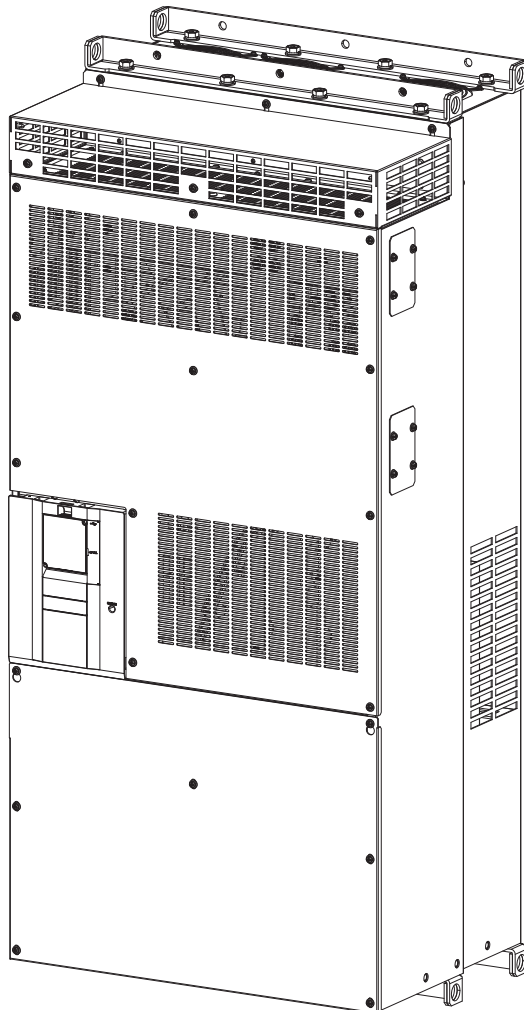


INVERTER CC2 INSTRUCTION MANUAL

Converter Unit

FR-CC2-H315K to H630K



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Safety instructions

Thank you for choosing this Mitsubishi Electric converter unit.

This Instruction Manual provides handling information and precautions for use of the FR-CC2.

Incorrect handling might cause an unexpected fault. Before using this product, always read this Instruction Manual carefully to ensure proper use.


Do not attempt to install, operate, maintain or inspect this product until you have read the Instruction Manuals and appended documents carefully. Do not use this product until you have a full knowledge of this product mechanism, safety information and instructions.


Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, qualified personnel means a person who meets all the following conditions:

- A person who possesses a certification in regard with electric appliance handling, or person took a proper engineering training.
Such training may be available at your local Mitsubishi Electric office. Contact your local sales office for schedules and locations.
- A person who can access operating manuals for the protective devices (for example, light curtain) connected to the safety control system, or a person who has read these manuals thoroughly and familiarized themselves with the protective devices.

In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

 **WARNING** Incorrect handling may cause hazardous conditions, resulting in death or severe injury.

 **CAUTION** Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.

Note that even the  **CAUTION** level may lead to a serious consequence depending on conditions. Be sure to follow the instructions of both levels as they are critical to personnel safety.

◆Electric shock prevention

WARNING

- Do not remove the front cover or the wiring cover while the power of this product is ON, and do not run this product with the front cover or the wiring cover removed as the exposed high voltage terminals or the charging part of the circuitry can be touched. Otherwise you may get an electric shock.
 - Even if power is OFF, do not remove the front cover except for wiring or periodic inspection as the inside of this product is charged. Doing so may cause an electric shock.
 - Before wiring or inspection, check that the LED display of the operation panel is OFF. Any person who is involved in wiring or inspection shall wait for 10 minutes or longer after the power supply has been cut off, and check that there are no residual voltage using a digital multimeter or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
 - This product must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 61140 class 1 and other applicable standards).
 - Any person who is involved in wiring or inspection of this product shall be fully competent to do the work.
 - This product body must be installed before wiring. Otherwise you may get an electric shock or be injured.
 - Do not touch the setting dial or keys with wet hands. Doing so may cause an electric shock.
 - Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Doing so may cause an electric shock.
 - Do not change the cooling fan while power is ON as it is dangerous.
 - Do not touch the printed circuit board or handle the cables with wet hands. Doing so may cause an electric shock.
-

◆Fire prevention

CAUTION

- This product must be installed on a nonflammable wall without holes in it so that its components cannot be touched from behind. Installing it on or near flammable material may cause a fire.
 - If this product becomes faulty, the product power must be switched OFF. A continuous flow of large current may cause a fire.
 - Be sure to perform daily and periodic inspections as specified in the Instruction Manual. There is a possibility of explosion, damage, or fire if this product is used without inspection.
-

◆Injury prevention

CAUTION

- The voltage applied to each terminal must be as specified in the Instruction Manual. Otherwise an explosion or damage may occur.
 - The cables must be connected to the correct terminals. Otherwise an explosion or damage may occur.
 - The polarity (+ and -) must be correct. Otherwise an explosion or damage may occur.
 - While power is ON or for some time after power-OFF, do not touch the inverter as it will be extremely hot. Doing so may cause burns.
-

◆Additional instructions

The following instructions must be also followed. If this product is handled incorrectly, it may cause unexpected fault, an injury, or an electric shock.

