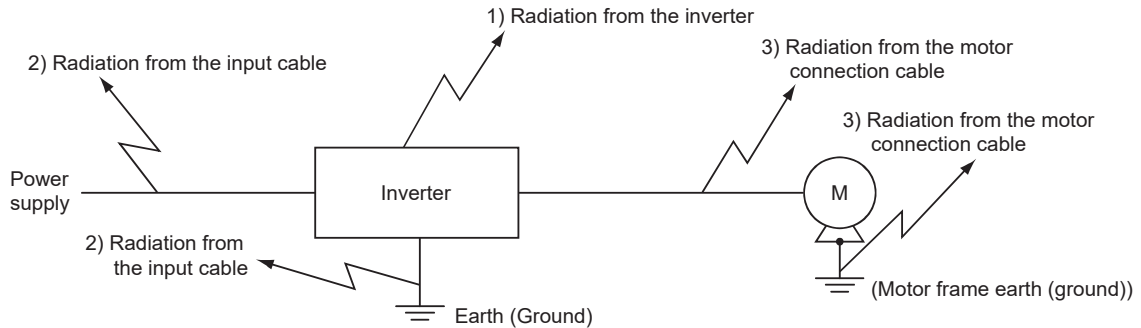


Fig. 7.13 Air propagated noise

(2) Electromagnetic induction noise: Path 4) and 5)

The noise is transmitted by the interlinkage of the power supply cables and signal cables for the peripheral devices in the magnetic field that is generated by the I/O side current of the inverter. (Refer to Fig. 7.14.)

When both cables are close and parallel, or when the loop of each cable is large, the induced noise increases.

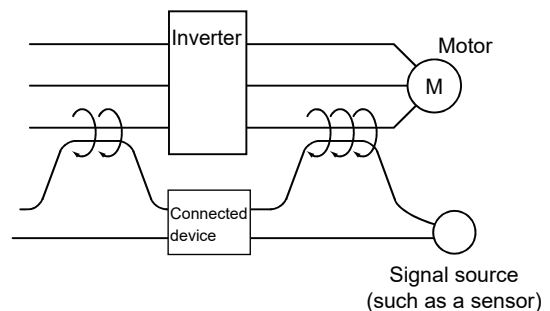


Fig. 7.14 Electromagnetic induction noise

(3) Electrostatic induction noise: Path 6)

The noise is transmitted when the electric field that is generated by the I/O cables of the inverter is coupled with the signal cables through the static capacitance. (Refer to Fig. 7.15.)

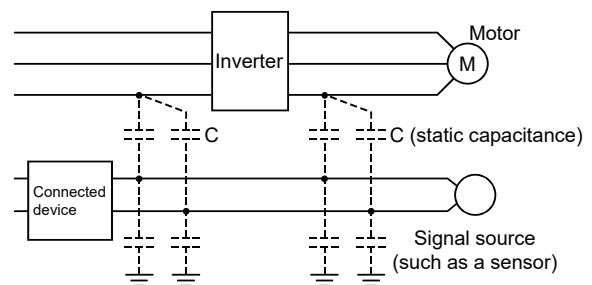


Fig. 7.15 Electrostatic induction noise

(4) Electrical path propagated noise: Path 7)

The high frequency noise generated in the inverter is transmitted to the peripheral devices through the cables at the power supply side. (Refer to Fig. 7.16.)

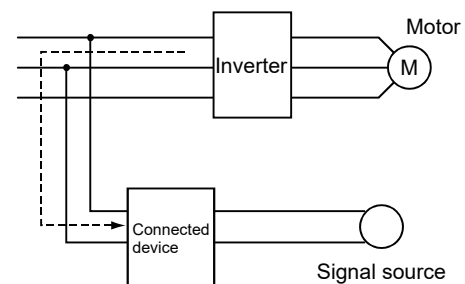


Fig. 7.16 Electrical path propagated noise

POINT

Failure example: Noise

[Failure]

When using an inverter for the sprinkler in a golf course, an electric cart stopped while sprinkling water.

[Cause]

The noise of the inverter affected the power supply of the electric cart (supplied from the rail).



[Countermeasure]

Countermeasures against the noise were taken.

7.2.3 Countermeasures against noise

(1) Stance of countermeasures against noise

Although there are many noise propagation paths as described in 7.2.2, the noise source can be classified into the following three types, as shown in Fig. 7.11 and Fig. 7.12.

- 1) Conduction, induction, or radiation from the input power supply cable
- 2) Induction or radiation from the motor connection cable
- 3) Radiation from the inverter

Each noise level tends to be decreased as the frequency band rises. In general, it does not matter in the frequency band of 10 MHz or more.

Therefore, it does not affect televisions or FM radios that use frequency over 70 MHz. However, it affects low frequency band radios such as AM radios. Accordingly, it is rational to consider the countermeasures with regard to the frequency band of the noise.

(a) Reducing the noise that leaks into the power supply cables

Inserting a filter between an inverter and the power supply cable is effective.

There are several types of filters as described below.

The following explains the usage and effect.

1) Radio noise filter FR-BIF (200 V class), FR-BIF-H (400 V class)

This filter requires distinction between 200 V and 400 V, however, it is common to all capacities.

Connect the filter to the power supply input terminal of the inverter as shown in Fig. 7.17. A long connection cable between the filter and inverter becomes the noise radiation antenna, which obstructs the effectiveness of the filter. Therefore, connect the cables including the earthing (grounding) cable directly to the inverter terminal so that they are as short as possible.

In addition, when the inverter earth (ground) terminal is far from the earth, the earthing (grounding) cable may be the antenna which is obstructive to the effect of the filter.

Therefore, the earthing (grounding) cable should also be as short as possible.

This filter has large effect on several MHz or less and is effective to decrease the noise influence on AM radios.

Do not connect the filter to the inverter output side because it has a capacitor. Otherwise it will be damaged.

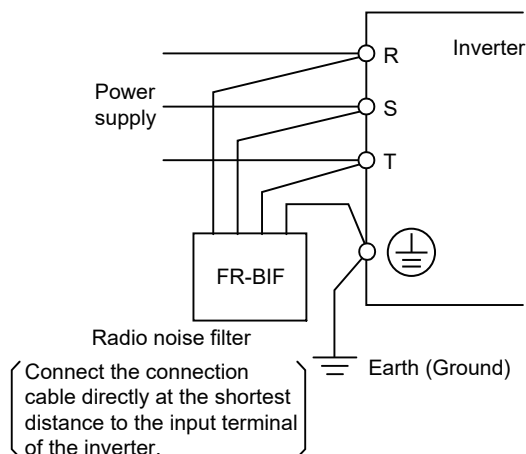


Fig. 7.17 Installation of the radio noise filter FR-BIF

2) Line noise filter FR-BSF01, FR-BLF

This filter consists of the core. Therefore, it can be used for all models regardless of the power supply voltage or capacity.

Wind all three-phase cables around the filter in the same direction as shown in Fig. 7.18 and insert it to the inverter power input side. The more times it is wound, the more effect the filter has. Wind the cables as much as possible, at least three times (four turns).

For the thick cable which cannot be wound three times (four turns) or more, use two filters so that the number of winding times is three times (four turns) or more in total. (Inverter input side)

Use either of the two types of the filter depending on the used cable gauge.

This filter has large effect on several 100 kHz or more. The filter can be used at the inverter output side as well. When it is inserted to the inverter output side, the number of winding times must be within three times (four turns).

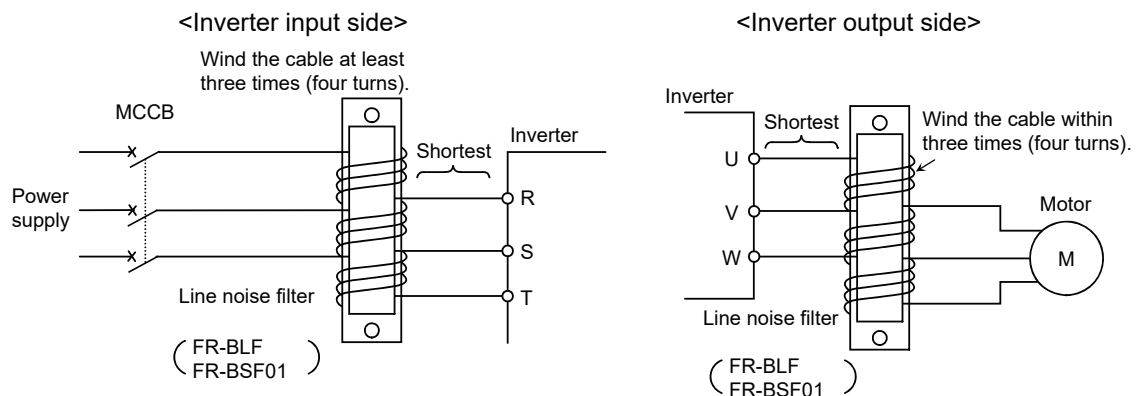
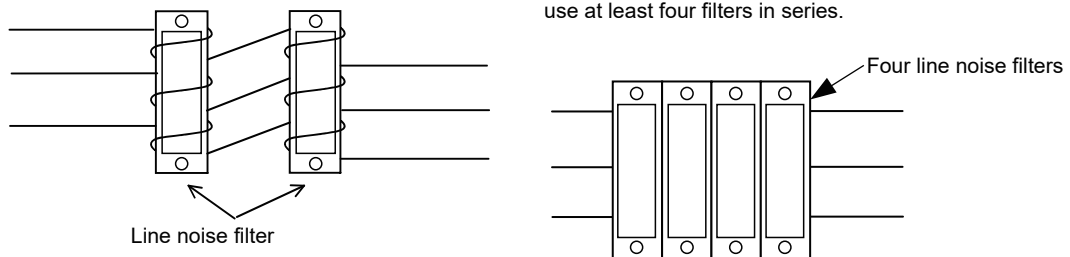


Fig. 7.18 Installation of the line noise filter FR-BSF01, FR-BLF

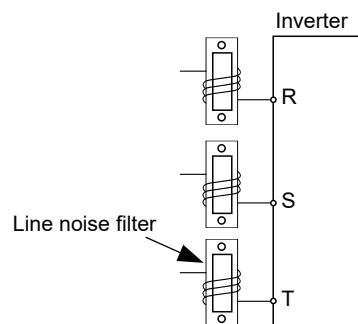
Use multiple line noise filters to wind the cable four turns.

For the thick cable which cannot be wound, use at least four filters in series.



Point: Wind each three-phase cable to the same direction.

Fig. 7.19 How to use multiple line noise filters



Point: Wind three-phase cables to the same line noise filter.

Fig. 7.20 Incorrect usage of line noise filters

Table 7.2 Cable used and number of pass-through times

●FR-BSF01

Cable used (mm ²)	Number of pass-through times (T)
2	4
3.5	4
5.5	3
8	2
14	2
22	1
38 to 150	× Cannot be used.

When the cable is thick (5.5mm² or more)



The cable cannot be wound four turns to one filter. It is recommended to use two or more filters to wind the cable four turns in total.

Use the above mentioned type or FR-BLF type line noise filter.

●FR-BLF

Cable used (mm ²)	Number of pass-through times (T)
2 to 22	4
30 to 60	3
80	2
100 to 150	1

When the cable is thick (30mm² or more)



The cable cannot be wound four turns to one filter. It is recommended to use two or more filters to wind the cable four turns in total.

3) Using FR-BIF(-H) and FR-BLF or FR-BSF01 together

As described above, FR-BIF is effective for the noise with a relatively low frequency, and FR-BLF is effective for the noise with a high frequency. Therefore, the effect can be enhanced by using both filters together.

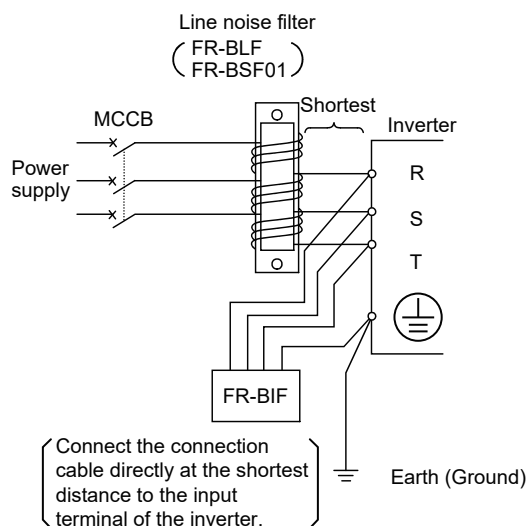


Fig. 7.21 Using FR-BIF and FR-BLF or FR-BSF01 together

☒ POINTS for understanding !

The FR-A800 and FR-F800 series 55 kW or lower inverters have the filters equivalent to the line noise filter and radio noise filter on the input side.

The 75 kW or higher inverters have the filters equivalent to the radio noise filter only.

4) Noise suppression transformer

Noise suppression transformers are transformers having extremely small magnetic and electrostatic coupling of the primary and secondary coils and effective in noise reduction.

- (b) Reducing the noise radiated from the wire between the inverter and the motor
- Although the radiated noise can be reduced by inserting the line noise filter FR-BLF or FR-BSF01 to the inverter output side as described previously, it is usually reduced by using a metallic pipe or shielded cable as shown in Fig. 7.22. For effective earthing (grounding) of the motor, connect one cable of the 4-core cable on the inverter side and use a pipe whose thickness is 2 mm or more.
- Wiring inside the concrete pit or room surrounded by concrete has an effect similar to the metallic pipe.

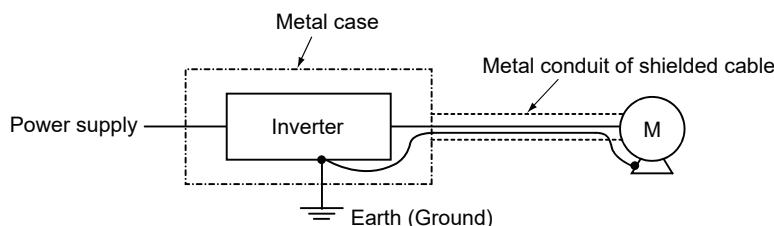


Fig. 7.22 Pipe arrangement for the motor connection cable

- (c) Reducing the noise radiated from the inverter
- Usually, the noise radiated from an inverter is relatively small and does not matter. However, when an inverter needs to be installed near a device susceptible to the noise described above, store the inverter in a metal case as shown in Fig. 7.23, install a noise filter at the power supply side, and connect a metallic pipe to the case at the output side.

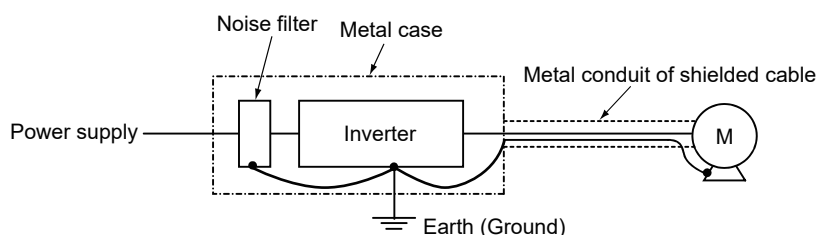
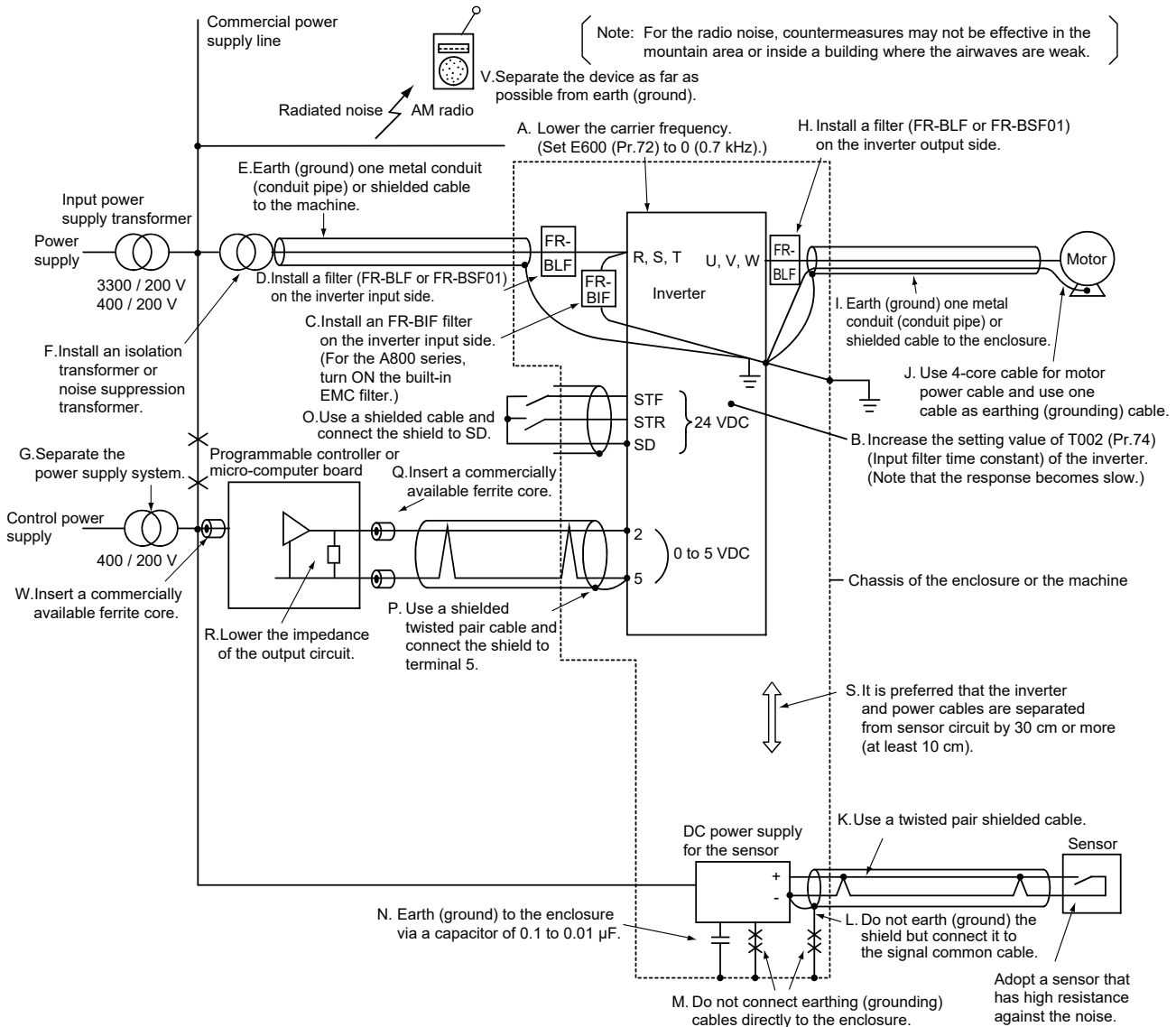


Fig. 7.23 Reducing the noise radiated from the inverter

(2) Specific examples of countermeasures

The following figure shows promising countermeasures against the inverter noise.



Wiring method inside the enclosure

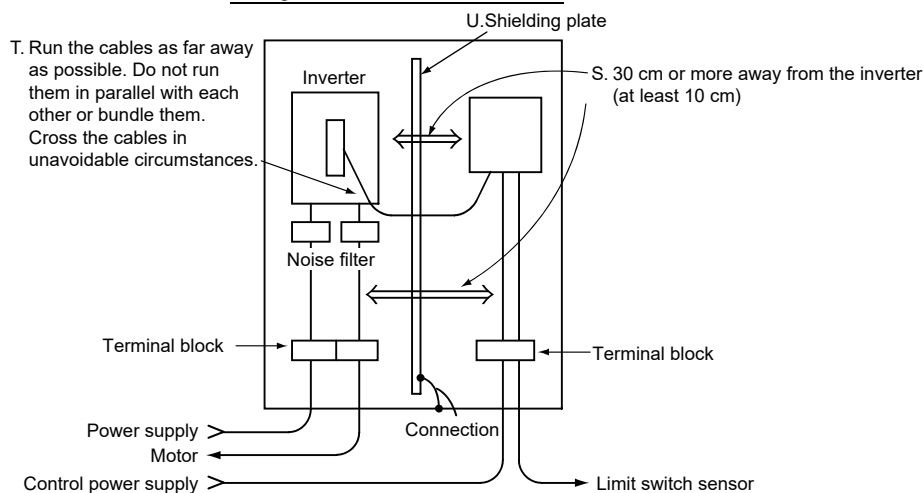


Fig. 7.24 Example of countermeasures against noise

The following table lists the promising effects (estimation) for each item of countermeasure examples (refer to the previous page). When taking actual countermeasures, refer to the list to determine the priorities.

Meaning of signs
 ⊙: Great effect
 ○: Effective
 Δ: Small effect
 —: No effect

Table 7.3 Effects of countermeasures against noise

Location	Measure symbol	Countermeasure	Propagation method of noise						
			Air propagated noise			Electromagnetic induction noise	Electrostatic induction noise	Electrical path propagated noise	
			Radiation from inverter	Radiation from power supply cables	Radiation from motor cables			Power supply cable	Undesirable current of earthing (grounding) cable
Inverter	A	Decrease the carrier frequency in E600 (Pr.72).	⊙	⊙	⊙	⊙	⊙	⊙	⊙
	B	Increase the input filter time constant in T002 (Pr.74).	Δ	Δ	Δ	○	Δ	—	—
Input side	C	Install the radio noise filter FR-BIF(-H). (For the FR-A800 series, turn ON the built-in EMC filter.)	—	⊙	—	—	—	⊙	—
	D	Install the line noise filter FR-BSF01 or FR-BLF.	—	⊙	—	—	—	⊙	Δ
	E	Wire the power supply cable with a metal conduit or shielded cable.	—	⊙	—	—	—	⊙	—
	F	Install an isolation transformer or noise suppression transformer.	—	Δ	—	—	—	⊙	—
	G	Separate the power supply system.	—	—	—	—	—	⊙	⊙
Output side	H	Install the line noise filter FR-BSF01 or FR-BLF.	—	—	⊙	Δ	Δ	—	⊙
	I	Wire the output cable with a metal conduit or shielded cable.	—	—	⊙	○	○	—	—
	J	Use 4-core cable for motor power cable and use one cable as	—	—	Δ	Δ	Δ	—	⊙
Connected device	K	Use a shielded twisted pair cable for the signals from the sensor.	○	○	○	⊙	⊙	—	—
	L	Connect the shield to the sensor signal common cable.	—	—	—	⊙	⊙	—	⊙
	M	Do not earth (ground) the sensor power supply unit directly to the	—	—	—	—	—	Δ	⊙
	N	Earth (ground) the sensor power supply unit using a capacitor.	—	—	—	—	—	Δ	○
	O	Use a shielded cable for input signals and connect the shield to	Δ	Δ	Δ	○	⊙	—	Δ
	P	Use a shielded twisted pair cable for the speed input and connect	○	○	○	⊙	⊙	—	Δ
	Q	Attach a commercially available ferrite core to the speed input	Δ	Δ	Δ	○	—	—	—
	R	Reduce the output circuit impedance of the connected	Δ	Δ	Δ	○	—	—	—
	S	Keep a distance of 30 cm or more between the sensor circuit and	⊙	⊙	⊙	⊙	⊙	—	—
	T	Do not run cables in parallel with each other and do not bundle	Δ	Δ	Δ	⊙	⊙	—	—
	U	Install the shielding plate.	○	Δ	Δ	Δ	Δ	—	—
	V	Keep the device away from earth.	Δ	○	○	Δ	Δ	—	—
	W	Attach a commercially available ferrite core to the input side of the	—	—	—	—	—	○	Δ

7.2.4 leakage current

Capacitance exists between the inverter I/O cables, other cables and earth and in the motor, through which a leakage current flows. The amount of current leakage depends on the factors such as the size of the capacitance and the carrier frequency. Low acoustic noise operation at an increased carrier frequency of the inverter will increase current leakage. Take the following precautions to prevent current leakage. Earth leakage circuit breakers should be selected based on their rated current sensitivity, independently of the carrier frequency setting.

(1) To-earth (ground) leakage currents

Table 7.4 Effects and countermeasures of to-earth (ground) leakage current

Type	Description
Effect and countermeasure	<ul style="list-style-type: none"> Leakage currents may flow not only into the power system of the inverter but also into the other power systems through the earthing (grounding) cable, etc. These leakage currents may operate earth leakage circuit breakers and earth leakage relays unnecessarily. Countermeasures If the carrier frequency setting is high, decrease the E600 (Pr.72) PWM frequency selection setting. Note that motor noise increases. Selecting E601 (Pr.240) Soft-PWM operation selection makes the sound inoffensive. By using earth leakage circuit breakers designed to suppress harmonics and surge voltage in the power system of the inverter and other power systems, operation can be performed with the carrier frequency kept high (with low noise).
Undesirable current path	

7 REVIEW OF INSTALLATION ENVIRONMENT

(2) Line-to-line leakage current

Table 7.5 Effects and countermeasures of line-to-line leakage current

Type	Description
Effect and countermeasure	<ul style="list-style-type: none"> This leakage current flows via a static capacitance between the inverter output cables. Harmonics of leakage currents may operate the external thermal relay unnecessarily. When the wiring length is long (50 m or more) for the 400 V class small-capacity models (7.5 kW or lower), the external thermal relay is likely to operate unnecessarily because the ratio of the leakage current to the rated motor current increases. Countermeasures <ul style="list-style-type: none"> Use H000 (Pr.9) Electronic thermal O/L relay. If the carrier frequency setting is high, decrease the E600 (Pr.72) PWM frequency selection setting. <p>Note that motor noise increases. Selecting E601 (Pr.240) Soft-PWM operation selection makes the sound inoffensive.</p> <p>To ensure that the motor is protected against line-to-line leakage currents, it is recommended to use a temperature sensor to directly detect motor temperature.</p>
Undesirable current path	<p>The diagram illustrates the electrical setup and the path of leakage current. On the left, three power supply lines pass through an MCCB (Molded Case Circuit Breaker) and an MC (Main Circuit) breaker before entering an Inverter. The Inverter's output passes through a Thermal relay to a Motor, represented by a circle with 'M'. Between the inverter output cables, there are line-to-line static capacitances, shown as two parallel lines with arrows pointing to them. A dashed line labeled 'Line-to-line leakage currents path' shows the current flowing from one phase to another through these capacitances. The Inverter and Motor are both grounded.</p>

7.2.5 Earth (ground)

Generally, an electrical apparatus has an earth (ground) terminal, which must be connected to the ground before use.

An electrical circuit is usually insulated by an insulating material and encased. However, it is impossible to manufacture an insulating material that can shut off a leakage current completely, and actually, a slight current flows into the case.

The original purpose of the earth (ground) terminal is earthing (grounding) the case of an electrical apparatus to prevent operators from getting an electric shock from this leakage current when they touch it.

To avoid the influence of external noises, earthing (grounding) is important to machines that handle low-level signals or operate very fast such as audio equipment, sensors, and computers.

As described above, earthing (grounding) has two completely different types, and a problem occurs when these are earthed (grounded) together. Therefore, consider a dirty earth (ground) for electric shock prevention and a clean earth (ground) for noise prevention separately.

When an inverter is used, its output voltage has not a sine waveform but a precipitous waveform. Therefore, the charging/discharging current to the static capacitance in the isolated section flows as the leakage current.

Furthermore, the same charging/discharging leakage current flows into the motor where the output voltage of the inverter is applied. The leakage current contains more high frequency components and the current value is larger compared to the operation with a commercial power supply as shown in Fig. 7.26. The higher the carrier frequency of the inverter is, the stronger this tendency is.

(1) Earthing (grounding) system to be established

As described previously, the purpose of earthing (grounding) is roughly classified into the electrical shock prevention and the prevention of malfunction due to the influence of electromagnetic noise. These two purposes should be clearly distinguished, and the appropriate earth (ground) system must be established to prevent the leakage current having high frequency components from reversing through another earth (ground) point for malfunction prevention by following these instructions:

- (a) Make the separate earth (ground) connection (I) for the inverter from any other devices wherever possible. (Refer to Fig. 7.25.)

Establishing adequate common (single-point) earth (ground) system (II) is allowed if the separate earth (ground) system (I) is not feasible. Do not use the other equipment's earthing (grounding) cable to earth (ground) the inverter as shown in (III).

Especially, the common earthing (grounding) with the high-power devices such as motors or transformers must be avoided.

As leakage currents containing many high frequency components flows into the earthing (grounding) cables of the inverter and the motor driven by the inverter, the inverter must also be earthed (grounded) separately from EMI-sensitive devices described above.

In a high building, it may be effective to use its iron structure frames as earthing (grounding) electrode for EMI prevention in order to separate from the earth (ground) system for electric shock prevention.

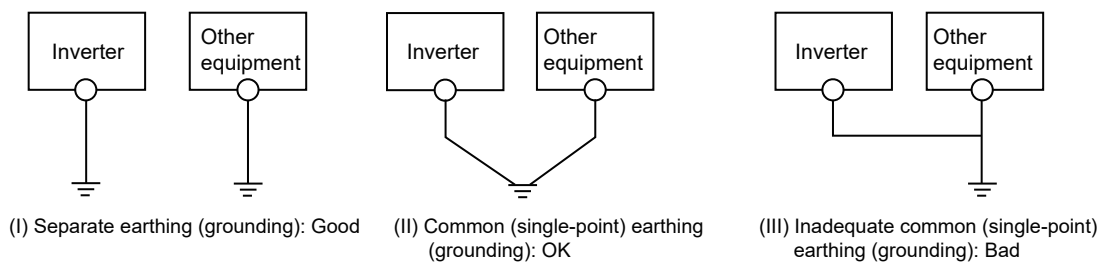


Fig. 7.25 Earthing (grounding) methods

- (b) Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 61140 class 1 and other applicable standards).

A neutral-point earthed (grounded) power supply must be used for 400 V class of this product to be compliant with EN standard.

- (c) Use the thickest possible earthing (grounding) cable. The size of the earthing (grounding) cable should be the same or larger than the one indicated in the Instruction Manual.
- (d) The earthing (grounding) point should be as close as possible to the inverter, and the earth (ground) wire length should be as short as possible.
- (e) Run the earthing (grounding) cable as far away as possible from the I/O wiring of the EMI-sensitive devices and run them in parallel in the minimum distance.
- (f) For the earth (ground) terminal of the motor, use one cable of the 4-core cable and earth (ground) at the inverter side.

When earthing (grounding) of the inverter, motor driven by the inverter, and devices such as audio devices, sensors, and computers are connected together, the leakage current becomes the noise source and the noise that affects the devices.

To resolve this problem, separate the dirty earth (ground) for the inverter and the clean earth (ground) for devices such as audios, sensors, and computers.

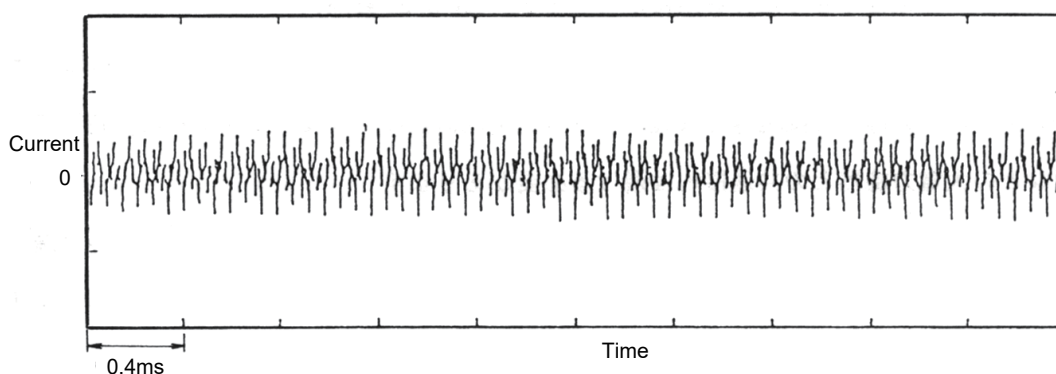


Fig. 7.26 Example of the earthing (grounding) cable current of the inverter-driven motor (Inverter: 200 V class 0.75 K, Motor: SF-JR 0.75 kW 4 P)

7.2.6 PWM carrier frequency and Soft-PWM control [Training]

The motor sound can be changed.

(1) PWM carrier frequency (PWM frequency selection E600 (Pr.72) = "1 (initial value)")

Setting range: 0 to 15

The setting value represents the frequency in kHz. Note that "0" indicates 0.7 kHz, "15" indicates 14.5 kHz.

The PWM carrier frequency of the inverter can be changed.

Reducing the PWM carrier frequency can be effective for avoiding the resonance frequency of the mechanical system or motor, as a countermeasure against EMI generated from the inverter, or for reducing leakage current caused by PWM switching. Note that motor noise increases.

Remark

Under Real sensorless vector control, Vector control, and PM sensorless vector control, the setting value is not the same as the carrier frequency. For details, refer to the FR-E800 Instruction Manual (Function).

(2) Soft-PWM control (Soft-PWM operation selection E601 (Pr.240) initial value = "1": Enabled)

Soft-PWM control is a function that changes the motor noise from a metallic sound into an inoffensive, complex tone.

7.3 Problems and measures when using inverter

This section explains the reliability and life of the inverter and important precautions depending on the installation environment of the inverter and the operating condition.

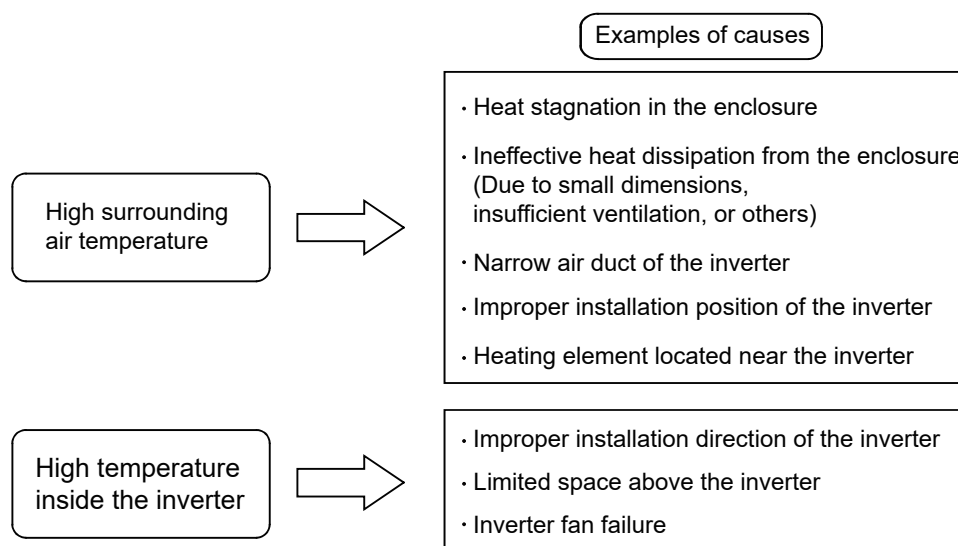
In addition, the circuit design, precautions on wiring, and operating procedure for using an inverter are explained as well.

7.3.1 Environment and installation condition

(1) Reliability of the inverter and temperature

The reliability of the inverter is significantly influenced by the temperature. High surrounding air temperature or incorrect installation may cause unexpected troubles such as failures and damages due to the increased temperature inside the inverter which is installed in an undesired place or not installed correctly.

The possible causes are shown below.



(2) Surrounding air temperature

Surrounding air temperature of the inverter is the temperature at the immediate periphery of the position where the inverter is installed.

- 1) Measure the temperature at the position shown in Fig. 7.27.
- 2) The permissible temperature range is from -20°C to $+60^{\circ}\text{C}$ (for the FR-E800).
(Too high or low temperature causes a trouble.)
- 3) When the temperature inside the enclosure is $+50^{\circ}\text{C}$ or lower, consider that the surrounding air temperature of the enclosure is 40°C or lower.

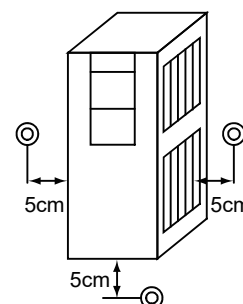


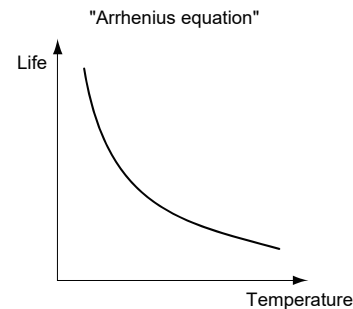
Fig. 7.27 Measuring the surrounding air temperature

☒ Good to know for checking an inverter

Life

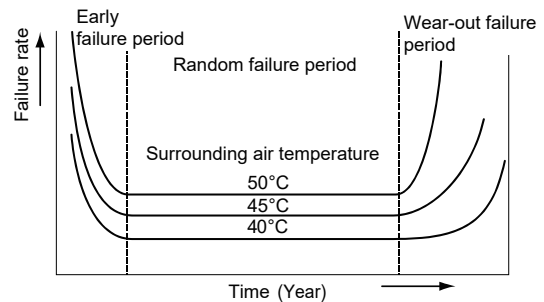
The smoothing electrolytic capacitor used in the inverter is one of the components to which the "Arrhenius equation" is applied. It will shorten the life by half for every 10°C increase in surrounding air temperature (double for every 10°C decrease).

The life of other components is very much affected by the temperature as well.



Relation between failure occurrence rate and temperature

The inverter consists of many electronic parts such as semiconductor devices. For these components, the failure rate is closely related to the surrounding temperature. It is important to operate them at as lower temperature as possible to reduce the failure rate.



(3) Heat of an inverter

The amount of heat generated by the inverter depends on the inverter capacity or the motor load factor.

Options contained in the enclosure with the inverter such as an AC reactor, DC reactor, and brake unit (including the resistor) generate relatively large amount of heat. Consider this heat when designing the enclosure. Generated heat amount is shown in Table 7.6 and Table 7.7.

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Table 7.6 Amount of heat generated by the inverter (FR-E800) (when installing the heat sink inside the enclosure)

Voltage	Inverter model	Amount of heat generated (W)			
		Standard model		Ethernet model / Safety communication model	
		LD	ND	LD	ND
Three-phase 200 V class	FR-E820-0008(0.1K)	16	11	17	12
	FR-E820-0015(0.2K)	21	16	22	17
	FR-E820-0030(0.4K)	35	29	36	30
	FR-E820-0050(0.75K)	61	48	62	49
	FR-E820-0080(1.5K)	91	74	92	75
	FR-E820-0110(2.2K)	107	91	108	92
	FR-E820-0175(3.7K)	177	153	178	154
	FR-E820-0240(5.5K)	251	191	252	192
	FR-E820-0330(7.5K)	317	249	318	250
	FR-E820-0470(11K)	426	341	427	342
	FR-E820-0600(15K)	547	414	548	415
	FR-E820-0760(18.5K)	735	600	736	601
	FR-E820-0900(22K)	1063	745	1064	746
Three-phase 400 V class	FR-E840-0016(0.4K)	33	25	34	26
	FR-E840-0026(0.75K)	55	38	56	39
	FR-E840-0040(1.5K)	84	58	85	59
	FR-E840-0060(2.2K)	88	75	89	76
	FR-E840-0095(3.7K)	136	112	137	113
	FR-E840-0120(5.5K)	223	136	224	137
	FR-E840-0170(7.5K)	299	197	300	198
	FR-E840-0230(11K)	410	239	411	240
	FR-E840-0300(15K)	486	321	487	322
	FR-E840-0380(18.5K)	510	348	511	349
	FR-E840-0440(22K)	589	401	590	402
Single-phase 200 V class	FR-E820S-0008(0.1K)	—	11	—	12
	FR-E820S-0015(0.2K)	—	17	—	18
	FR-E820S-0030(0.4K)	—	32	—	33
	FR-E820S-0050(0.75K)	—	49	—	50
	FR-E820S-0080(1.5K)	—	80	—	81
	FR-E820S-0110(2.2K)	—	95	—	96
Single-phase 100 V class	FR-E810W-0008(0.1K)	—	11	—	12
	FR-E810W-0015(0.2K)	—	17	—	18
	FR-E810W-0030(0.4K)	—	29	—	30
	FR-E810W-0050(0.75K)	—	47	—	48

Remark

- The figures indicate the amount of heat generated when the output current is the rated current, power supply voltage is 110 V (100 V class), 220 V (200 V class), or 440 V (400 V class), and the carrier frequency is 1 kHz.
- For information on the amount of heat generated when installing the heat sink outside the enclosure, refer to the FR-E800 Instruction Manual (Connection).