CAUTION

Transportation and installation

- To prevent injury, wear cut-resistant gloves when opening packaging with sharp tools.
- Use proper lifting techniques or a trolley when carrying products. Failure to do so may lead to injuries.
- Do not stand or place any heavy object on this product.
- Do not stack the boxes containing this product higher than the number recommended.
- When carrying this product, do not hold it by the front cover. It may fall or break.
- During installation, caution must be taken not to drop this product as doing so may cause injuries.
- The product must be installed on a surface that withstands the weight of the product.
- Do not install this product on a hot surface.
- Ensure the mounting orientation of this product is correct.
- Ensure this product is mounted securely in its enclosure.
- Do not install or operate this product if it is damaged or has parts missing.
- Foreign conductive objects must be prevented from entering this product. That includes screws and metal fragments or flammable substance such as oil.
- As this product is a precision instrument, do not drop or subject it to impact.
- The surrounding air temperature must be between -10°C and +50°C (non-freezing) for the FR-CC2-H315K to H560K, and between -10°C and +40°C (non-freezing) for the FR-CC2-H630K. Otherwise this product may be damaged.
- The ambient humidity must be 95% RH or less (non-condensing) for this product. Otherwise this product may be damaged. (Refer to [page 25](#) for details.)
- The temporary storage temperature (applicable to a short limited time such as a transportation time) must be between -20°C and +65°C. Otherwise this product may be damaged.
- This product must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt). Otherwise this product may be damaged.
- Do not use this product at an altitude above 2500 m. Vibration should not exceed 5.9 m/s² at 10 to 55 Hz in X, Y, and Z directions. Otherwise this product may be damaged. (Refer to [page 25](#) for details.)
- If halogens (including fluorine, chlorine, bromine, and iodine) contained in fumigants for wood packages enter this product, the product may be damaged. Prevent the entry of fumigant residuals or use an alternative method such as heat disinfection. Note that sterilization of disinfection of wood packages should be performed before packing the product.

Test operation

- Before starting the test operation, confirm or adjust the parameter settings. Failure to do so may cause some machines to make unexpected motions.
-

WARNING

Usage

- Stay away from the equipment after using the retry function in this product as the equipment will restart suddenly after the output shutoff of this product.
 - Depending on the function settings of this product, the product does not stop its output even when the STOP/RESET key on the operation panel is pressed. To prepare for it, provide a separate circuit and switch (to turn OFF the power of this product, or apply a mechanical brake, etc.) for an emergency stop.
 - Be sure to turn OFF the start (STF/STR) signal before clearing the fault as this product will restart the motor suddenly after a fault is cleared.
 - Do not modify this product.
 - Do not remove any part which is not instructed to be removed in the Instruction Manuals. Doing so may lead to a failure or damage of this product.
-

CAUTION

Usage

- Do not repeatedly start or stop this product with a magnetic contactor on its input side. Doing so will shorten the life of the inverter and the converter unit.
- Use a noise filter or other means to minimize the electromagnetic interference with other electronic equipment used nearby the converter unit.
- Appropriate precautions must be taken to suppress harmonics. Otherwise harmonics in power systems generated from the inverter or the converter unit may heat/damage a power factor correction capacitor or a generator.
- As all parameters return to their initial values after Parameter clear or All parameter clear is performed, the parameters must be set again as required before the operation is started.
- Perform an inspection and test operation of this product if it has been stored for a long period of time.
- To avoid damage to this product due to static electricity, static electricity in your body must be discharged before you touch this product.
- To maintain the security (confidentiality, integrity, and availability) of the inverter, the converter unit, and the system against unauthorized access, DoS^{*1} attacks, computer viruses, and other cyberattacks from external devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions. We shall have no responsibility or liability for any problems involving inverter trouble, converter unit trouble, and system trouble by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.
- When the emergency drive function is enabled, the operation is continued or the retry operation (automatic reset and restart) is repeated even if a fault occurs, which may damage or burn the inverter, the converter unit, or the motor. Before restarting the normal operation after the operation using the emergency drive function, make sure that the inverter, the converter unit, and the motor have no fault.

Emergency stop

- A safety backup such as an emergency brake must be provided for devices or equipment in a system to prevent hazardous situations from occurring in case of failure of the inverter and converter unit or an external device controlling them.
- If the breaker installed on the input side of this product trips, check for wiring faults (such as short circuits) and damage to internal parts of this product. Identify and remove the cause of the trip before resetting the tripped breaker (or before applying the power to this product again).
- When any fault occurs, take an appropriate corrective action, then reset the converter unit or the inverter, and resume the operation.

Maintenance, inspection and parts replacement

- Do not carry out a megger (insulation resistance) test on the control circuit of this product. Doing so will cause failure.

Disposal

- This product must be treated as industrial waste.

^{*1} DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

General instruction

- For clarity, illustrations in this Instruction Manual may be drawn with covers or safety guards removed. Ensure all covers and safety guards are properly installed prior to starting operation.
-

MEMO

CHAPTER 1 INTRODUCTION

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1.2	Component names	14
1.3	Related manuals	15

1 INTRODUCTION

The contents described in this chapter must be read before using this product.
Always read the instructions before use.

◆ Abbreviations

Item	Description
Operation panel	Inverter operation panel (FR-DU08)
Converter unit	Converter unit FR-CC2
Pr.	Parameter number (Number assigned to function)

◆ Trademarks

- Microsoft and Visual C++ are registered trademarks of Microsoft Corporation in the United States and other countries.
- MODBUS is a registered trademark of SCHNEIDER ELECTRIC USA, INC.
- Other company and product names herein are the trademarks and registered trademarks of their respective owners.