7 REVIEW OF INSTALLATION ENVIRONMENT

Table 7.7 Amount of heat generated by the reactor

Motor capacity (kW)	Reactor			
	Amount of heat generated (W)			
	FR-HEL		FR-HAL	
	200 V	400 V	200 V	400 V
0.4	6	6	10	16
0.75	7	7	14	23
1.5	8	8	20	30
2.2	11	11	24	43
3.7	13	13	33	46
5.5	17	17	40	52
7.5	19	19	46	52
11	23	23	60	60
15	26	26	75	60
18.5	29	29	74	76
22	34	34	82	74
30	38	38	97	91

7 REVIEW OF INSTALLATION ENVIRONMENT

(4) Interference of heat inside the enclosure and ventilation

The arrangement of the inverter and ventilation fan is one of the important points when they are installed in the enclosure.

When installing multiple inverters or using a ventilation fan in the enclosure, note that the surrounding air temperature of the inverter increases or the ventilation becomes less effective depending on the installing position.

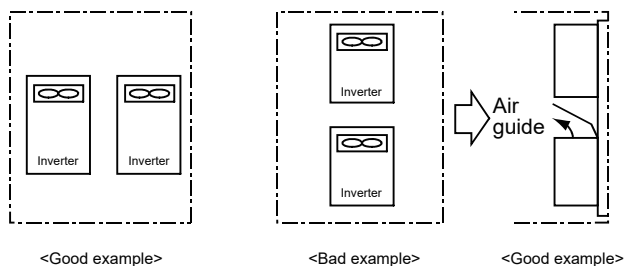


Fig. 7.28 When installing multiple inverters

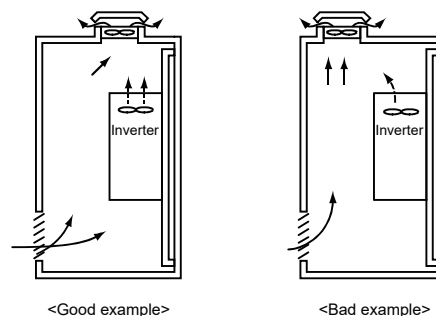


Fig. 7.29 Location of the ventilation fan

(5) Arrangement of the discharging resistor

When using a discharging resistor or externally installed high-duty brake resistor (FR-ABR), take necessary countermeasures against the heat generated from the resistor.

Consider the cooling system regarding the resistor as a heater.

It is recommended to install the discharging resistor outside the enclosure.

Provide a cover which has a strong heat dissipation effect to prevent danger such as burn injury.

Use a cooling fan as required.

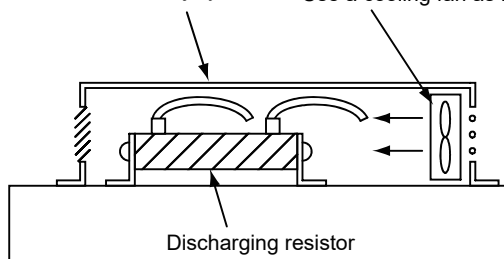


Fig. 7.30 Installing method of the resistor

Caution: The temperature of the resistor surface may increase up to approximately 300°C. Pay attention to the material of the installation side and the arrangement of multiple resistors.

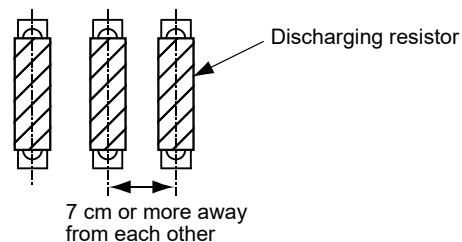
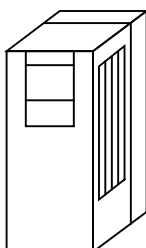


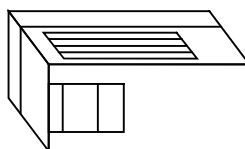
Fig. 7.31 Arrangement of the resistors

(6) Installation orientation of the inverter

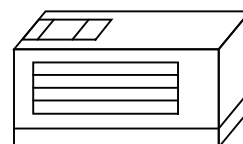
If the installing orientation is not correct, the heat dissipation effect of the inverter is reduced significantly, and the generated heat remains inside the inverter. (The printed plate of the control circuit is not cooled by a cooling fan.)



<Good example>
Vertical installation



<Bad example>
Side installation



<Bad example>
Horizontal installation

Fig. 7.32 Installation orientation of the inverter

(7) Standard specifications of the installation environment (for the FR-E800 series 200 V class)

Item	Description
Surrounding air temperature	-20°C to +60°C (The rated current must be derated at a temperature above 50°C.)
Ambient humidity	With circuit board coating: 95% RH or less (non-condensing) Without circuit board coating: 90% RH or less (non-condensing)
Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
Altitude	Maximum 3000 m
Vibration	5.9 m/s ² or less at 10 to 55 Hz (in either X, Y, or Z direction)
AC voltage/frequency	Three-phase 200 to 240 V, 50/60 Hz
Permissible voltage fluctuation	170 to 264 V, 50/60 Hz
Permissible frequency fluctuation	±5%

7 REVIEW OF INSTALLATION ENVIRONMENT

- Temperature

- (a) Measures against high temperature

- 1) Use a forced ventilation system or similar cooling system. (Refer to (4).)
- 2) Install the enclosure in an air-conditioned electric chamber.
- 3) Block direct sunlight.
- 4) Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
- 5) Ventilate the area around the enclosure well.

- (b) Measures against low temperature

- 1) Provide a space heater in the enclosure.
- 2) Do not power OFF the inverter. (Keep the start signal of the inverter OFF.)

- (c) Sudden temperature changes

- 1) Select an installation place where temperature does not change suddenly.
- 2) Avoid installing the inverter near the air outlet of an air conditioner.
- 3) If temperature changes are caused by opening/closing of a door, install the inverter away from the door.

- Humidity

Operate the inverter within the ambient air humidity of usually 45 to 90% (up to 95% with circuit board coating). Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may cause a spatial electrical breakdown. The humidity conditions for the insulation distance defined in JEM 1103 standard "Insulation Distance from Control Equipment" is 45 to 85%.

- (a) Measures against high humidity

- 1) Make the enclosure enclosed, and provide it with a hygroscopic agent.
- 2) Provide dry air into the enclosure from outside.
- 3) Provide a space heater in the enclosure.

- (b) Measures against low temperature

Air with proper humidity can be blown into the enclosure from outside. Also, when installing or inspecting the unit, discharge your body (static electricity) beforehand, and keep your body away from the parts and patterns.

- (c) Measures against condensation

Condensation may occur if frequent operation stops change the in-enclosure temperature suddenly or if the outside air temperature changes suddenly. Condensation causes such faults as reduced insulation and corrosion.

- 1) Take the measures against high humidity described in (a).
- 2) Do not power OFF the inverter. (Keep the start signal of the inverter OFF.)

(8) When driving an explosion-proof motor with an inverter

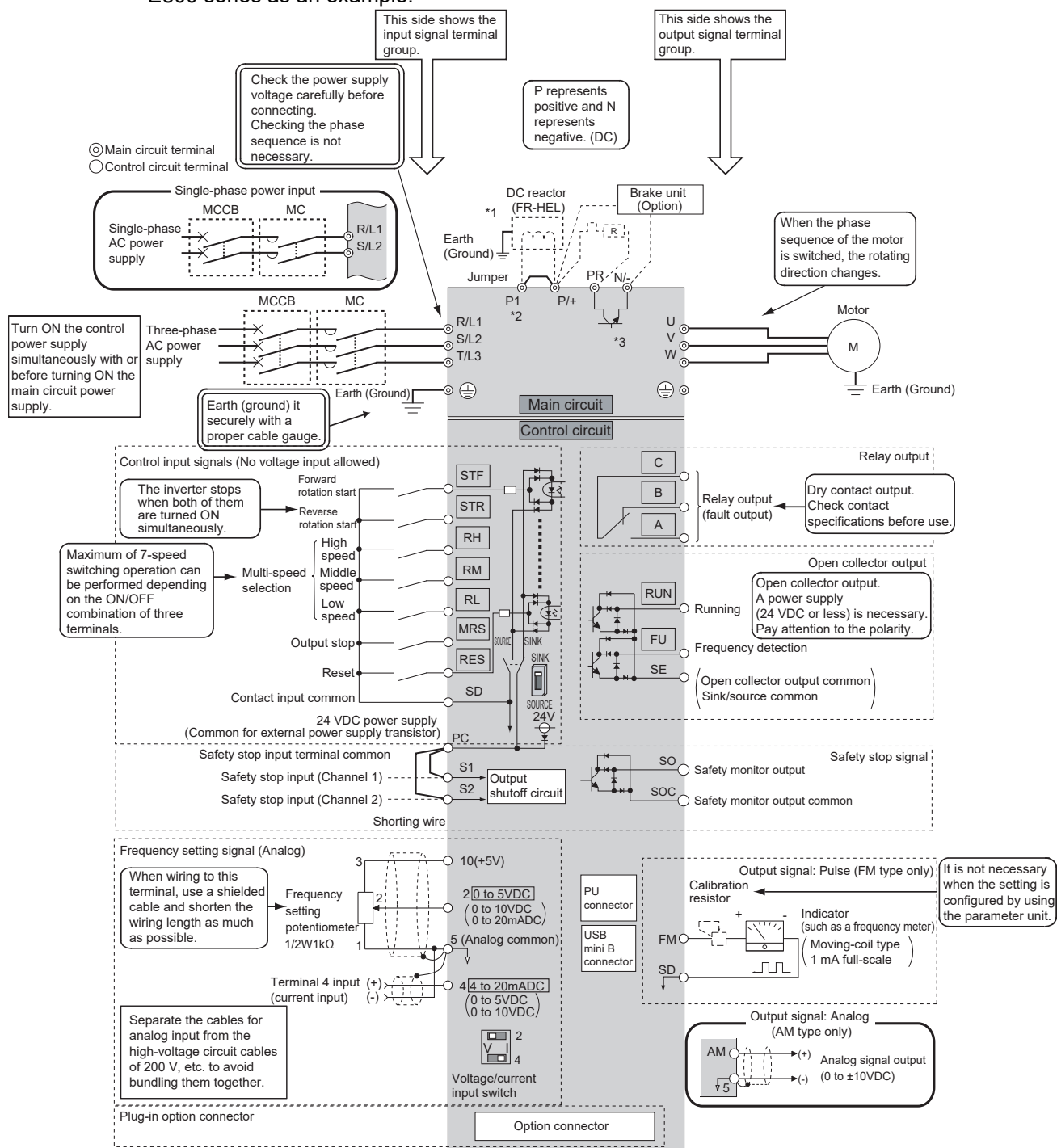
An explosion-proof motor has an authorization system in combination with the driving inverters. Check the following points for installing them.

- (a) For the existing explosion-proof motor for commercial power supply drive and a safety explosion-proof motor, the inverter operation is not available.
The motor must pass the explosion-proof test by Ministry of Health, Labour and Welfare in combination with the inverter. The Technology Institution of Industrial Safety organizes the test.
The combination of the explosion-proof motor and the inverter which has passed the test in advance can be used. However, only the inverters which have the same model (including the capacity) as the one passed the test can be used. Furthermore, operation range is limited within the certified terms.
The inverter-driven dedicated explosion-proof type motor and inverter are prepared by Mitsubishi Electric. For details, refer to the catalog.
- (b) Take the test to use the rating out of the certified terms or model that has not been passed the test.
- (c) When using the inverter option together, refer to the Instruction Manual.
- (d) Using a safety explosion-proof motor in combination with an inverter is not economical not only because it costs the test fee but also the operation condition (such as reduction in incurred loss and improvement of cooling effect) is strictly restricted.
It is recommended to use the explosion-proof motor that has passed the test.
- (e) The inverter itself is not explosion-proof. Always install it in a non-explosion location.

7.3.2 Connection of the inverter

(1) Terminal connection diagram

Connection statuses of various terminals to operate an inverter are described in the catalog. The following explains the specifications and usage notes of these terminals when using the FR-E800 series as an example.



*1 A DC reactor (FR-HEL) cannot be connected to the single-phase 100 V power input models.

*2 Terminal P1 is not available for the single-phase 100 V power input models.

*3 The following models are not equipped with the brake transistor.

FR-E820-0008(0.1K), 0015(0.2K)

FR-E820S-0008(0.1K), 0015(0.2K)

FR-E810W-0008(0.1K), 0015(0.2K)

Fig. 7.33 Terminal connection diagram (FM type)

POINT

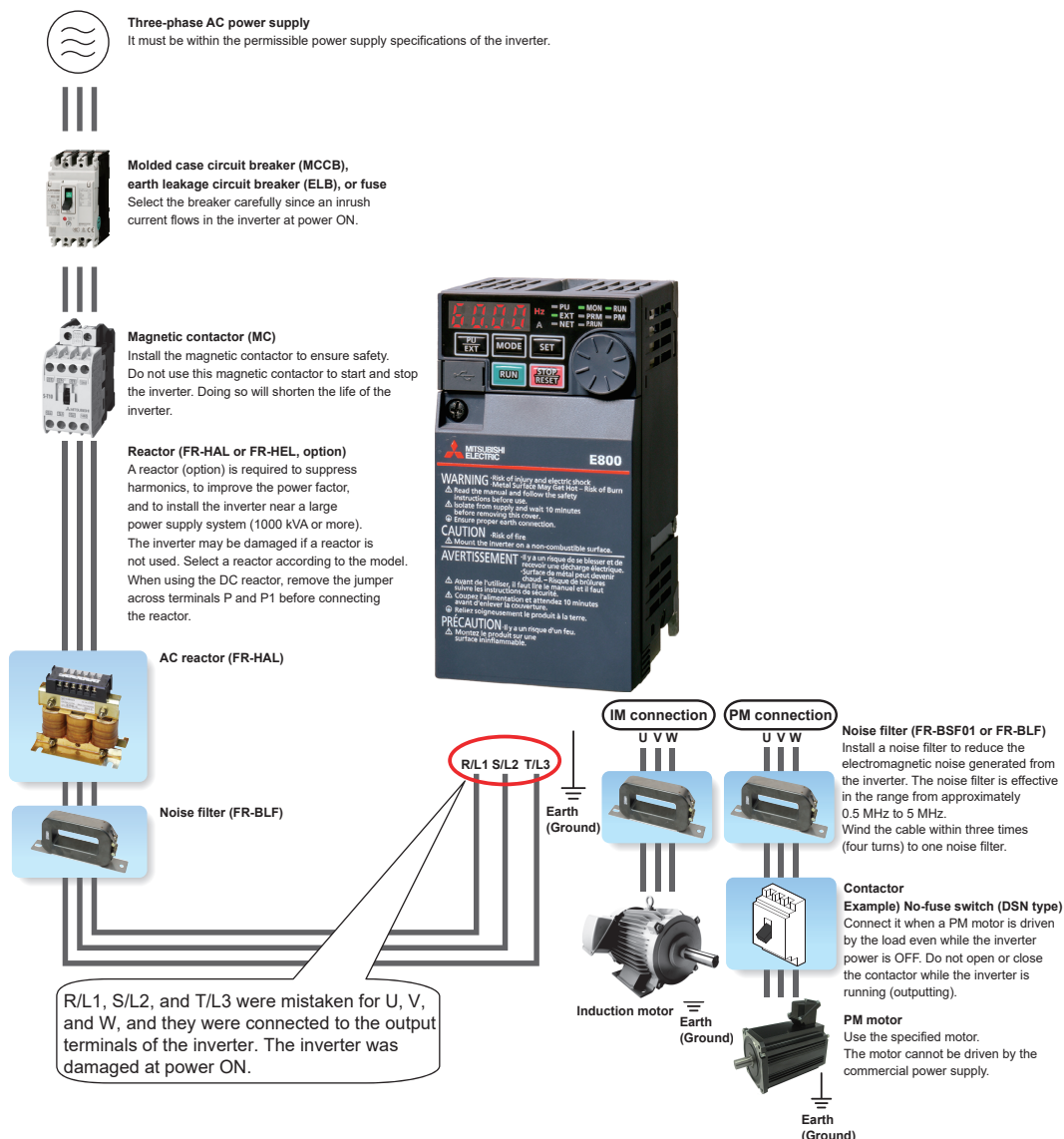
Failure example 1: Wiring for the power supply

[Failure]

Nothing was displayed on the monitor (LED display) when power of the inverter was turned ON.

[Cause]

The commercial power supply inputs R/L1, S/L2, and T/L3 were connected to the inverter output terminals U, V, and W. The display of the power supply itself was incorrect.



7 REVIEW OF INSTALLATION ENVIRONMENT

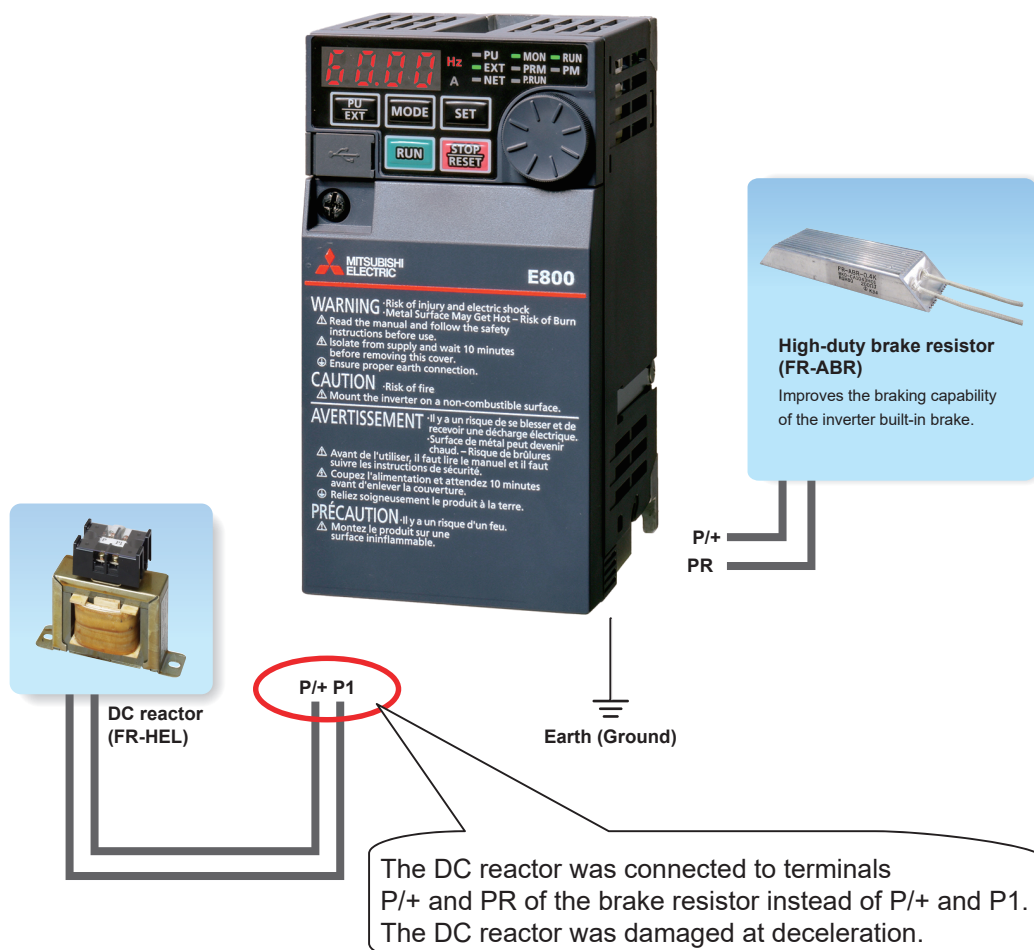
Failure example 2: Incorrect connection of the DC reactor

[Failure]

At a motor test drive, OV was displayed and the DC reactor was burned.

[Cause]

The DC reactor was connected to terminals P/+ and PR of the brake resistor instead of P/+ and P1.



* Single-phase 100 V power input model is not compatible with the DC reactor as terminal P1 is not available. Use the AC reactor.

(2) Connection of the main circuit

Since the main circuit is a power circuit, incorrect connection may not only damage the inverter but also pose a risk to operators. The following figure shows points likely to fail.