◆ Notes on descriptions in this Instruction Manual

- Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to [page 47](#).)

◆ Harmonic Suppression Guidelines

All the models of the inverters used by specific consumers are covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage". (For details, refer to [page 66](#).)

1.1 Product checking

Unpack the product and check the rating plate and the capacity plate of the converter unit to ensure that the model is as ordered and the product is intact.

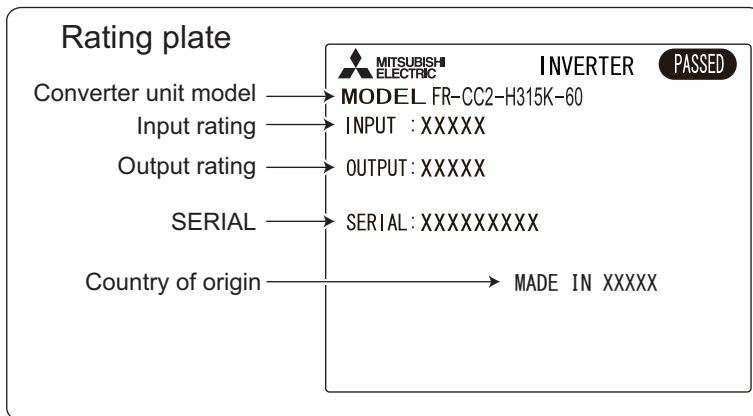
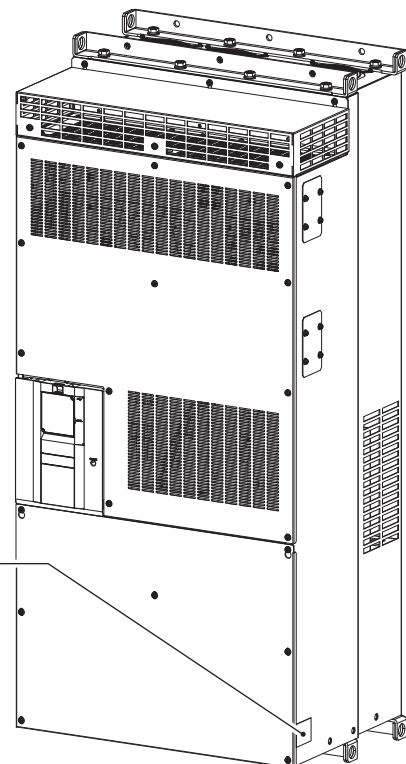
◆ Converter unit model

Symbol	Voltage class
H	400V class

Symbol	Description
315K to 630K	Rated converter unit capacity (kW)

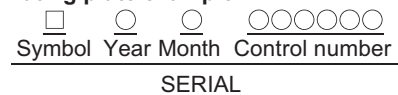
FR-CC2-H 315K-60

Symbol	Circuit board coating (conforming to IEC60721-3-3:1994 3C2/3S2)	Plated conductor
60	With	Not used
06	With	With