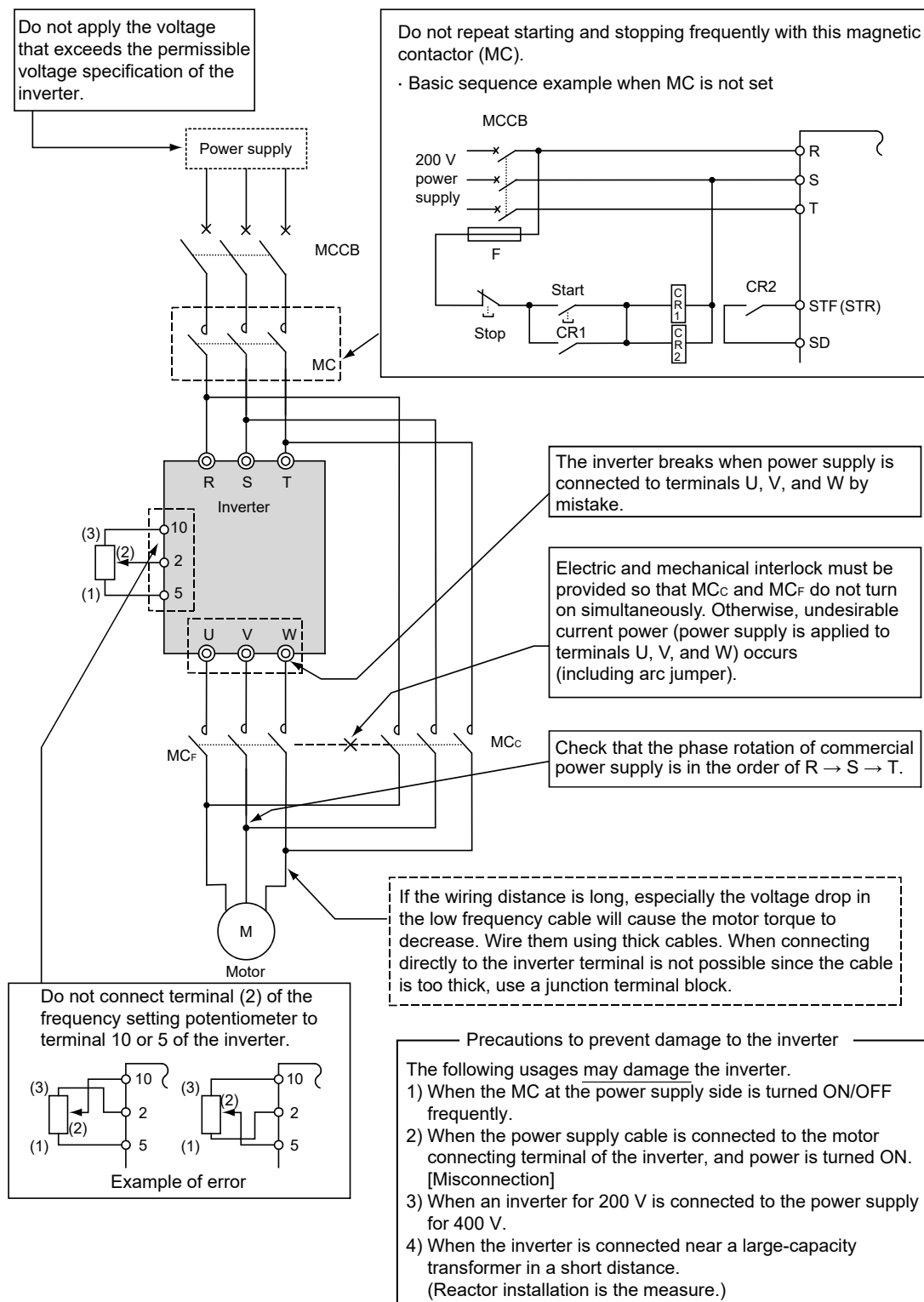


Fig. 7.34 Main circuit connection

(3) Connection of the control circuit

The following table lists the formats of the I/O terminals in the inverter and common terminals.

Terminal	Format	Example of terminal	Common terminal
Input terminal	Contact (or open collector)	Start signal (STF, STR) Selection signal (RH, RM, RL, AU, etc.)	SD or PC (power supply ⊕ common)
	Analog	Frequency setting signal (such as 2, 1, and 4)	5
Output terminal	Contact	Fault output (A, B)	C
	Open collector	Running signal (RUN, SU, OL, IPF, FU)	SE
	Pulse train	For an indicator (frequency meter) (FM)	SD
	Analog	For analog voltage output (AM)	5

(a) Connection to input terminals

1) Contact or open collector input terminal (insulated from the inverter internal circuit)

Each terminal functions by short-circuiting with the common terminal SD. Since the power distribution current is the micro-current (4 to 6 mADC), use switches or relays for micro-current (such as twin contacts) to prevent a contact faults.

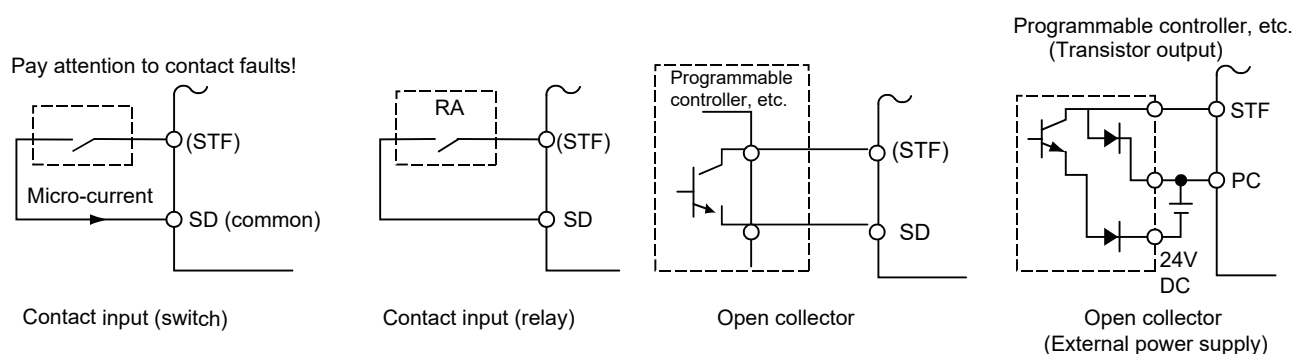


Fig. 7.35 Connection of input signals

2) Analog input terminal (It is not insulated from the inverter internal circuit.)

Separate the cables from the high-voltage circuit cables of 200 V (400 V) to avoid bundling them together. Always use the shielded cable as a countermeasure against the external noise.

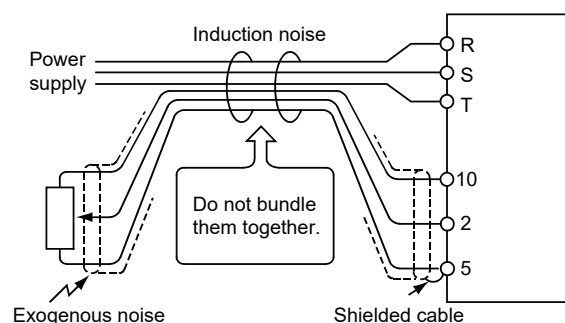


Fig. 7.36 Connection example of the frequency setting input terminal

- 3) How to connect the frequency setting potentiometer correctly
 Each terminal of the frequency setting potentiometer has a terminal symbol. Incorrect connection causes an inverter failure.
 The resistance is also important for selection.
 <Specification> 2 W 1 k Ω Wire-wound variable resistor type B characteristic

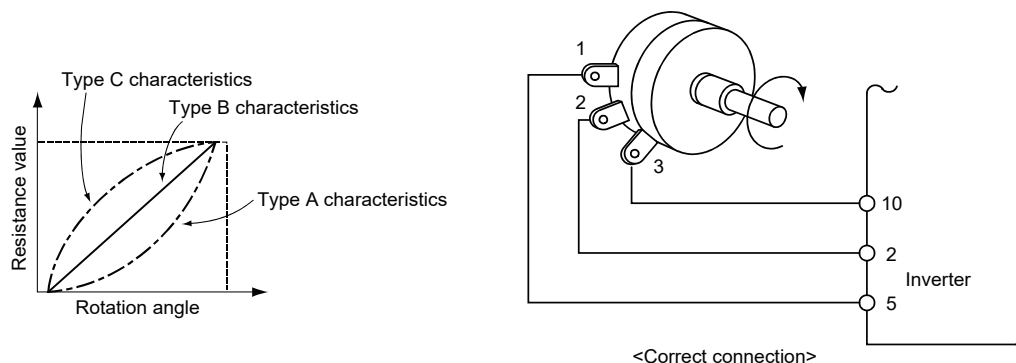
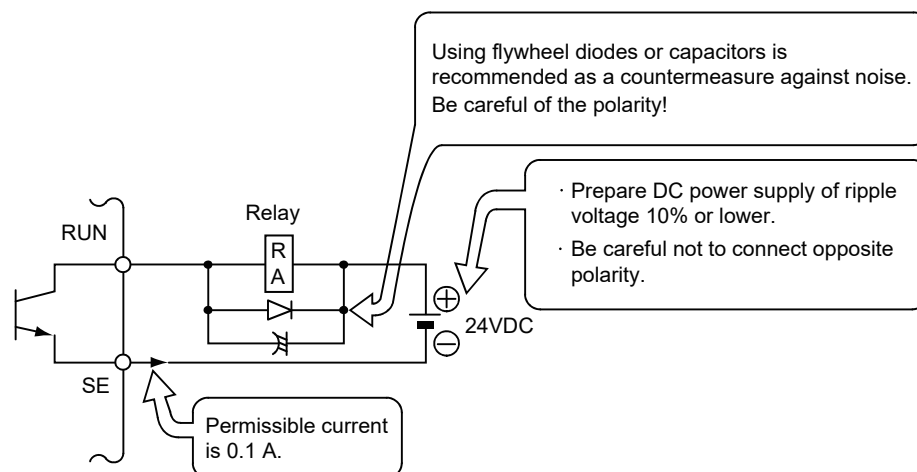


Fig. 7.37 Connection of the frequency setting potentiometer

- (b) Connection to output terminals
 1) Open collector output terminal



- 2) Pulse train output terminal

- 3) Analog voltage output
 (0 to 10 VDC)

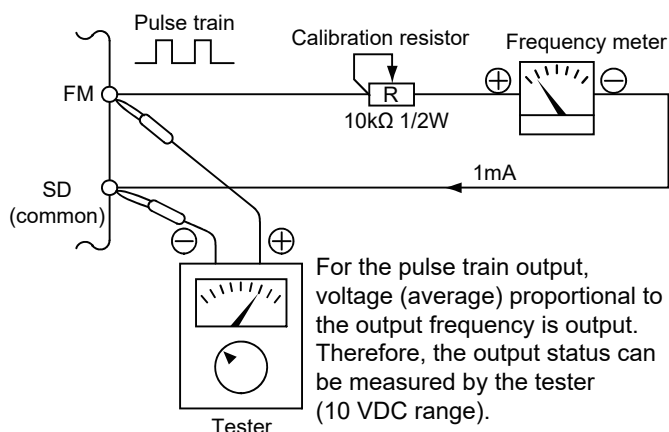
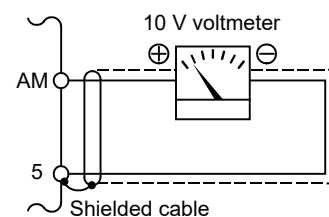


Fig. 7.38 Connection of output signal terminals

(4) Wiring distance of I/O cables

Restrictions differ depending on the I/O terminal. Although the control signals are isolated at the input by photocoupler to improve noise tolerance, they are not isolated for the analog input.

Therefore, pay particular attention to the wiring of the frequency setting signal and shorten the wire length as much as possible or take other countermeasures against the external noise. A guide of the permissible wiring length for each signal and how to handle the length exceeding it are shown in Fig. 7.39.

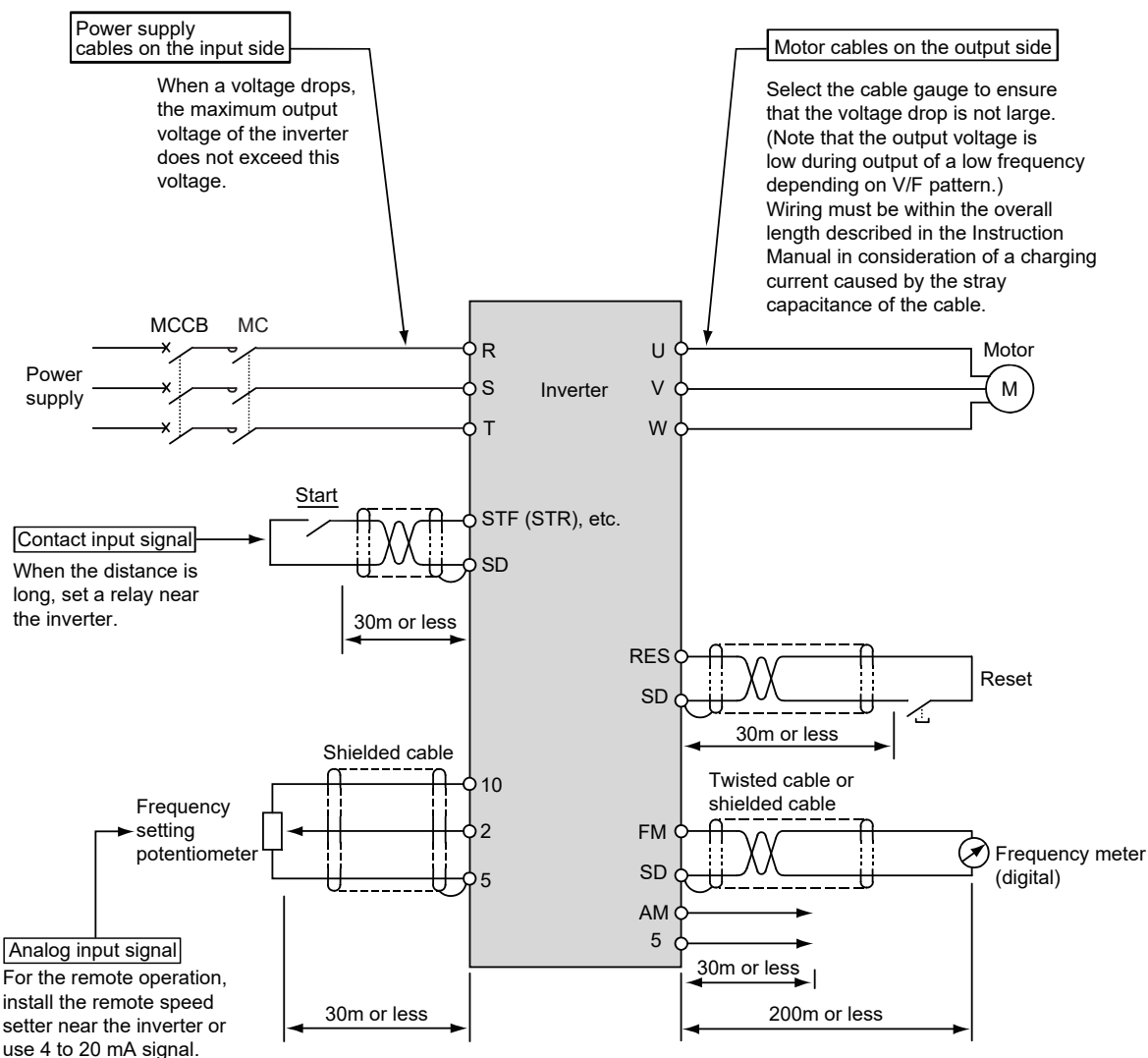
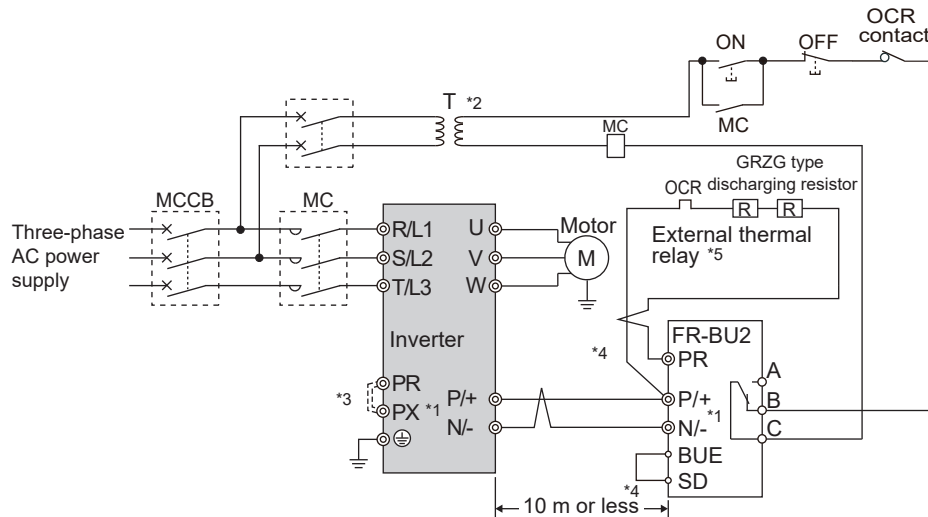


Fig. 7.39 Wiring distance of I/O cables

(5) Wiring of the FR-BU2 brake unit

For the wiring, connect a pair of the FR-BU2 brake unit and discharging resistor or resistor unit to the inverter terminals P/+ and N/-.

(a) FR-BU2 brake unit and the discharging resistor

*1 When wiring, make sure to match the terminal symbols (P/+, N/-) on the inverter and on the brake unit (FR-BU2). (Incorrect connection will damage the inverter and brake unit.)

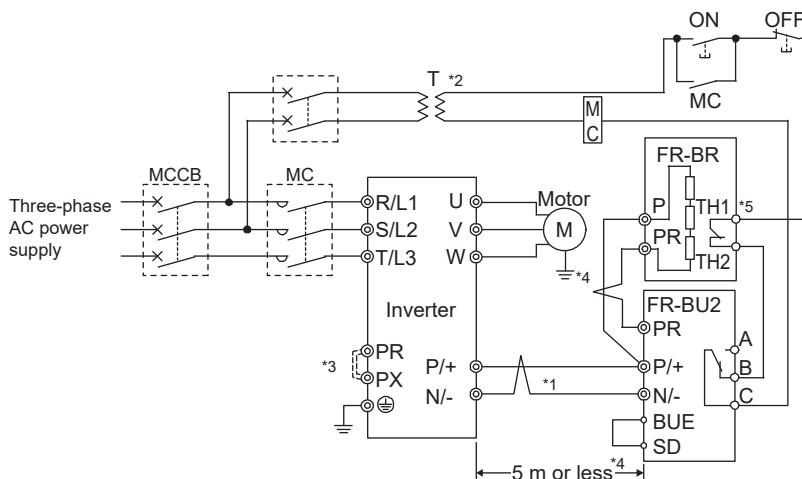
*2 When the power supply is 400 V class, install a stepdown transformer.

*3 Remove the jumper across terminals PR and PX when using the FR-BU2 with the inverter of the FR-A800 series 7.5K or lower or the FR-V500 series 5.5K or lower.

*4 The wiring distance between the inverter, brake unit (FR-BU2), and discharging resistor must be within 5 m. Even when the cable is twisted, the wiring length must be within 10 m.

*5 It is recommended to install an external thermal relay to prevent overheat of the discharging resistor.

Fig. 7.40 Wiring method of the brake unit (GRZG type discharging resistor)

(b) FR-BU2 brake unit and the FR-BR resistor unit

*1 When wiring, make sure to match the terminal symbols (P/+, N/-) on the inverter and on the brake unit (FR-BU2). (Incorrect connection will damage the inverter and brake unit.)

*2 When the power supply is 400 V class, install a stepdown transformer.

*3 Remove the jumper across terminals PR and PX when using the FR-BU2 with the inverter of the FR-A800 series 7.5K or lower or the FR-V500 series 5.5K or lower.

*4 The wiring distance between the inverter, brake unit (FR-BU2), and resistor unit (FR-BR) must be within 5 m. Even when the cable is twisted, the wiring length must be within 10 m.

*5 The contact between TH1 and TH2 is closed in the normal status and is open at a fault.

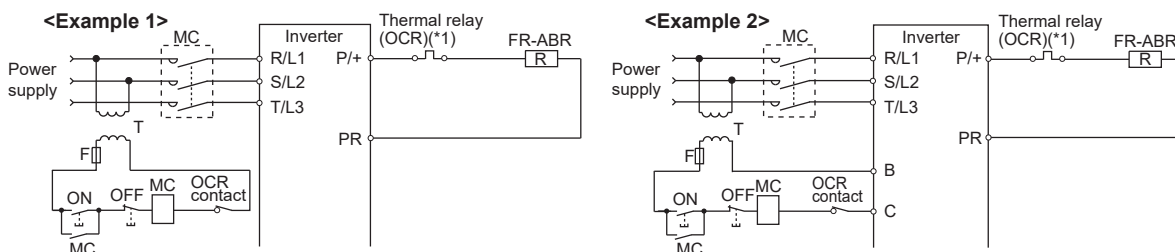
*6 For details on the MT-BR5 type resistor unit, refer to the option catalog.

Fig. 7.41 Wiring method of the brake unit (FR-BR resistor unit)

(6) Wiring of the brake resistor (MRS or MYS) or the high-duty brake resistor (FR-ABR)

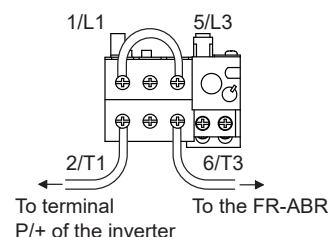
It is recommended to configure a sequence, which shuts off power on the input side of the inverter by the external thermal relay as follows, to prevent overheat and burnout of the brake resistor (MRS, MYS) or the high duty brake resistor (FR-ABR) in case the regenerative brake transistor is damaged.

(Not available for FR-E820(S)-0008(0.1K), FR-E820(S)-0015(0.2K), FR-E810W-0008(0.1K), and FR-E810W-0015(0.2K).)



*1 Refer to the following table for the thermal relay models for each capacity. Refer to the following diagram for the connection. (Always install a thermal relay when using a brake resistor for the inverters with 11K or higher capacity.)

Power supply voltage	Brake resistor	Thermal relay model (Mitsubishi Electric product)	Rated operating current
100 V / 200 V	MRS120W200	TH-T25-0.7A	120 VAC: 2 A (NO contact) / 3 A (NC contact), 240 VAC: 1 A (NO contact) / 2 A (NC contact) (AC15 class) 110 VDC: 0.2 A, 220 VDC: 0.1 A (DC13 class)
	MRS120W100	TH-T25-1.3A	
	MRS120W60	TH-T25-2.1A	
	MRS120W40	TH-T25-3.6A	
	MYS220W50 (two in parallel)	TH-T25-5A	
Power supply voltage	High-duty brake resistor	Thermal relay model (Mitsubishi Electric product)	Rated operating current
100 V / 200 V	FR-ABR-0.4K	TH-T25-0.7A	120 VAC: 2 A (NO contact) / 3 A (NC contact), 240 VAC: 1 A (NO contact) / 2 A (NC contact) (AC15 class) 110 VDC: 0.2 A, 220 VDC: 0.1 A (DC13 class)
	FR-ABR-0.75K	TH-T25-1.3A	
	FR-ABR-2.2K	TH-T25-2.1A	
	FR-ABR-3.7K	TH-T25-3.6A	
	FR-ABR-5.5K	TH-T25-5A	
	FR-ABR-7.5K	TH-T25-6.6A	
	FR-ABR-11K	TH-T25-11A	
	FR-ABR-15K	TH-T25-11A	
	FR-ABR-22K	TH-T65-22A	
400 V	FR-ABR-H0.4K	TH-T25-0.24A	
	FR-ABR-H0.75K	TH-T25-0.35A	
	FR-ABR-H1.5K	TH-T25-0.9A	
	FR-ABR-H2.2K	TH-T25-1.3A	
	FR-ABR-H3.7K	TH-T25-2.1A	
	FR-ABR-H5.5K	TH-T25-2.5A	
	FR-ABR-H7.5K	TH-T25-3.6A	
	FR-ABR-H11K	TH-T25-6.6A	
	FR-ABR-H15K	TH-T25-6.6A	
	FR-ABR-H22K	TH-T25-9A	

**CAUTION**

- Do not use the brake resistor (MRS type, MYS type) with a lead wire extended.
- Do not connect a resistor to terminals P/+ and N/-. Doing so may cause a fire.

7.4 Precautions for storing an inverter in the enclosure

Refer to Fig. 7.42 for precautions for enclosure storage.

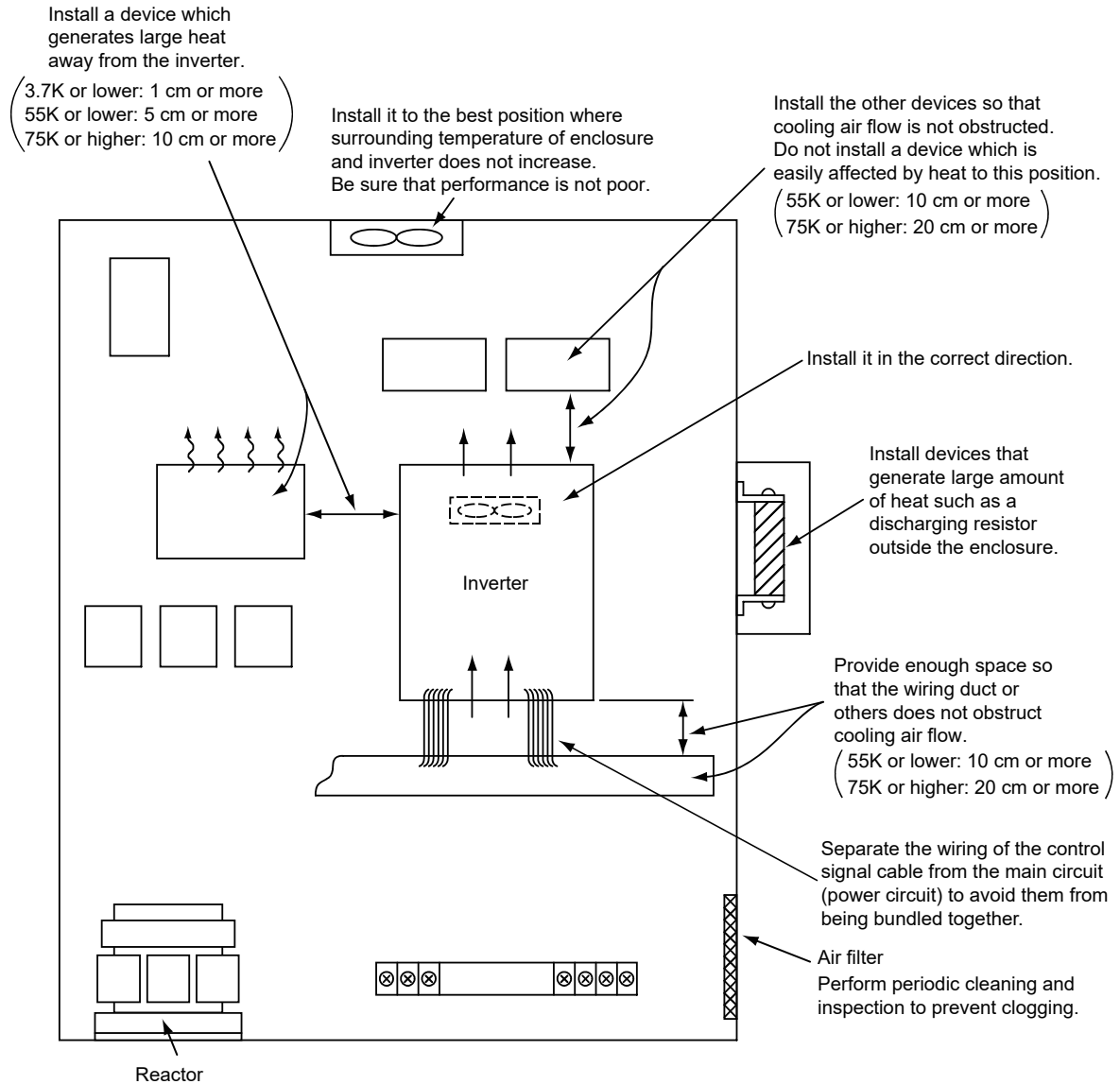


Fig. 7.42 Precautions for enclosure storage

POINT

Failure example 1: Inverter failure due to leaking

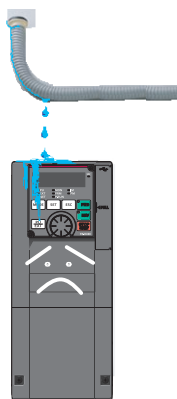
[Failure]

An inverter in an enclosure installed outside stopped on a rainy day.

[Cause]

A short-circuit of the internal circuit board was found on the investigation of the inverter in the enclosure.

A detailed examination inside the enclosure revealed that rain had trickled from the accordion hose (for storing wires) to the inverter.



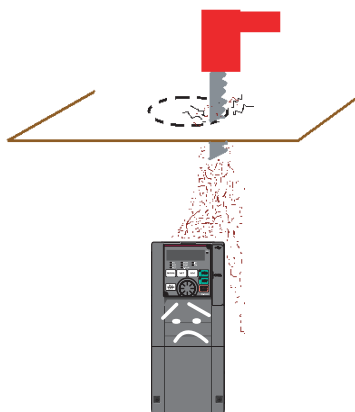
Failure example 2: Inverter failure due to foreign object

[Failure]

Nothing was displayed on the monitor (LED display) when power of the inverter was turned ON.

[Cause]

A short-circuit of the internal circuit board was found on the investigation of the inverter in the enclosure. According to the enclosure manufacturer, post-installation processing related to the upper pipe added to the enclosure was performed, resulting in significant cutting chips.



[Similar failure]

After the cables are stripped during processing, the wire length is adjusted, causing the cutting chips to fall onto the inverter.



- Dust, dirt, oil mist

Dust and dirt will cause such faults as poor contacts, reduced insulation and cooling effect due to the moisture-absorbed accumulated dust and dirt, and in-enclosure temperature rise due to a clogged filter.

In an atmosphere where conductive powder floats, dust and dirt will cause such faults as malfunction, deteriorated insulation and short circuit in a short time.

Since oil mist will cause similar conditions, it is necessary to take adequate measures.

Countermeasures

(a) Place the inverter in a totally enclosed enclosure.

Take measures if the in-enclosure temperature rises.

(b) Purge air.

Pump clean air from outside to make the in-enclosure air pressure higher than the outside air pressure.

- Corrosive gas, salt damage

If the inverter is exposed to corrosive gas or to salt near a beach, the printed board patterns and parts will corrode or the relays and switches will result in poor contact.

In such places, take the measures given in (a) and (b) of the previous paragraph.

- Explosive, flammable gases

As the inverter is non-explosion proof, it must be contained in an explosion-proof enclosure. In places where explosion may be caused by explosive gas, dust, or dirt, an enclosure cannot be used unless it structurally complies with the guidelines and has passed the specified tests. This makes the enclosure itself expensive (including the test charges).

The best way is to avoid installation in such places and install the inverter in a non-hazardous place.

- High altitude

Use the inverter at an altitude of within 1000 m. For use at an altitude above 1000 m (up to 3000 m for the FR-E800), consider a 3% reduction in the rated current per 500 m increase in altitude. If it is used at a higher place, it is likely that thin air will reduce the cooling effect and low air pressure will deteriorate dielectric strength.

- Vibration, impact

The vibration resistance of the inverter is up to 5.9 m/s^2 * at 10 to 55 Hz frequency (directions of X, Y, Z axes).

Applying vibration and impacts for a long time may loosen the structures and cause poor contacts of connectors, even if those vibration and impacts are within the specified values.

* 2.9 m/s^2 depending on the capacity.

Especially, repeated impacts require attention because accidents including installation feet damage are likely to occur.

Countermeasures

(a) Provide the enclosure with rubber vibration isolators.

(b) Strengthen the structure to prevent the enclosure from resonance.

(c) Install the enclosure away from the sources of the vibration.

CHAPTER 8 LIFE OF INVERTER PARTS

8.1 Replacement of parts

The inverter consists of many electronic parts such as semiconductor devices.

The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or fault of the inverter. For preventive maintenance, the parts must be replaced periodically.

For 800 series inverters, use the life check function as a guidance of parts replacement.

Replacement of inverter parts (800 series inverters)

Part name	Estimated lifespan ^{*1}	Description
Cooling fan	10 years	Replace (as required)
Main circuit smoothing capacitor	10 years ^{*2}	Replace (as required)
On-board smoothing capacitor	10 years ^{*2}	Replace the board (as required)
Relays	—	As required

*1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C.
(without corrosive gas, flammable gas, oil mist, dust and dirt etc.)

*2 Output current: 80% of the inverter rating

POINT

In the table above, only the cooling fan is user-replaceable. All other parts require manufacturer service.

(1) Cooling fans

The estimated life of the bearing of the cooling fan used for cooling the heat-generating parts such as the main circuit semiconductor device is 87600 hours (for the 800 series inverters). Therefore, the parts including the cooling fan in continuous operation should usually be replaced once in every 10 years. The replacement interval is greatly affected by the surrounding air temperature. When unusual noise and/or vibration are noticed during inspection, the cooling fan must be replaced immediately.

The 800 series inverters have a function to set the ON/OFF control of the cooling fan. With the ON/OFF control setting, the cooling fan life can be longer. Also, a cassette type cooling fan can be replaced easily.

(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc. Replacement intervals vary greatly with surrounding temperatures and operating conditions. Replace them roughly every 10 years when used in normal air-conditioned environments. The capacitors are deteriorated rapidly since a certain time period has passed. Therefore, perform the inspection at least once in every year (once in every half-year is recommended near the end of the capacitor's life).

The appearance criteria for inspection are as follows:

- 1) Case: Check the side and bottom faces for expansion.
- 2) Sealing plate: Check for a remarkable warp and extreme crack.
- 3) Explosion-proof valve: Check for remarkable expansion and operation.
- 4) Check for an external crack, discoloration, and liquid leakage etc.

Judge that the capacitor has reached its life when the measured capacitance of the capacitor reduced below 85% of the rating for the A800, and below 80% for the E800. The inverter has a function to diagnose capacitor life.

Remark

Continuous use of a deteriorated capacitor may lead to a burst, breakage, or fire.
Replace any such capacitor without delay if found during inspection.

(3) Relays

The contacts of relays deteriorate over time. To prevent faults from occurring, relays must be replaced when they have reached the maximum of switching operations (switching life).

The control circuit terminal block must be replaced in case of failure of the relay connected to the relay output terminals A, B, and C. (Refer to page 4-12.) Other parts which have a short life, such as lamps, must be replaced with new ones when performing the periodic inspection.

8.2 Inverter parts life display

The degree of deterioration of the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, relay contacts of terminals A, B, and C, inverter module, and control circuit board can be diagnosed on the monitor. When a part approaches the end of its life, a warning can be output by self diagnosis to prevent a fault. (Note that the life diagnosis of this function should be used as a guideline only, the life values are theoretical calculations.)

Parameter number	Name	Initial value	Setting range	Description
E709 (198)	Display corrosion level	1	(1 to 3)	Displays the corrosion level of the control circuit board. Read-only. (Available only for FR-E800 coated models (-60/-06).)
E700 (255)	Life alarm status display	0	(0 to 1007) *1	Displays whether or not the life alarm output level is reached for the following parts: the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, relay contacts of terminals A, B, and C, inverter module, and control circuit board. Read-only.
E701 (256)	Inrush current limit circuit life display	100%	(0% to 100%)	Displays the deterioration degree of the inrush current limit circuit. Read-only.
E702 (257)	Control circuit capacitor life display	100%	(0% to 100%)	Displays the deterioration degree of the control circuit capacitor. Read-only.
E703 (258)	Main circuit capacitor life display	100%	(0% to 100%)	Displays the deterioration degree of the main circuit capacitor. Read-only. The value measured by E704 (Pr.259) is displayed.
E704 (259)	Main circuit capacitor life measuring	0	0, 1 (2, 3, 8, 9)	Setting "1" and turning the power supply OFF starts the measurement of the main circuit capacitor life. If the setting value of E704 (Pr.259) becomes "3" after turning the power supply ON again, it means that the measurement is completed. The deterioration degree is read to E703 (Pr.258).
E705 (506)	Display estimated main circuit capacitor residual life	100%	(0% to 100%)	Displays the estimated residual life of the main circuit capacitor. Read-only.
E706 (507)	Display/reset ABC relay contact life	100%	0% to 100%	Displays the degree of deterioration of the relay contacts of terminals A, B, and C.
E707 (508)*2	Display/reset ABC2 relay contact life	100%	0% to 100%	Displays the degree of deterioration of the relay contacts of terminals A2, B2, and C2.
E708 (509)	Display power cycle life	100%	(0% to 100%)	Displays the degree of deterioration of the inverter module. Read-only.

*1 The setting range (read-only) depends on the inverter.

*2 The setting is available for the IP67 model only.

Remark

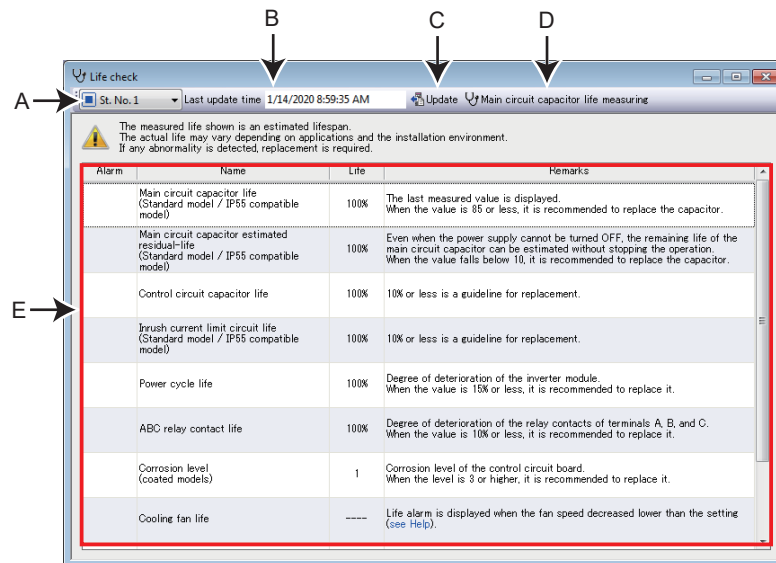
For details on life diagnosis parameters, refer to page 8-8.

8.3 Life check (FR Configurator2: FR-E800)

POINT

The life check items vary depending on the model. For models other than the FR-E800, refer to the Instruction Manual of each model.

Select [Life check...] in the [Diagnose] menu to display the "Life check" window as a sub window.



Symbol	Name	Function/description
A	St. No. selection (Station number selection)	Select a station for the life check.
B	Last update time	Displays the last update time (system clock time of the personal computer).
C	Update	Updates the life information data.
D	Main circuit capacitor life measuring	Starts life measuring of the main circuit capacitor.
E	Parts life information	Displays parts life information read from the inverter.  mark is shown in the alarm field for the parts recommended to be replaced.

Remark

The latest status can be checked by updating the information in online mode. However, the main circuit capacitor life section is not shown unless the main circuit capacitor life measurement is performed.

Name	Initial value	Display range	Remarks
Life of main circuit capacitor (Standard models and IP67 models)	100%	0% to 100%	The last measured value of main circuit capacitor life is shown. 85% or less is a guideline for replacement.
Estimated residual-life of main circuit capacitor (Standard models and IP67 models)	100%	0% to 100%	Even when the power supply cannot be turned OFF, the remaining life of the main circuit capacitor can be estimated without stopping the operation. When the value falls below 10%, it is recommended to replace it.
Control circuit capacitor life	100%	0% to 100%	When the value falls below 10%, it is recommended to replace it.
Inrush current limit circuit fault (Standard models and IP67 models)	100%	0% to 100%	10% or less is a guideline for replacement.
Power cycle life	100%	0% to 100%	Degree of deterioration of the inverter module. 15% or less is a guideline for replacement.
ABC relay contact life	100%	0% to 100%	Degree of deterioration of the relay contacts of terminals A, B, and C. 10% or less is a guideline for replacement.
Corrosion level (coated models)	1	1 to 3	Corrosion level of the control circuit board. When the level is 3 or higher, it is recommended to replace it.
Cooling fan life			Life alarm is displayed when the fan speed decreased lower than the specified speed.
Cumulative energization time	0 h	Cumulative time	The cumulative energization time since the inverter shipment is shown.
Actual operation time	0 h	Cumulative time	The cumulative operation time is shown.

POINT

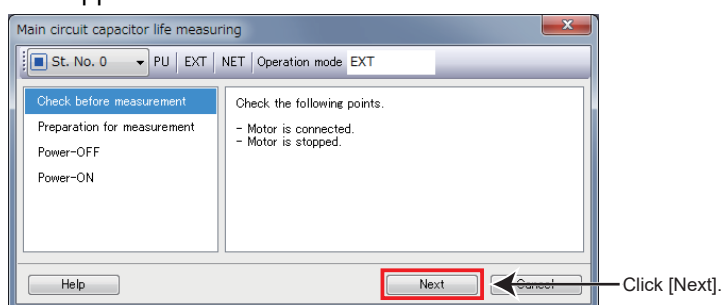
For accurate life measurement of the main circuit capacitor, wait three hours or longer after turning OFF the power supply as the temperature left in the main circuit capacitor affects measurement.