◆ How to read the SERIAL number

Rating plate example

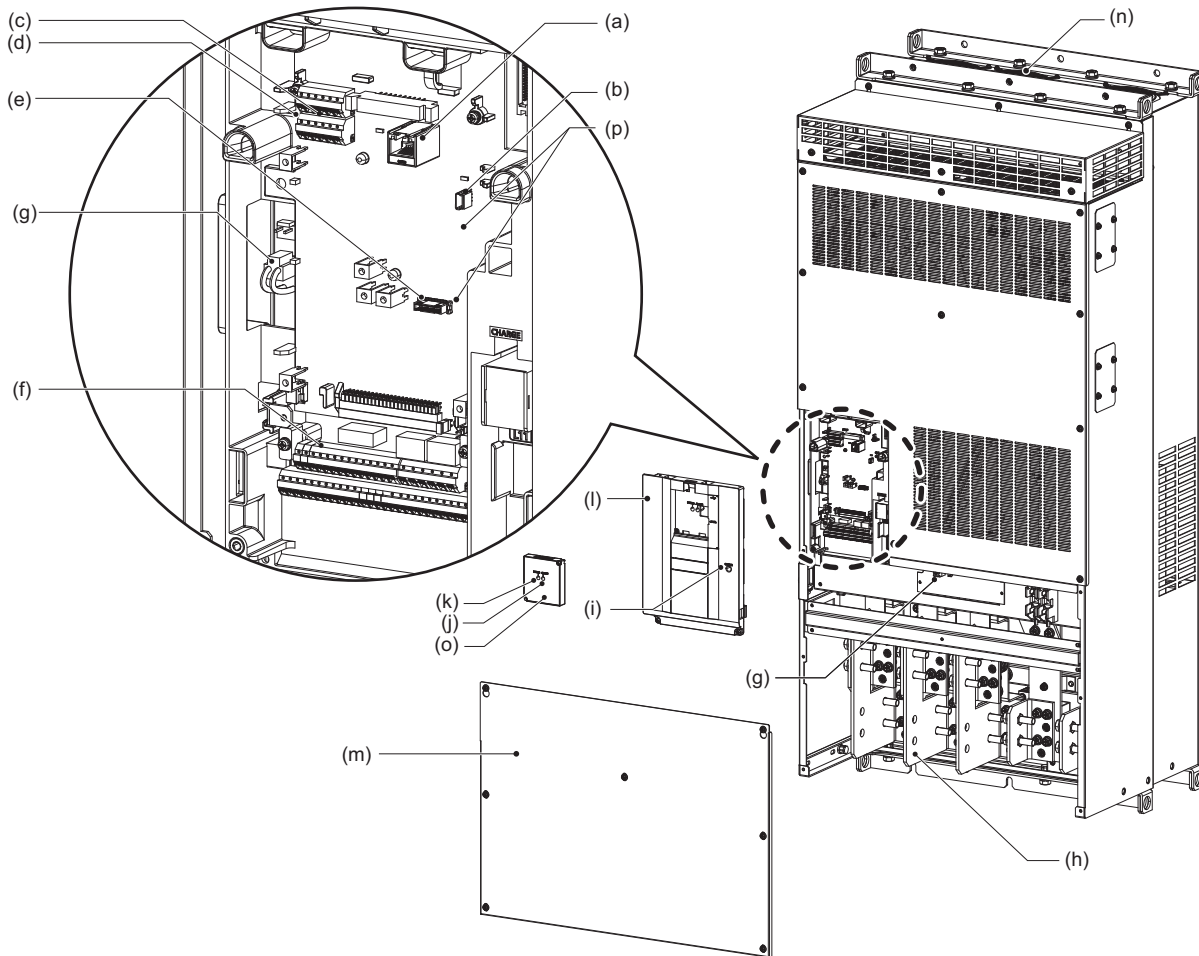



The SERIAL consists of one symbol, two characters indicating the production year and month, and six characters indicating the control number.

The last digit of the production year is indicated as the Year, and the Month is indicated by 1 to 9, X (October), Y (November), or Z (December).

1.2 Component names

Component names are as follows.



Symbol	Name	Description	Refer to page
(a)	PU connector	Connects the operation panel (FR-DU08). This connector also enables the RS-485 communication.	56
(b)	For manufacturer setting. Do not use.		—
(c)	RS-485 terminals	Enable RS-485 communication.	57
(d)	Terminating resistor selection switch (SW1)	Selects whether or not to use the terminating resistor for RS-485 communication.	57
(e)	For manufacturer setting. Do not use.		—
(f)	Control circuit terminal block	Connects cables for the control circuit.	46
(g)	EMC filter ON/OFF connector	Turns ON/OFF the EMC filter.	64
(h)	Main circuit conductor	Connects cables for the main circuit.	37
(i)	Charge lamp	Stays ON while the power is supplied to the main circuit.	37
(j)	Alarm lamp	Turns ON when the protective function of the converter unit is activated.	37, 156
(k)	Power lamp	Stays ON while the power is supplied to the control circuit (R1/L11, S1/L21).	37
(l)	Upper front cover	Remove this cover for wiring to control circuit terminals, RS-485 terminals, etc.	23
(m)	Lower front cover	Remove this cover for wiring.	23
(n)	Cooling fan	Cools the converter unit.	175
(o)	Accessory cover	Covers the operation panel (FR-DU08) installation area.	23
(p)	Switches (SW3 and SW4) for manufacturer setting	Do not change the initial setting (OFF ).	—

1.3 Related manuals

Manuals related to the FR-CC2 converter unit are shown in the following table.

Name	Manual number
FR-A802 Instruction Manual (Hardware)	IB-0600534ENG
FR-A802-E Instruction Manual (Hardware)	IB-0600631ENG
FR-A800 Instruction Manual (Detailed)	IB-0600503ENG
FR-F802 Instruction Manual (Hardware)	IB-0600550ENG
FR-F802-E Instruction Manual (Hardware)	IB-0600648ENG
FR-F800 Instruction Manual (Detailed)	IB-0600547ENG

MEMO

CHAPTER 2 INSTALLATION AND WIRING

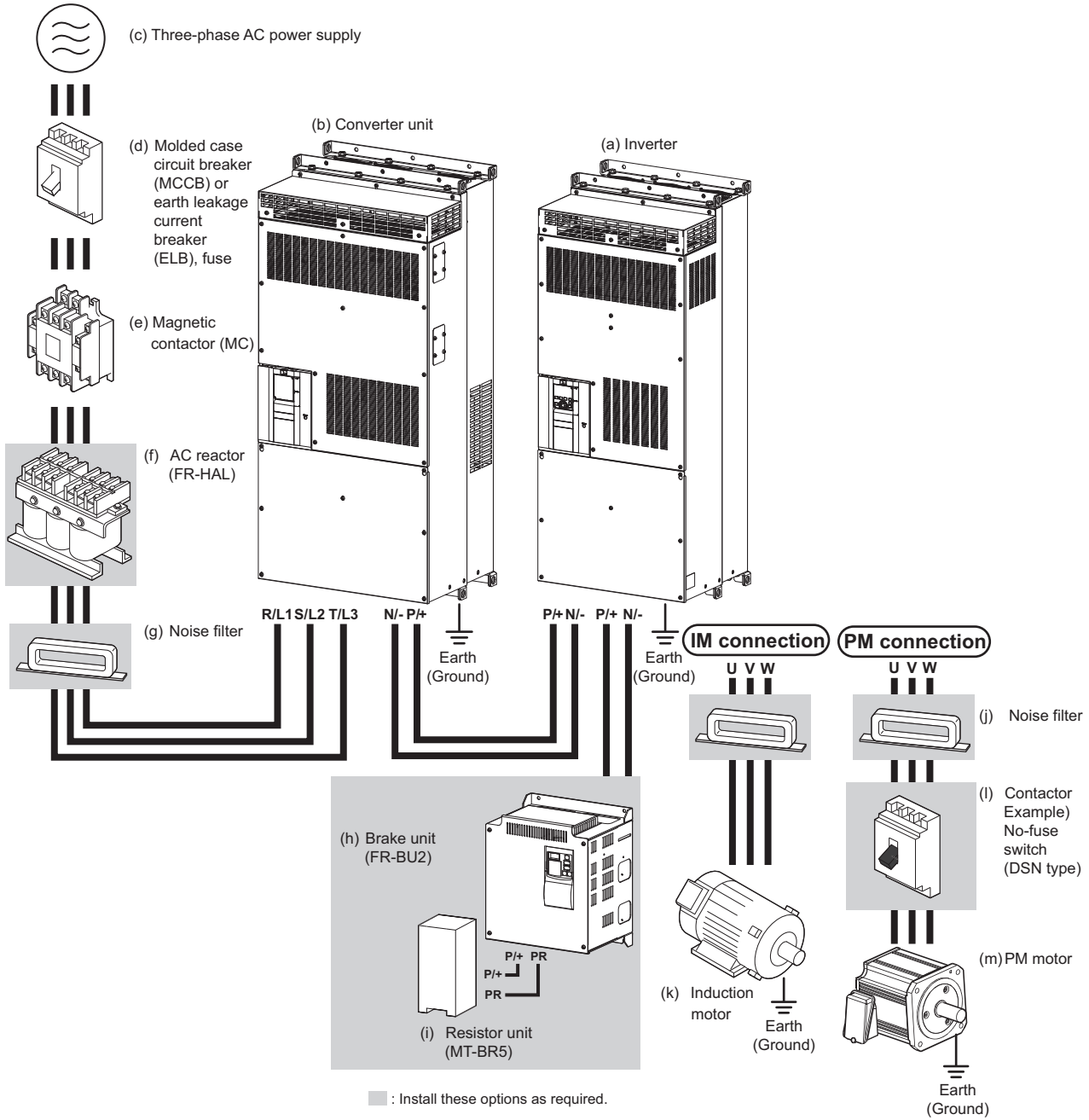
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2 INSTALLATION AND WIRING

This chapter explains the installation and the wiring of this product.
Always read the instructions before use.

2.1 Peripheral devices

2.1.1 Converter unit and peripheral devices



Symbol	Name	Overview	Refer to page
(a)	Inverter (FR-A800/FR-F800)	The life of the inverter and the converter unit is influenced by the surrounding air temperature. The surrounding air temperature should be as low as possible within the permissible range. This must be noted especially when the inverter is installed in an enclosure. Incorrect wiring may lead to damage of the inverter and the converter unit.	25, 32, 64
(b)	Converter unit (FR-CC2)	The control signal lines must be kept fully away from the main circuit lines to protect them from noise. The built-in EMC filter of the converter unit can reduce the noise.	
(c)	Three-phase AC power supply	Must be within the permissible power supply specifications of the converter unit.	182
(d)	Molded case circuit breaker (MCCB), earth leakage circuit breaker (ELB), or fuse	Must be selected carefully since an inrush current flows in the converter unit at power ON.	19
(e)	Magnetic contactor (MC)	Install this to ensure safety. Do not use this to start and stop the inverter. Doing so will shorten the life of the inverter and the converter unit.	71
(f)	AC reactor (FR-HAL)	Install this to suppress harmonics and to improve the power factor. An AC reactor (FR-HAL) (option) is required when installing the inverter near a large power supply system (1000 kVA or more). The inverter or the converter unit may be damaged if you do not use a reactor. Select a reactor according to the applied motor capacity.	70
(g)	Noise filter	Suppresses the noise radiated from the power supply side of the converter unit.	62
(h)	Brake unit (FR-BU2)	Allows the inverter to provide the optimal regenerative braking capability.	—
(i)	Resistor unit (MT-BR5)	Install this as required.	
(j)	Noise filter	Install this to reduce the electromagnetic noise generated from the inverter and the converter unit. The noise filter is effective in the range from about 0.5 to 5 MHz.	62
(k)	Induction motor	Connect a squirrel-cage induction motor.	—
(l)	Example) No-fuse switch (DSN type)	Connect this for an application where a PM motor is driven by the load even while the inverter power is OFF. Do not open or close the contactor while the inverter is running (outputting).	—
(m)	PM motor	A PM motor can be used. A PM motor cannot be driven by the commercial power supply.	—

NOTE

- To prevent an electric shock, always earth (ground) the converter unit, the inverter, and the motor.
- Do not install a power factor correction capacitor, surge suppressor, or capacitor type filter on the inverter's output side. Doing so will cause the inverter shut off or damage the capacitor or surge suppressor. If any of the above devices is connected, immediately remove it. When installing a molded case circuit breaker on the output side of the inverter, contact the manufacturer of the molded case circuit breaker.
- Electromagnetic wave interference:
The input/output (main circuit) of the inverter or the converter unit includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter or the converter unit. To minimize interference, enabling the built-in EMC filter or installing an external EMC filters is effective. (Refer to [page 64](#).)
- For details of options and peripheral devices, refer to the respective Instruction Manual.
- A PM motor cannot be driven by the commercial power supply.
- A PM motor is a motor with permanent magnets embedded inside. High voltage is generated at the motor terminals while the motor is running. Before closing the contactor at the output side, make sure that the inverter power is ON and the motor is stopped.