8.3.1 Procedure of main circuit capacitor life measuring

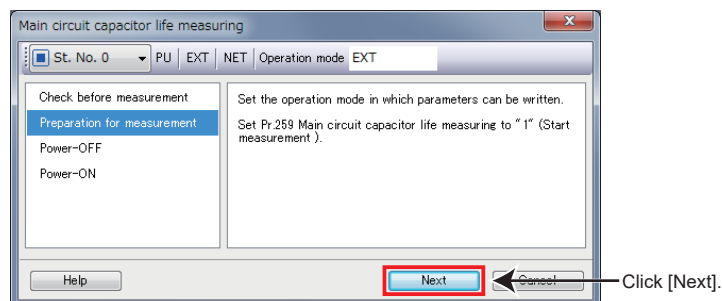
- 1) The "Check before measurement" instructions are shown. Check the following items, and click [Next].

Motor is connected.

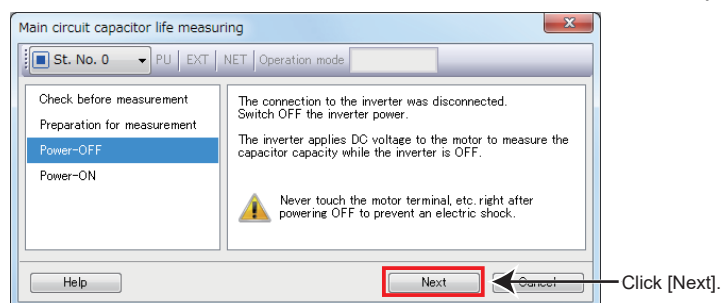
Motor is stopped.



- 2) The "Preparation for measurement" instructions are shown. Set the operation mode in which parameters can be written and click [Next]. Set E704 (Pr.259) Main circuit capacitor life measuring to "1".



- 3) The "Power-OFF" instructions are shown. Turn OFF the inverter power, and click [Next].

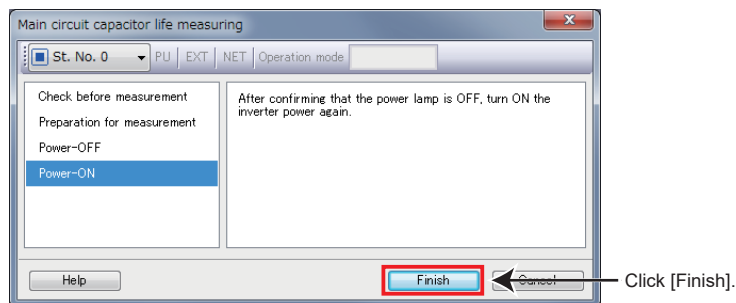


WARNING

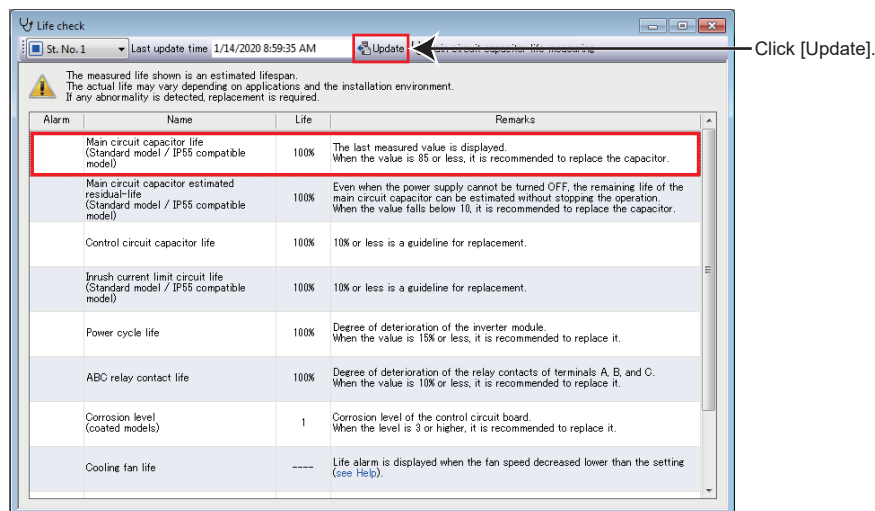
⚠ When measuring the main circuit capacitor capacity (E704 (Pr.259) Main circuit capacitor life measuring = "1"), the DC voltage is applied to the motor for about one second at power OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.

8 LIFE OF INVERTER PARTS

- 4) The "Power-ON" instructions are shown. After confirming that the power lamp is OFF, switch ON the inverter power again, and click [Finish].



- 5) After the online connection is established in FR Configurator2, click [Update] in the "Life check" window to display the measured results.



POINT

- For parts replacement, consult the nearest Mitsubishi Electric FA Center.
- Since this demonstration machine has special specifications, performing the main circuit capacitor life measurement procedure results in an error. Instead, perform the main circuit capacitor estimated residual-life measurement procedure.

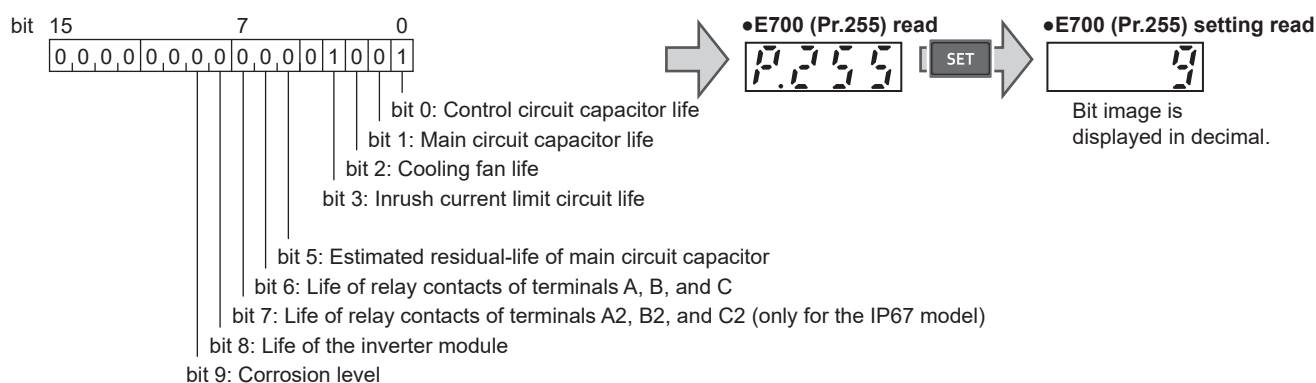
8.3.2 Life diagnosis parameter details

(1) Life alarm display and signal output (Y90 signal, E700 (Pr.255))

POINT

In the life diagnosis of the main circuit capacitor, the Life alarm (Y90) signal is not output unless measurement by turning OFF the power supply is performed.

- E700 (Pr.255) Life alarm status display and the Life alarm (Y90) signal can be used to check whether or not the life alarm output level is reached for the following parts: the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, relay contacts of terminals A, B, and C, inverter module, or control circuit board.



- When the parts have reached the life alarm output level, the corresponding bits of E700 (Pr.255) turns ON. The ON/OFF state of the bits can be checked with E700 (Pr.255). The following table shows examples.

E700 (Pr.255)		bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Remarks
Decimal	Binary											
879	1101101111	○	○	×	○	○	×	○	○	○	○	All parts have reached alarm output level for standard model.
5	101	×	×	×	×	×	×	×	○	×	○	Control circuit capacitor and cooling fan have reached alarm output level.
0	0	×	×	×	×	×	×	×	×	×	×	No parts have reached alarm output level.

○: Parts reaching alarm output level ×: Parts not reaching alarm output level

- The Life alarm (Y90) signal turns ON when the warning level is reached for either of the following: the control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life, the estimated residual-life of the main circuit capacitor, life of relay contacts of terminals A, B, and C, life of relay contacts of terminals A2, B2, and C2 (only for the IP67 model), life of the inverter module, or life of the control circuit board.
- For the terminal used for the Y90 signal, set "90" (positive logic) or "190" (negative logic) in any parameter from M400 (Pr.190) to M406 (Pr.197) (Output terminal function selection).

POINT

- Changing the terminal assignment using M400 (Pr.190) to M406 (Pr.197) (Output terminal function selection) may affect the other functions. Set parameters after confirming the function of each terminal.
- For replacement of each part, contact the nearest Mitsubishi FA center.

(2) Life display of the inrush current limit circuit (E701 (Pr.256))

- The life of the inrush current limit circuit (relay, contactor and inrush resistor) is displayed in E701 (Pr.256).
- The number of contact (relay, contactor, thyristor) ON times is counted, and it is counted down from 100% (0 time) every 1%/10,000 times. When the counter reaches 10% (900,000 times), bit 3 of E700 (Pr.255) is turned ON and the Y90 signal is also output as an alert.

(3) Life display of the control circuit capacitor (E702 (Pr.257))

- The deterioration degree of the control circuit capacitor is displayed in E702 (Pr.257).
- In the operating status, the control circuit capacitor life is calculated from the energization time and temperature, and is counted down from 100%. When the counter goes down from 10%, bit 0 of E700 (Pr.255) is turned ON and the Y90 signal is also output as an alert.

(4) Life display of the main circuit capacitor (E703 (Pr.258), E704 (Pr.259))

POINT

For accurate life measurement of the main circuit capacitor, wait three hours or longer after turning OFF. The temperature left in the main circuit capacitor affects measurement.

- The deterioration degree of the main circuit capacitor is displayed in E703 (Pr.258).
- With the main circuit capacitor capacity at factory shipment as 100%, the capacitor life is displayed in E703 (Pr.258) every time measurement is made. When the measured value falls to 85% or lower, bit 1 of E700 (Pr.255) turns ON and the Y90 signal is also output as an alert.
- Measure the capacitor capacity according to the following procedure and check the deterioration degree of the capacitor capacity.
 - 1) Check that the motor is connected and at a stop.
 - 2) Set "1" (measuring start) in E704 (Pr.259).
 - 3) Switch the power OFF. The inverter applies DC voltage to the motor to measure the capacitor capacity while the inverter is OFF.
 - 4) After confirming that the LED of the operation panel is OFF, power ON again.
 - 5) Check that "3" (measurement complete) is set in E704 (Pr.259), read E703 (Pr.258), and check the deterioration degree of the main circuit capacitor.

E704 (Pr.259)	Description	Remarks
0	No measurement	Initial value
1	Start measurement	Measurement starts when the power supply is switched OFF.
2	During measurement	Only displayed and cannot be set.
3	Measurement complete	
8	Forced end	
9	Measurement error	

POINT

- When the main circuit capacitor life is measured under the following conditions, "forced end" (E704 (Pr.259) = "8") or "measurement error" (E704 (Pr.259) = "9") may occur, or the status may remain in "measurement start" (E704 (Pr.259) = "1").
To perform measurement, first eliminate the following conditions.
Under the following conditions, even if "measurement complete" (E704 (Pr.259) = "3") is reached, measurement cannot be performed correctly.

Condition in which measurement cannot be performed	Condition in which the measured value may fluctuate
<ul style="list-style-type: none"> FR-HC2 or FR-XC is connected. The power supply is switched ON during measurement. The motor is not connected to the inverter. The inverter output is shut off or a fault occurred while the power was OFF. The inverter output is shut off with the MRS signal. The start command is given while measuring. The EtherCAT communication is used or the control using the controlword is enabled. 	<ul style="list-style-type: none"> DC power supply is connected to terminals P/+ and N/-. The motor is running (coasting). The motor capacity is smaller than the inverter capacity by two ranks or more. The applied motor setting is incorrect. The parameter unit (FR-PU07) is connected. Terminal PC is used for power supply. An I/O terminal of the control circuit terminal block or the plug-in option is ON (continuity). A plug-in option is installed (only for 0.75K or lower). "EV" is displayed on the operation panel (main circuit power supply is OFF, during 24 V external power supply operation).

- Operation environment: Surrounding air temperature (annual average of 40°C (free from corrosive gas, flammable gas, oil mist, dust and dirt)).
Output current: 80% of the inverter rating
- Since repeated inrush currents at power ON will shorten the life of the converter circuit, frequent starts and stops of the magnetic contactor must be avoided.

**WARNING**

⚠ When measuring the main circuit capacitor capacity (E704 (Pr.259) = "1"), the DC voltage is applied to the motor for about 1 second at power OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.

(5) Life display of the cooling fan

- If a cooling fan speed of less than the specified speed is detected, Fan alarm "FN" is displayed on the operation panel or the parameter unit. As an alert output, bit 2 of E700 (Pr.255) turns ON, and the Y90 signal and Alarm (LF) signal are also output.
- For the terminal used for the LF signal, set "98" (positive logic) or "198" (negative logic) in any parameter from M400 (Pr.190) to M406 (Pr.197) (Output terminal function selection).

POINT

- When the inverter is mounted with two or more cooling fans, "FN" is displayed even only one of the fans is detected.
- Changing the terminal assignment using M400 (Pr.190) to M406 (Pr.197) (Output terminal function selection) may affect the other functions. Set parameters after confirming the function of each terminal.

(6) Display estimated main circuit capacitor residual life (E705 (Pr.506))

- Even when the power supply cannot be turned OFF, the remaining life of the main circuit capacitor can be estimated without stopping the operation. Note that the remaining life of the main circuit capacitor estimated by this function is theoretical, and should be used as a guideline only.
- The estimated residual life of the main circuit capacitor is displayed in E705 (Pr.506).
- The remaining life of the main circuit capacitor is calculated from the energization time and the inverter output power (100% = Start of service life). When the remaining life of the main circuit capacitor falls below 10%, bit 5 of E700 (Pr.255) turns ON and a warning is output by the Y90 signal.

(7) Life display of the relay contacts of terminals A, B, and C (E706 (Pr.507), E707 (Pr.508))

- The degree of deterioration of the relay contacts of terminals A, B, and C is displayed in E706 (Pr.507), and that for terminals A2, B2, and C2 is displayed in E707 (Pr.508) (only for the IP67 model).
- The number of times the contacts of relay turn ON is counted down from 100% (0 time) by 1% (500 times). When the counter reaches 10% (45000 times), bit 6 or bit 7 (IP67 model only) of E700 (Pr.255) turns ON and a warning is output by the Y90 signal.
- Any value can be set in E706 (Pr.507) and E707 (Pr.508) (IP67 model only).

(8) Life display of the inverter module (E708 (Pr.509))

- The degree of deterioration of the inverter module is displayed in E708 (Pr.509).
- The degree of deterioration of the inverter module is determined by the change in the surrounding air temperature of the module. (The degree is counted down from 100% (no deterioration).) When the remaining life of the inverter module reaches 15%, bit 8 of E700 (Pr.255) turns ON and a warning is output by the Y90 signal.

(9) Environmental impact diagnosis function (corrosion level display) (E709 (Pr.198))

- The risk of the inverter's corrosive damage (degree of corrosion) can be checked by using a metal corrosion sensor.
- The degree of corrosion is monitored using the metal corrosion sensor (the degree is counted up from level 1). Use E709 (Pr.198) to check the corrosion level. When level 3 is reached, bit 9 of E700 (Pr.255) turns ON, a warning is output by the Y90 signal, and "Cor" appears on the LCD display of the operation panel.
- The following table shows the details of the corrosion level.

Level	Possibility of danger	Definition	Remaining design life (estimation)*1	Warning output
1	0% to 5%	Corrosion that may affect the inverter is very unlikely to occur.	—	Not output
2	6% to 24%	Corrosion that may affect the inverter is likely to occur. Users should improve the environment (by a filter or ventilation).	Corrosive damage may cause faults of the inverter in a period 16 times as long as the service life so far.	Not output
3	25% to 100%	Corrosion that may affect the inverter is very likely to occur. Users should improve the environment (by a filter or ventilation). Consider replacing the inverter early as required.	Corrosive damage may cause faults of the inverter in a period 4 times as long as the service life so far.	Output

*1 Means the remaining service life from when the level is reached. For example, a fault may occur after 4 months if level 3 is reached in a month, and after 12 years if level 3 is reached in 3 years.

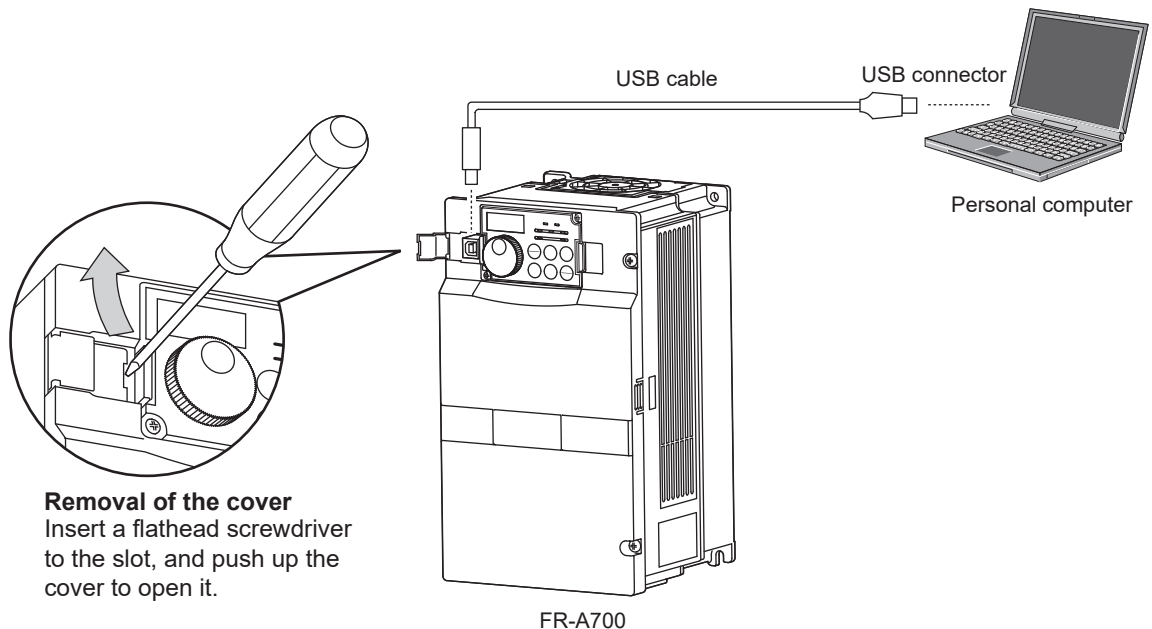
Memo

CHAPTER 9 REPLACEMENT PROCEDURE

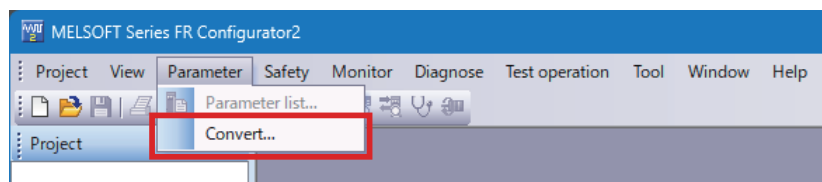
This chapter describes how to replace the Mitsubishi Electric inverter FR-A700 series with FR-A800 series.

9.1 Saving FR-A700 parameters and replacing with FR-A800 parameters

- (1) Prepare a personal computer where FR Configurator2 (SW1DND-FRC2-E) is installed and a cable for inverter connection.
- (2) Turn ON the FR-A700.
- (3) Connect the personal computer with the FR-A700.

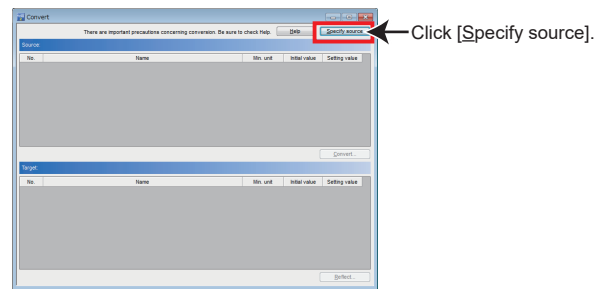


- (4) Turn ON the computer and start FR Configurator2 (SW1DND-FRC2-E). To display the "Convert" window, select [Convert] in the [Parameter] menu.

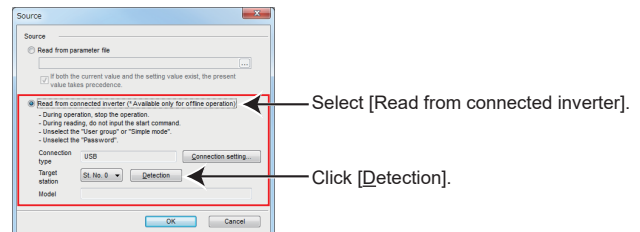


- (5) Check the online condition. (Click  on the menu bar to switch the condition to online.)