2.1.2 Peripheral devices

◆ Compatible inverters

According to the connected motor capacity, configure the converter units and the inverters as follows.

- FR-A800 series

Motor capacity (kW) ^{*1}	Converter unit FR-CC2-[]	Inverter												
		SLD (superlight duty)			LD (light duty)			ND (normal duty, initial value)			HD (heavy duty)			
		Model FR-A842-[]	Rated current (A)	Model FR-A842-[]	Rated current (A)	Model FR-A842-[]	Rated current (A)	Model FR-A842-[]	Rated current (A)	Model FR-A842-[]	Rated current (A)			
280	H315K	—	—	—	—	—	—	—	—	—	—	315K	07700	547
315	H315K	—	—	—	—	—	—	315K	07700	610	—	355K	08660	610
355	H355K	—	—	—	315K	07700	683	355K	08660	683	—	400K	09620	683
400	H400K	315K	07700	770	355K	08660	770	400K	09620	770	—	450K	10940	770
450	H450K	355K	08660	866	400K	09620	866	450K	10940	866	—	500K	12120	866
500	H500K	400K	09620	962	450K	10940	962	500K	12120	962	—	—	—	—
560	H560K	450K	10940	1094	500K	12120	1094	—	—	—	—	—	—	—
630	H630K	500K	12120	1212	—	—	—	—	—	—	—	—	—	—

- FR-F800 series

Motor capacity (kW) ^{*1}	Converter unit FR-CC2-[]	Inverter					
		SLD (superlight duty)			LD (light duty)		
		Model FR-F842-[]	Rated current (A)	Model FR-F842-[]	Rated current (A)		
355	H355K	—	—	355K	07700	683	—
400	H400K	355K	07700	400K	08660	770	—
450	H450K	400K	08660	450K	09620	866	—
500	H500K	450K	09620	500K	10940	962	—
560	H560K	500K	10940	560K	12120	1094	—
630	H630K	560K	12120	—	—	—	—

*1 The motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi Electric standard 4-pole motor.

◆ Selecting the breaker / magnetic contactor (for 6-phase rectification)

Check the model name of the inverter and the converter unit you purchased. Appropriate peripheral devices must be selected according to the capacity.

Refer to the following table for right selection.

- 400 V class

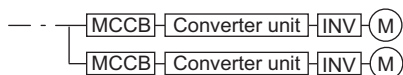
Motor output (kW)	Applicable converter unit model ^{*1}	Molded case circuit breaker (MCCB) ^{*1,2} or earth leakage circuit breaker (ELB) (NF or NV type)	Magnetic contactor (MC) ^{*1,3} on converter unit's input side
315	FR-CC2-H315K	700 A	S-N600
355	FR-CC2-H355K	800 A	S-N600
400	FR-CC2-H400K	900 A	S-N800
450	FR-CC2-H450K	1000 A	1000 A rated product
500	FR-CC2-H500K	1200 A	1000 A rated product
560	FR-CC2-H560K	1500 A	1200 A rated product
630	FR-CC2-H630K	2000 A	1400 A rated product

*1 Assumes the use of a Mitsubishi Electric standard 4-pole motor with the power supply voltage of 400 VAC 50 Hz.

*2 Select an MCCB according to the power supply capacity.

Install one MCCB per converter unit.

(For the use in the United States or Canada, refer to [page 193](#) and [page 195](#), and select the appropriate fuse.)



*3 The matrix shows the magnetic contactor selected according to the standards of Japan Electrical Manufacturers' Association (JEM standards) for AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the MC is used for emergency stops during motor driving, the electrical durability is 25 times.

If using an MC for emergency stop during motor driving, select an MC for the converter unit input current according to the rated current against JEM 1038 standards for AC-3 class. When installing an MC on the inverter output side to switch to the commercial-power supply operation while running a general-purpose motor, select the MC for the rated motor current according to the rated current against JEM 1038 standards for AC-3 class.

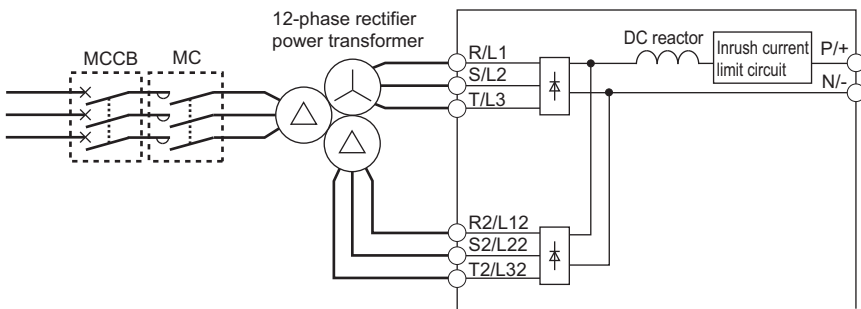
NOTE

- When the converter unit capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the converter unit model, and select cables and reactors according to the motor output.
- When the breaker on the converter unit's input side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter or the converter unit, etc. Identify and remove the cause of the trip before resetting the tripped breaker (or before applying the power to this product again).

◆ Selecting the breaker / magnetic contactor (for 12-phase rectification)

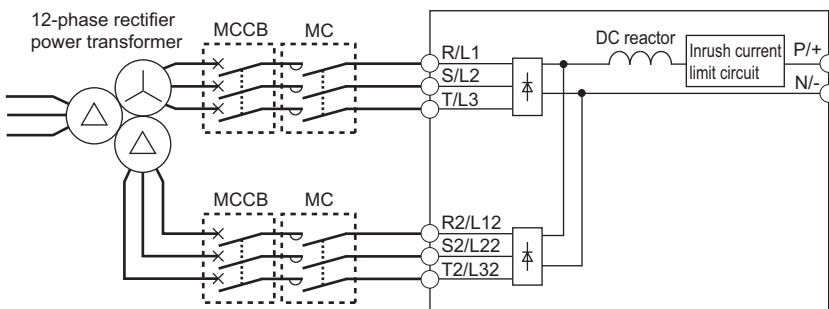
Check the model name of the inverter and the converter unit you purchased. Appropriate peripheral devices must be selected according to the capacity.

- For connecting the power distribution control equipment to the input side of the 12-phase transformer (not used to reduce the voltage at the 12-phase transformer)



Refer to the table for 6-phase rectification to prepare the same appropriate peripheral devices.

- For connecting the power distribution control equipment to the output side of the 12-phase transformer (used to reduce the voltage at the 12-phase transformer)



Refer to the following table to prepare appropriate peripheral devices.

Motor output (kW)	Applicable converter unit model ^{*1}	Rated input current from delta/ye connection ^{*1}	Molded case circuit breaker (MCCB) ^{*1*2} (NF type)	Magnetic contactor (MC) ^{*1*3} on converter unit's input side
315	FR-CC2-H315K	406 A	500 A	S-N400
355	FR-CC2-H355K	454 A	600 A	S-N400
400	FR-CC2-H400K	512 A	600 A	S-N600
450	FR-CC2-H450K	576 A	700 A	S-N600
500	FR-CC2-H500K	640 A	800 A	S-N600
560	FR-CC2-H560K	728 A	900 A	S-N800
630	FR-CC2-H630K	806 A	1000 A	S-N800

*1 Assumes the use of a Mitsubishi Electric standard 4-pole motor with the power supply voltage of 400 VAC 50 Hz.

*2 Select an MCCB according to the power supply capacity.

Install one MCCB between the delta/ye connection and the converter unit.

(For the use in the United States or Canada, refer to page 193 and page 195, and select the appropriate fuse.)

- *3 The matrix shows the magnetic contactor selected according to the standards of Japan Electrical Manufacturers' Association (JEM standards) for AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the MC is used for emergency stops during motor driving, the electrical durability is 25 times.
- If using an MC for emergency stop during motor driving, select an MC for the converter unit input current according to the rated current against JEM 1038 standards for AC-3 class. When installing an MC on the inverter output side to switch to the commercial-power supply operation while running a general-purpose motor, select the MC for the rated motor current according to the rated current against JEM 1038 standards for AC-3 class.

 **NOTE**

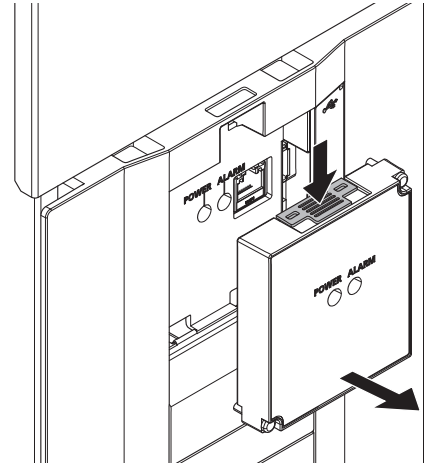
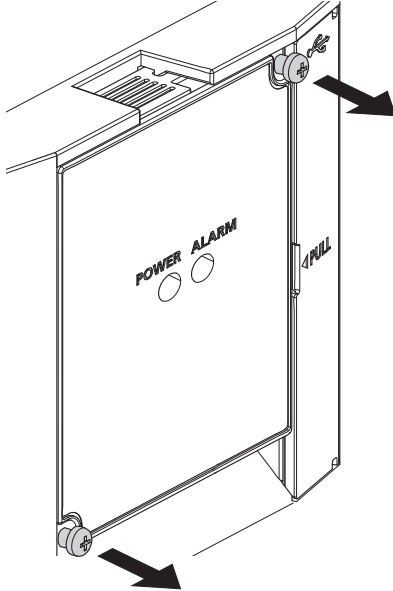
- When the converter unit capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the converter unit model, and select cables and reactors according to the motor output.
 - When the breaker on the converter unit's input side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter or the converter unit, etc. Identify and remove the cause of the trip before resetting the tripped breaker (or before applying the power to this product again).
 - E.ILF is not activated when input is lost for one of the three phases (terminals R2/L12, S2/L22, and T2/L32) while the converter unit is used with a 12-phase transformer.
-