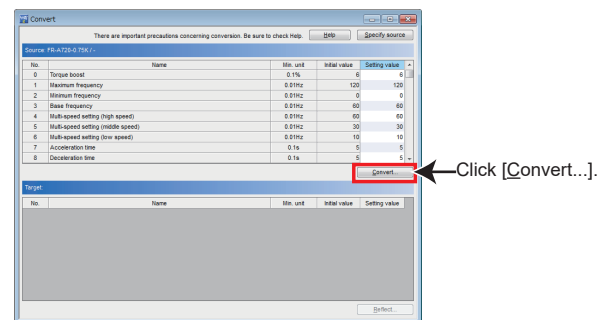
- (6) Click [Specify source] in the "Convert" window to display the "Source" window.



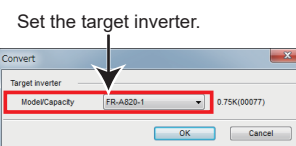
- (7) Select [Read from connected inverter]. Check that [Connection type] is "USB", and specify the station number connected to the source inverter in [Target station]. After specifying the station number, click [Detection]. After detection, check the inverter model in the [Model] field, and click [OK] to convert the parameters and return to the "Convert" window.



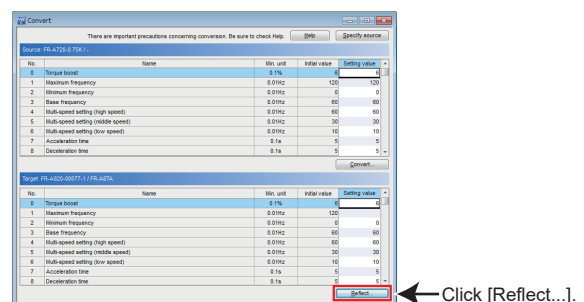
- (8) The setting value can be changed for some parameters of the source. To change the parameter setting value, enter the desired value in the setting value field of the source parameter list. After the parameters of the source inverter are displayed in the list, the [Convert...] button in the "Convert" window will be active. Click [Convert...] to display the "Convert" sub window.



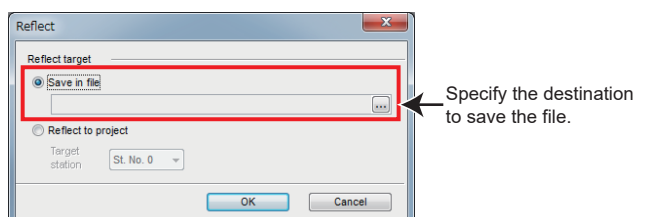
- (9) Specify the "Model/Capacity" of the [Target inverter] in the "Convert" sub window. Click [OK] to convert the parameters and return to the "Convert" window.



- (10) The result of parameter converting is shown in the "Convert" window.



- (11) Click [Reflect...] in the "Convert" window to display the "Reflect" window. Select [Save in file]. Specify the destination to save the file and click [OK]. The converted parameter setting is saved in the parameter file (*.pr4).



9 REPLACEMENT PROCEDURE

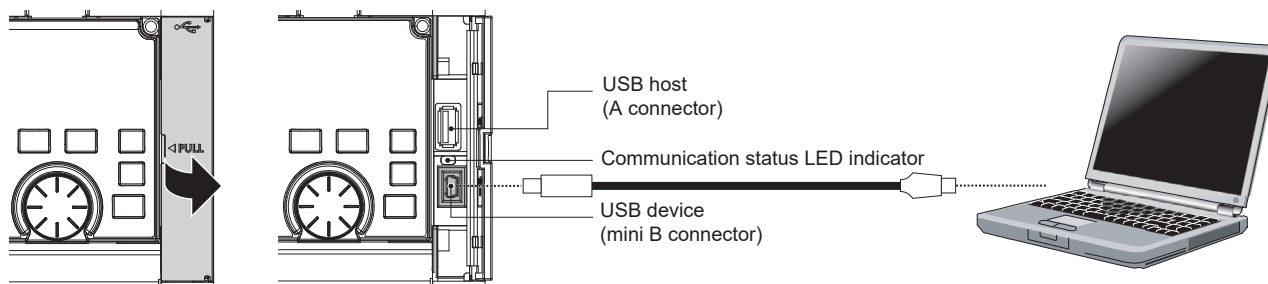
[Converting without a personal computer]

If a personal computer cannot be prepared, the parameter setting values for FR-A800 series must be created. The parameter numbers are almost the same as for FR-A700 series, but some of the setting values differ. Refer to the parameter section in "Information for Replacement of FR-A700 Series (BCN-C21002-162)" and create the parameter setting values for FR-A800 series.

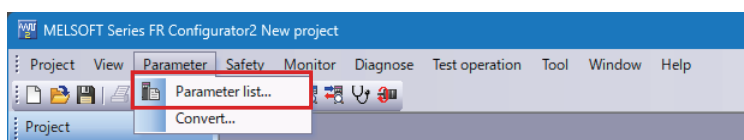
9 REPLACEMENT PROCEDURE

9.2 Setting the parameter

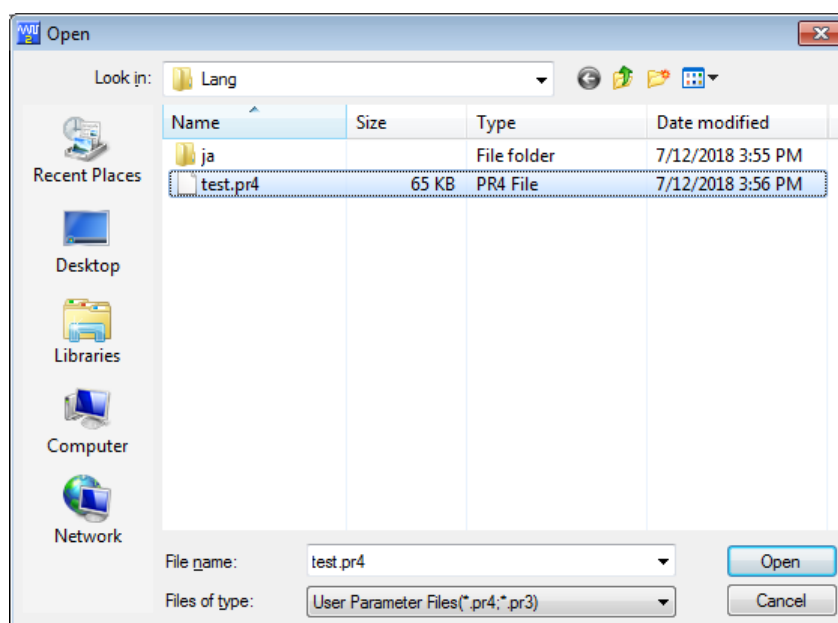
- (1) Prepare a personal computer where FR Configurator2 (SW1DND-FRC2-E) is installed and a cable for inverter connection.
- (2) Turn ON the FR-A800.
- (3) Connect the personal computer with the FR-A800.



- (4) Turn ON the computer and start FR Configurator2 (SW1DND-FRC2-E). Click the [Parameter list] in the [Parameter] menu, or click  on the toolbar to display "Parameter list".

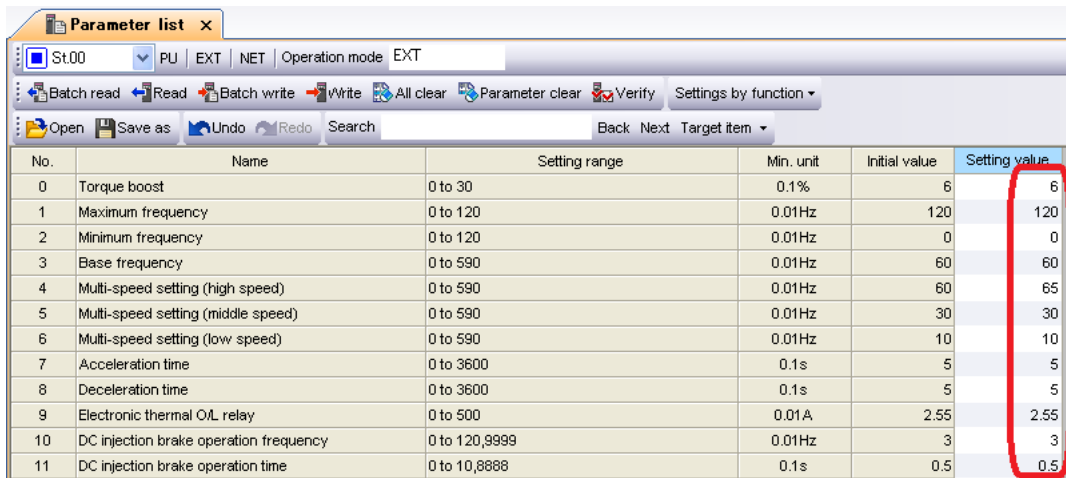


- (5) While displaying the parameter list window, select [Open] in the [File] menu, or select  in the tool menu of the parameter list window to open the parameter file saved in 9.1(11).



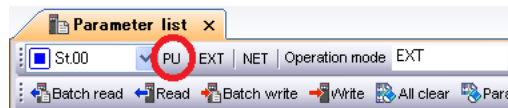
9 REPLACEMENT PROCEDURE

- (6) Parameters converted for the FR-A800 are listed on the [Setting value] column.



No.	Name	Setting range	Min. unit	Initial value	Setting value
0	Torque boost	0 to 30	0.1%	6	6
1	Maximum frequency	0 to 120	0.01Hz	120	120
2	Minimum frequency	0 to 120	0.01Hz	0	0
3	Base frequency	0 to 590	0.01Hz	60	60
4	Multi-speed setting (high speed)	0 to 590	0.01Hz	60	65
5	Multi-speed setting (middle speed)	0 to 590	0.01Hz	30	30
6	Multi-speed setting (low speed)	0 to 590	0.01Hz	10	10
7	Acceleration time	0 to 3600	0.1s	5	5
8	Deceleration time	0 to 3600	0.1s	5	5
9	Electronic thermal O/L relay	0 to 500	0.01A	2.55	2.55
10	DC injection brake operation frequency	0 to 120,9999	0.01Hz	3	3
11	DC injection brake operation time	0 to 10,8888	0.1s	0.5	0.5

- (7) Click [PU] to change the operation mode to PU.



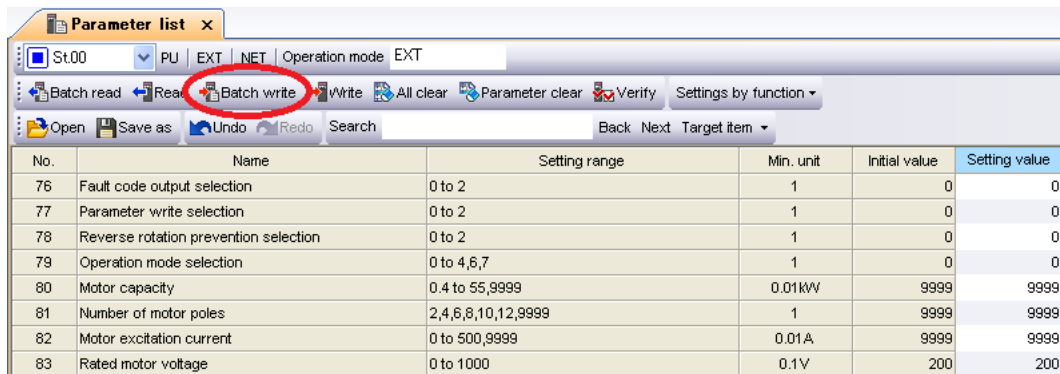
- (8) Check and write down the setting values of E400 (Pr.77) and D000 (Pr.79).
 When E400 (Pr.77) is "1", change the setting value of E400 (Pr.77) to "0".
 When D000 (Pr.79) is other than "0 or 1", change the setting value of D000 (Pr.79) to "0".
 To change a setting value, click the target value on the [Setting value] column.

76	Fault code output selection	0 to 2	1	0	0
77	Parameter write selection	0 to 2	1	0	1
78	Reverse rotation prevention selection	0 to 2	1	0	0
79	Operation mode selection	0 to 4,6,7	1	0	2
80	Motor capacity	0.4 to 55,9999	0.01kW	9999	9999
81	Number of motor poles	2,4,6,8,10,12,9999	1	9999	9999
82	Motor excitation current	0 to 500,9999	0.01A	9999	9999
83	Rated motor voltage	0 to 1000	0.1V	200	200

76	Fault code output selection	0 to 2	1	0	0
77	Parameter write selection	0 to 2	1	0	0
78	Reverse rotation prevention selection	0 to 2	1	0	0
79	Operation mode selection	0 to 4,6,7	1	0	0
80	Motor capacity	0.4 to 55,9999	0.01kW	9999	9999
81	Number of motor poles	2,4,6,8,10,12,9999	1	9999	9999
82	Motor excitation current	0 to 500,9999	0.01A	9999	9999
83	Rated motor voltage	0 to 1000	0.1V	200	200

- (9) Check the online condition. (Click  on the "tool menu bar" to switch the condition to online.)

(10) Click [Batch write] to write the parameters on the FR-A800.



(11) Turn OFF the personal computer, and then turn OFF the inverter. (Note that some parameter setting values will be applied at the next power-OFF or inverter reset.)
Install the operation panel.

(12) If the setting values of E400 (Pr.77) and D000 (Pr.79) are changed in step (8), turn ON the inverter and set the values of E400 (Pr.77) and D000 (Pr.79) written down earlier, and then turn OFF the inverter.

[Precautions for converting]

There are adjustment parameters and parameters which cannot be converted. Read the Instruction Manual of FR Configurator2 [SW1DND-FRC2-E] carefully before converting parameters.

Remark

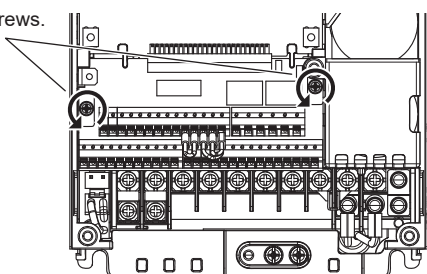
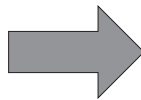
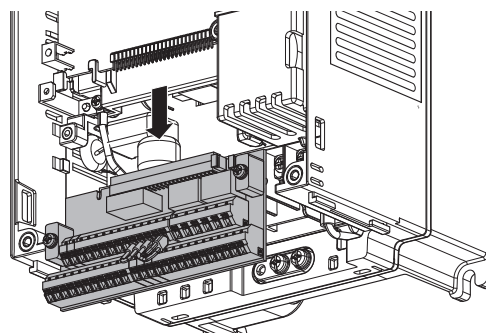
- Models compatible with the convert function

Source inverter	Target inverter
FR-A500(L)	FR-A800(-E)
FR-A700	FR-A800(-E)
FR-B (A700)	FR-B
FR-B3-(N)(H) (A700)	FR-B3-(N)(H)
FR-F700(P)	FR-F800(-E)
FR-E500	FR-E800(-E/-SCE)
FR-E700(-NE)	FR-E800(-E/-SCE)

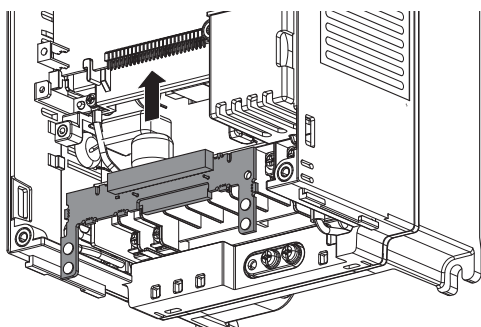
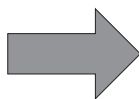
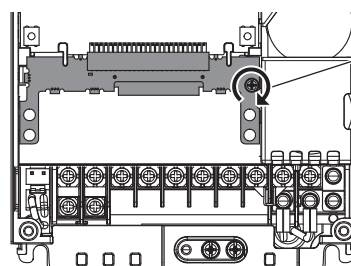
9.3 Installation of the FR-A800

- (1) Install the FR-A800 to the enclosure.
Since the installation size of 280K model or lower of the FR-A800 inverter is the same as that of the FR-A700, the FR-A800 can be installed using the same mounting holes of the FR-A700.
- (2) Open the wiring cover and route the main circuit wires.
- (3) Perform the control circuit wiring.
By using the optional control circuit terminal block attachment (FR-A8TAT), the control circuit terminal block of the FR-A700 series inverter can be installed as it is in the FR-A800. (Leave the cables connected on the terminal block.)
 - 1) Loosen the two installation screws at the both sides of the control circuit terminal block of the 800 series inverter. (These screws cannot be removed.)
Slide down the control circuit terminal block to remove it.

Loosen the screws.



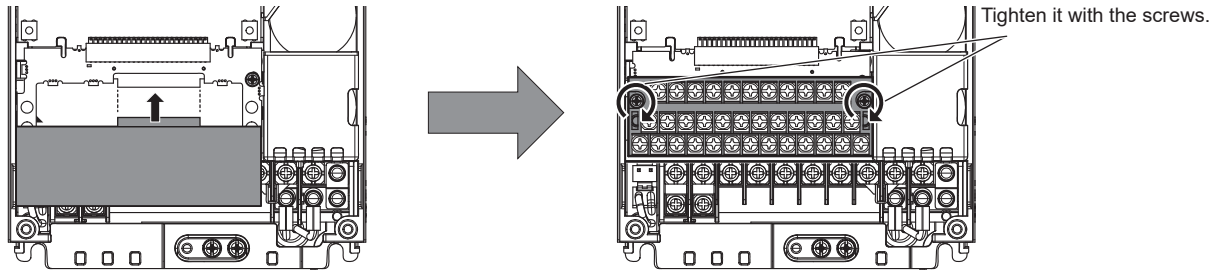
- 2) Install the control circuit terminal block attachment. Be careful not to bend the pins of inverter control circuit connector, and fix it by the installation screws supplied with the product.
(Tightening torque: 0.33 to 0.4 N·m)



Tighten it with the screw.

9 REPLACEMENT PROCEDURE

- 3) Install the control circuit terminal block of the 700 series inverter. Be careful not to bend the pins of the control circuit connector of the terminal block. Fix the control circuit terminal block with the installation screws of the control circuit terminal block. (Tightening torque: 0.33 to 0.4 N·m)

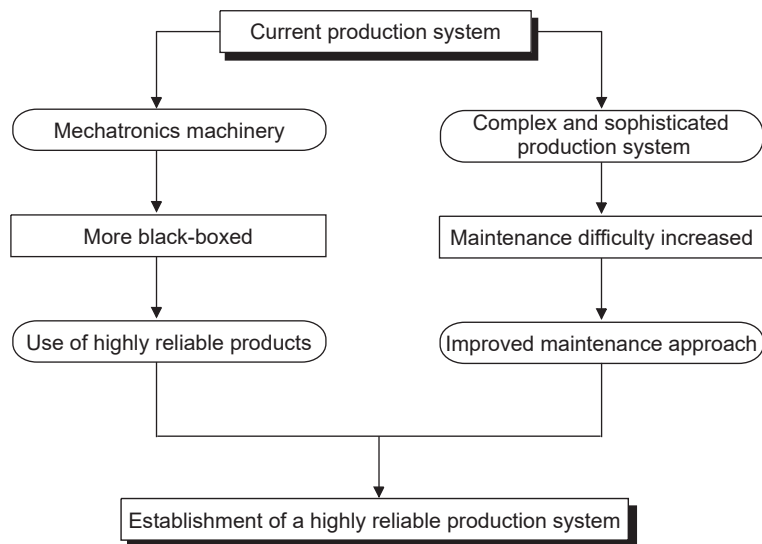


APPENDIX

Appendix 1 General approach to maintenance and its management

Appendix 1.1 Importance of maintenance

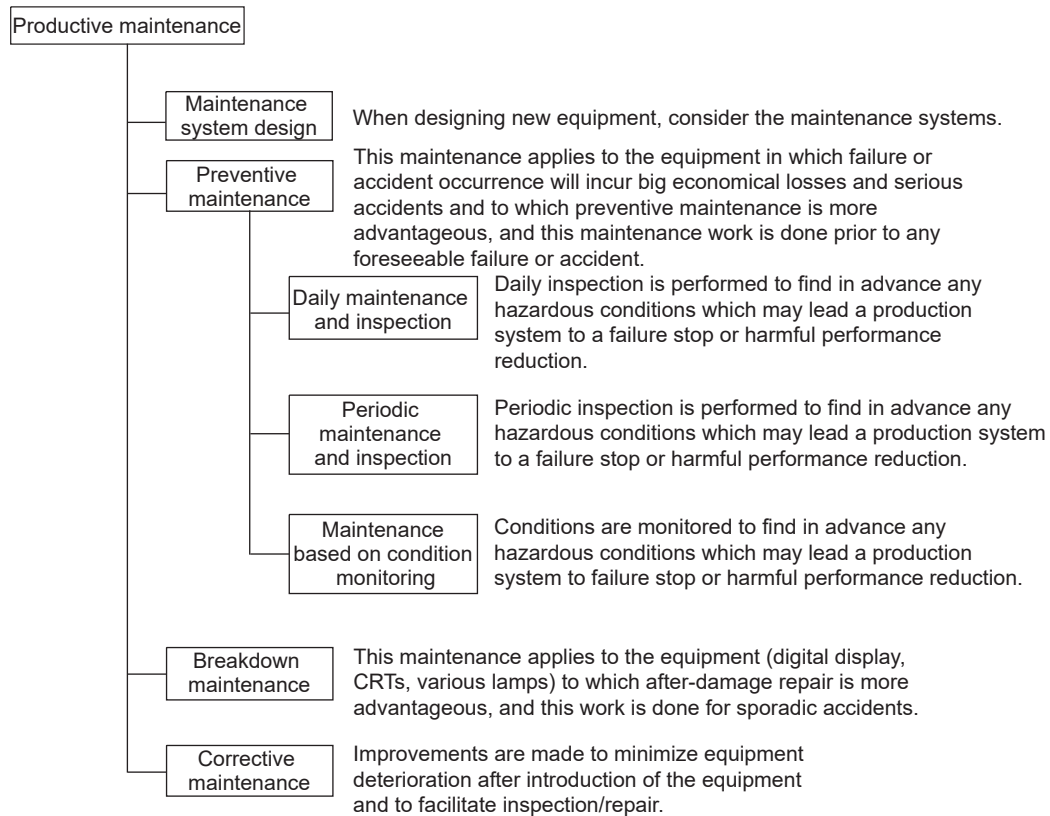
With remarkable progress of mechatronics machinery and more complexity and sophistication, recent production systems have become more black-boxed with increasing difficulty in maintenance, making it difficult to improve the operating rate. Therefore, highly reliable products and improved maintenance approach are strongly demanded.



Appendix 1.2 Maintenance system

To establish a highly reliable production system, it is important to a well-organized maintenance system.

The following chart outlines a maintenance system.



Appendix 1.3 Maintenance plan

In a production system, it is inefficient to consider repair after a failure occurs since repair time will be longer and the operating rate will not be improved.

For the efficient maintenance, build a maintenance plan at the introduction of the production system. In case of failure, perform the following maintenance systematically to repair the system in a short time.

Table APP.1 Inverter system maintenance plan

Category	Description	
Maintenance education	Knowledge about inverter	<ul style="list-style-type: none"> • Fundamental knowledge of inverter such as principle, functions, and performance • Characteristics of inverter • Positioning of inverter • Introduction status of inverter (usage condition in one's department) • Details of introduced (adopted) model (model, functions, performance, and characteristics of the inverter used)
	Scope and technique of maintenance	<ul style="list-style-type: none"> • Knowledge about maintenance of inverter (characteristics of inverter in terms of maintenance, maintenance items of inverter) • Precautions for inverter maintenance (handling method, key points, and others)
	Training	<ul style="list-style-type: none"> • Functions related to inverter maintenance • Functions related to peripheral device maintenance (such as troubleshooting functions) • Practice of troubleshooting (peripheral device operation, hardware replacement, etc.)
Maintenance timing	Distinguish clearly between the preventive maintenance target and breakdown maintenance target, and determine the timing of implementation.	
Maintenance equipment	Prepare the spares, members, instruments, and measuring tools for maintenance.	
Maintenance procedure	Prepare materials such as manuals and define the maintenance methods and details	
Maintenance personnel	Secure personnel and determine the positions and tasks.	
Improvement of maintenance method	Examine improvement of maintenance methods.	

APPENDIX

Table APP.1 Inverter system maintenance plan

Category	Description	
Understanding of customer service/ support system of the inverter manufacturer	After-sales service	<ul style="list-style-type: none"> • Service station (location, contact information, persons in charge, etc.) • Scope of service (applicable models, scope of handling, etc.) • Service time (start/end time, time required for arrival, emergency service, etc.) • Service period (warranty period, support service on commercial basis, etc.) • Service parts supply period (such as repair and supply period after production discontinuation) • Actions for production discontinuation (such as details of the declaration and repair period) • Time required for repair (such as the standard, shortest, and longest delivery times)
	Technical support	<ul style="list-style-type: none"> • Support station (location, contact information, persons in charge, etc.) • Scope of support (applicable models, hardware/software, and system) • Support method (telephone, FAX, visit, teaching, and machine operation) • Manuals (effective manuals for maintenance)

Appendix 1.4 Management of maintenance documents

To repair a failure in a short time, the documents as listed below must be arranged and managed.

Table APP.2 Maintenance documents to be managed

Category	Name	Description
System-specific documents	System/control specifications	The functions and operations of the corresponding system/control are described. (Operation sequence/timing, operational conditions, and operation procedure)
	Electric wiring diagrams	Schematic diagrams (Power supply circuit, motor circuit, control circuit, operation circuit, display circuit, and others) Inter-device/inter-board connection diagrams (Cabling diagram and earthing (grounding) cable diagram)
	Equipment layout diagrams	In-panel electrical equipment layout diagram, terminal block wire number layout diagram, and connector pin connection assignment table (Diagrams that show various instrument models, wire numbers, and others)
	List of the used hardware	List of electrical equipment used in the system (Models and specifications of all electrical equipment such as modules which comprise inverter system, peripheral devices, electrical parts in enclosure, I/O devices, software packages, and others)
	Instruction manual and maintenance/inspection procedure of the control target	For handling (operating) the control target and its maintenance/inspection
General documents	Catalog of the used hardware	Provide model configurations, manufacturers, and others
	Instruction manual and technical information of the used hardware	For troubleshooting of hardware and software

Appendix 1.5 Maintenance records

After repairing, the following maintenance records must be managed for future reference.

Table APP.3 Maintenance records to be managed

Record item	Description
Status of faults and failures	Equipment/facility name, phenomenon, and circumstances
System downtime	Occurrence time and stop duration
Effect of the occurrence	Amount of loss, time lost, and overall impact
Cause	Investigation method and cause including presumption
Recovery method	Recovery methods such as replacement and repair
Recurrence prevention	Methods to prevent similar failures and lessons learned
Trouble records	Records including causes and countermeasures
Person in charge	

Appendix 2 Measurement of main circuit voltages, currents and powers

Appendix 2.1 Measurement of powers

Use digital power meters (for inverter) both on the inverter's input and output sides.

Appendix 2.2 Measurement of voltages and use of PT

(1) Inverter input side

Use a digital power meter (for inverter) on the inverter's input side.

(2) Inverter output side

Always use a digital power meter for inverter for measurement as the output side voltage has a PWM-controlled rectangular wave. The value displayed on the operation panel is the inverter-controlled voltage itself. Monitoring values via the operation panel or by outputting the analog signal is recommended as these values are accurate.

Appendix 2.3 Measurement of currents

Use digital power meters (for inverter) both on the inverter's input and output sides.

Since the inverter input current tends to be unbalanced, measurement of three phases is recommended. The correct value cannot be obtained by measuring only one or two phases. On the other hand, the unbalanced ratio of each phase of the output current should be within 10%.

The inverter output current can be monitored on the operation panel. The value displayed on the operation panel is accurate even if the output frequency varies. Hence, it is recommended to monitor values on the operation panel or by outputting the analog signal.

Appendix 2.4 Measurement of inverter input power factor

Calculate the factor from the effective power and the apparent power. A power-factor meter cannot indicate an exact value.

[Three-phase power supply]

$$\begin{aligned}\text{Total power factor of the inverter} &= \frac{\text{Effective power}}{\text{Apparent power}} \\ &= \frac{\text{Three-phase input power found by the 3-wattmeter method}}{\sqrt{3} \times V (\text{power supply voltage}) \times I (\text{input current effective value})}\end{aligned}$$

[Single-phase power supply]

$$\begin{aligned}\text{Total power factor of the inverter} &= \frac{\text{Effective power}}{\text{Apparent power}} \\ &= \frac{\text{Three-phase input power found by the 3-wattmeter method}}{V (\text{power supply voltage}) \times I (\text{input current effective value})}\end{aligned}$$

Appendix 2.5 Measurement of converter output voltage (between terminals P and N)

The output voltage of the converter can be measured with a voltmeter (such as a digital multimeter) between terminals P and N. The voltage varies according to the power supply voltage. Approximately 270 to 300 V for the 100/200 V class, approximately 540 to 600 V for the 400 V class, and approximately 800 to 900 V for the 575 V class is output when no load is connected. The voltage decreases when a load is applied.

When energy is regenerated from the motor during deceleration, for example, the converter output voltage rises to nearly 400 to 450 V for the 100/200 V class, nearly 800 to 900 V for the 400 V class, and nearly 1100 to 1300 V for the 575 V class maximum.

Appendix 2.6 Measurement of inverter output frequency

In the initial setting of the FM type inverter, a pulse train proportional to the output frequency is output across the pulse train output terminals FM and SD on the inverter. This pulse train output can be counted by a frequency counter, or a digital multimeter can be used to read the mean value of the pulse train output voltage. When a digital multimeter is used to measure the output frequency, approximately 5 VDC is indicated at the maximum frequency. In the initial setting of the AM type inverter, a voltage proportional to the output frequency is output across the analog voltage output terminals AM and 5 on the inverter. Measure the voltage using a digital multimeter.

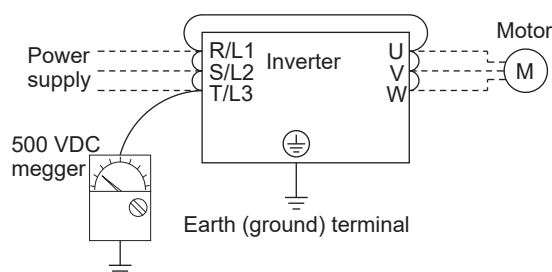
The output frequency can be checked using the operation panel for all models including Ethernet models.

For detailed specifications of the pulse train output terminal FM and analog voltage output terminal AM, refer to the FR-E800 Instruction Manual (Function) and FR-E800 Instruction Manual (Connection).

Appendix 2.7 Insulation resistance test using megger

For the inverter, conduct the insulation resistance test on the main circuit only as follows and do not perform the test on the control circuit. (Use a 500 VDC megger.)

Before the test, remove the wiring for terminals R/L1, S/L2, T/L3, U, V, and W (indicated by dashed lines in the diagram).



POINT

- Before performing the insulation resistance test on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
 - For the continuity test of the control circuit, use a tester for high resistance range and do not use the megger or buzzer.
-

Appendix 2.8 Withstand voltage test

Do not conduct a withstand voltage test. Deterioration may occur.

Appendix 3 FR-E800 inverters with circuit board coating

The following describes the specifications and applicable standards of FR-E800 inverters with circuit board coating.

(1) Circuit board coating

Polyurethane coating is applied on the circuit board used in the FR-E800 inverter, except for some components which cannot be coated such as connectors and a terminal block.

This coating allows the product to conform to JIS C60721-3-3 / IEC 60721-3-3 3C2/3S2.

POINT

However, while the coating is designed in consideration of the operating environment, it does not guarantee operation beyond the range specified in documents such as the product catalog.

(2) Model

For FR-E800 inverters with circuit board coating, the model includes a special code "-60" or "-06".

FR-E820-0.4K-1

Special
code

Special code	Circuit board coating	Plated conductor
Without	Without	Without
-60	With	Without
-06	With	With

(3) Standard for corrosive gases

(a) Corrosive gases

The environmental parameters listed in the following table, as specified in JIS C60721-3-3 / IEC 60721-3-3, are sea salt, sulfur dioxide, hydrogen sulfide, chlorine, hydrogen chloride, hydrogen fluoride, ammonia, ozone, and nitrogen oxides.

(b) Corrosive gas environment

Class 3C2 of JIS C60721-3-3 / IEC 60721-3-3 specifies the concentration of corrosive gases as shown in the following table.

Classification of chemically active substances (as quoted from JIS C60721-3-3 / IEC 60721-3-3)

No.	Environmental parameter	Unit	3C2	
			Average value	Maximum value
1	Sea salt	None	Salt mist	Salt mist
2	Sulfur dioxide	cm ³ /m ³	0.11	0.37
3	Hydrogen sulfide	cm ³ /m ³	0.071	0.36
4	Chlorine	cm ³ /m ³	0.034	0.1
5	Hydrogen chloride	cm ³ /m ³	0.066	0.33
6	Hydrogen fluoride	cm ³ /m ³	0.012	0.036
7	Ammonia	cm ³ /m ³	1.4	4.2
8	Ozone	cm ³ /m ³	0.025	0.05
9	Nitrogen oxides	cm ³ /m ³	0.26	0.52

APPENDIX

(4) Verification of products with circuit board coating

The FR-E800 inverter with circuit board coating has been tested under mixed gas acceleration tests assuming class 3C2/3S2 of JIS C60721-3-3 / IEC 60721-3-3 for a period equivalent to a design life of 10 years, and has been confirmed to operate normally.

POINT

The actual operating environment does not necessarily correspond to the environment specified for class 3C2/3S2 of JIS C60721-3-3 / IEC 60721-3-3. Note that failures may occur earlier than the above period depending on the operating environment.

Appendix 4 Inverter storage method

This section describes the storage method and precautions for storing the inverter in an unpowered state.

		Storage period	
		Less than 1 year	1 year or more
		Short time in transit	Storage as spare parts
Storage environment	Temperature	-20°C to +65°C	0°C to +35°C
	Humidity	90% RH or less	70% RH or less
	Atmosphere	Indoors, free from oil mist or dust and dirt	
	Altitude	Maximum 3000 m	
	Vibration	5.9 m/s ² (0.6G) or less	
Precautions	• In case of long-term storage, pay sufficient attention to humidity and atmosphere to prevent contact faults and malfunction of moving parts from occurring due to rust on metals of parts and ingress of dust. • For long-term storage, apply power (rated voltage) to the inverter for at least one hour once every two years. If left unpowered for a long time, the function of the electrolytic capacitor inside the inverter may deteriorate.		

Appendix 5 List of alternative models for the conventional series

(As of January 2025)

Conventional series name	Production termination schedule	Repair / parts supply termination *1	Alternative model
FR-F2	Dec. 1986	Nov. 1993	FR-F800, FR-A800 *2
FR-K	Dec. 1986	Nov. 1993	FR-A800
FR-K400	Jul. 1989	Jun. 1996	FR-A800
FR-F300	Jul. 1989	Jun. 1996	FR-F800, FR-A800 *2
FR-K3	Jul. 1989	Jun. 1996	FR-A800
FR-E	Sep. 1993	Aug. 2000	FR-A800
FR-Z020	Mar. 1994	Mar. 2001	FR-E800, FR-D800
FR-Z300	Jun. 1994	Jun. 2001	FR-A800
FR-Z100	Dec. 1994	Dec. 2001	FR-A800
FR-Z123	Mar. 1995	Mar. 2002	FR-E800, FR-D800
FR-F400	Jun. 1995	Jun. 2002	FR-F800, FR-A800 *2
FR-A200	Oct. 1995	Oct. 2002	FR-A800
FR-Z024	Oct. 1995	Oct. 2002	FR-E800, FR-D800
FR-V200	Apr. 1996	Apr. 2003	FR-A800 + FR-A8AP/FR-A8AL/FR-A8TP
FR-A100	Apr. 1996	Apr. 2003	FR-F800
FR-Z200	Jun. 1996	Apr. 2003	FR-A800
FR-A200E	Apr. 2000	Apr. 2007	FR-A800
MT-A100E	Apr. 2000	Apr. 2007	FR-F800
FR-A100E	Sep. 2000	Sep. 2007	FR-F800
MT-A200E	Sep. 2000	Sep. 2007	FR-A800
FR-U100	Sep. 2001	Sep. 2008	FR-D800
FR-S500 (Three-phase 200 V)	Jun. 2004	Jun. 2011	FR-D800
FR-V200E	Oct. 2004	Oct. 2011	FR-A800 + FR-A8AP/FR-A8AL/FR-A8TP
FR-S500 (Three-phase 400 V / single-phase 200 V / single-phase 100 V)	May 2006	May 2013	FR-D800
FR-F500(L)	May 2006	May 2013	FR-F800
FR-A500(L)	Apr. 2007	Apr. 2014	FR-A800
FR-A024/A044	Dec. 2008	Dec. 2015	FR-E800, FR-D800
FR-A201E	Sep. 2009	Sep. 2016	FR-A701
FR-S500E	Aug. 2010	Aug. 2017	FR-D800
FR-E500	Apr. 2011	Apr. 2018	FR-E800
FR-F700	Aug. 2011	Aug. 2018	FR-F800
FR-FP700	Aug. 2011	Aug. 2018	FR-F800
FR-HC (200 V)	Oct. 2011	Oct. 2018	FR-HC2 (200 V)
MT-HC (200 V)	Oct. 2011	Oct. 2018	FR-HC2 (200 V)
MT-B	Nov. 2011	Nov. 2018	FR-B
FR-F500J	Apr. 2012	Apr. 2019	FR-D800
FR-FP500J	Apr. 2012	Apr. 2019	FR-D800
FR-C500	Apr. 2012	Apr. 2019	FR-E800 + FR-A8NC E kit
FR-HC (400 V)	Oct. 2012	Oct. 2019	FR-HC2 (400 V)
MT-HC (400 V)	Oct. 2012	Oct. 2019	FR-HC2 (400 V)

APPENDIX

Conventional series name	Production termination schedule	Repair / parts supply termination *1	Alternative model
SC-A	Apr. 2015	Apr. 2022	FR-D800
MD-AX520	Sep. 2015	Sep. 2022	FR-A800
FR-A700	Dec. 2015	Dec. 2022	FR-A800
FR-F700P	Sep. 2016	Sep. 2023	FR-F800
FR-V500	Jan. 2017	Jan. 2024	FR-A800 + FR-A8TP
FR Configurator SW3	Oct. 2017	—	FR Configurator2
FR-B/B3 (A700 specifications)	Dec. 2017	Dec. 2024	FR-B/B3 (A800 specifications)
FR Series Manual Controller/Speed controller (FR-AX/FH)	Apr. 2018	Apr. 2025	FR-A800
FR-RC	Oct. 2018	Oct. 2025	FR-XC + FR-XCG
FR-CV	Jun. 2019	Jun. 2026	FR-XC + FR-XCL
FR-E700	Oct. 2023	Oct. 2030	FR-E800

*1: Even before the termination of repair or parts supply, we may be unable to perform repairs due to the availability of service parts.
Thank you for your understanding.

*2: For the operation where the inverter output current exceeds 120% of its rated current, select the FR-A800 series.

Appendix 6 Convert function for parameters in FR Configurator2

Parameter settings of the conventional models can be copied to the 800 series parameter settings using FR Configurator2.

- Models compatible with the convert function

Source inverter	Target inverter
FR-A500(L)	FR-A800(-E)
FR-A700	FR-A800(-E)
FR-B (A700)	FR-B
FR-B3-(N)(H) (A700)	FR-B3-(N)(H)
FR-F700(P)	FR-F800(-E)
FR-E500	FR-E800(-E/-SCE)
FR-E700(-NE)	FR-E800(-E/-SCE)

Remark

- Although the parameter name described in the Instruction Manual of the inverter and the parameter name used in FR Configurator2 may be different, there is no difference in the parameter function.
- If an option non-compatible with the target inverter is connected to the source inverter, if a unit for setting a parameter is fixed by the option while M000 (Pr.37) Speed display and M002 (Pr.144) Speed setting switchover of the source inverter are set to change the unit, the setting of the source inverter is copied unchanged to the target inverter.
- When the source inverter supports multiple ratings, the larger capacity inverter must be used as a target inverter depending on the multiple rating setting (E301 (Pr.570)).

For details, refer to the Help feature or the Instruction Manual of FR Configurator2.

[illegible]

INVERTER TROUBLE SHOOTING COURSE (FR-E800)

mitsubishi electric corporation
HEAD OFFICE: TOKYO BUILDING 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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