2.2 Removal and reinstallation of the cover

2

◆ Removal of the accessory cover and installation of the operation panel

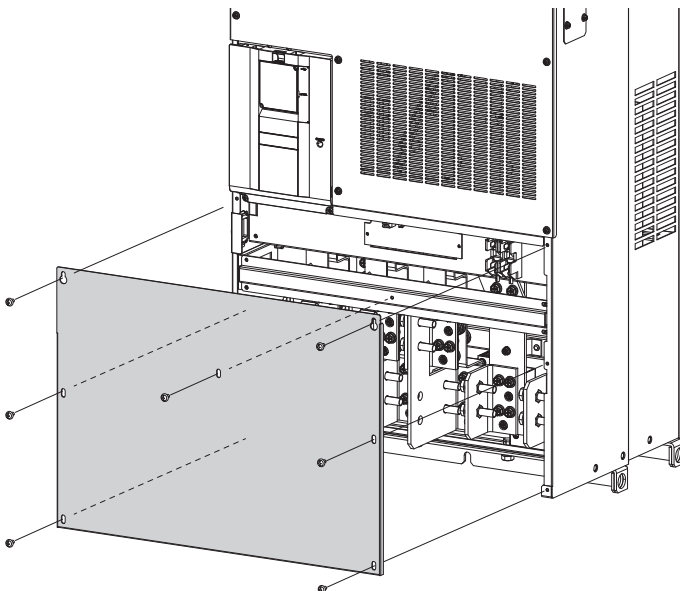
- Loosen the two fixing screws on the accessory cover. (These screws cannot be removed.)
- Press the upper edge of the operation panel while pulling out the operation panel.



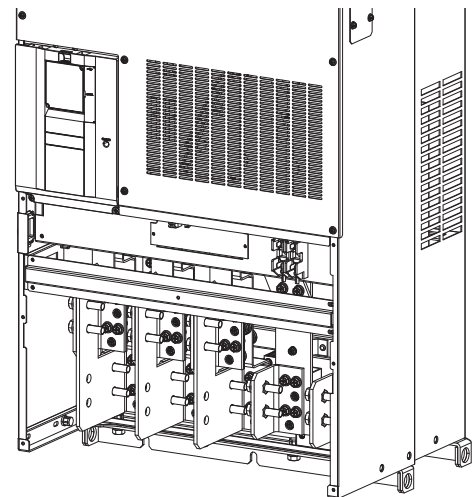
- To install the inverter operation panel, align its connector on the back with the PU connector of the converter unit, and insert the operation panel. After confirming that the operation panel is fit securely, tighten the screws. (Tightening torque: 0.40 to 0.45 N·m)

◆ Removal of the lower front cover

(a)

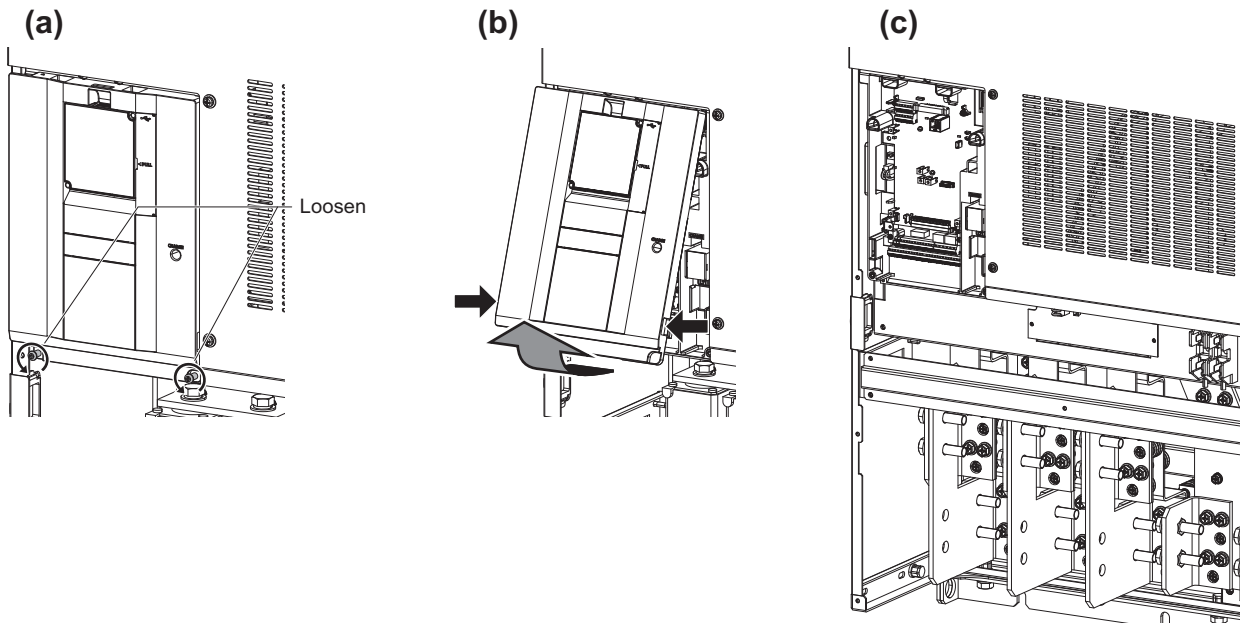


(b)



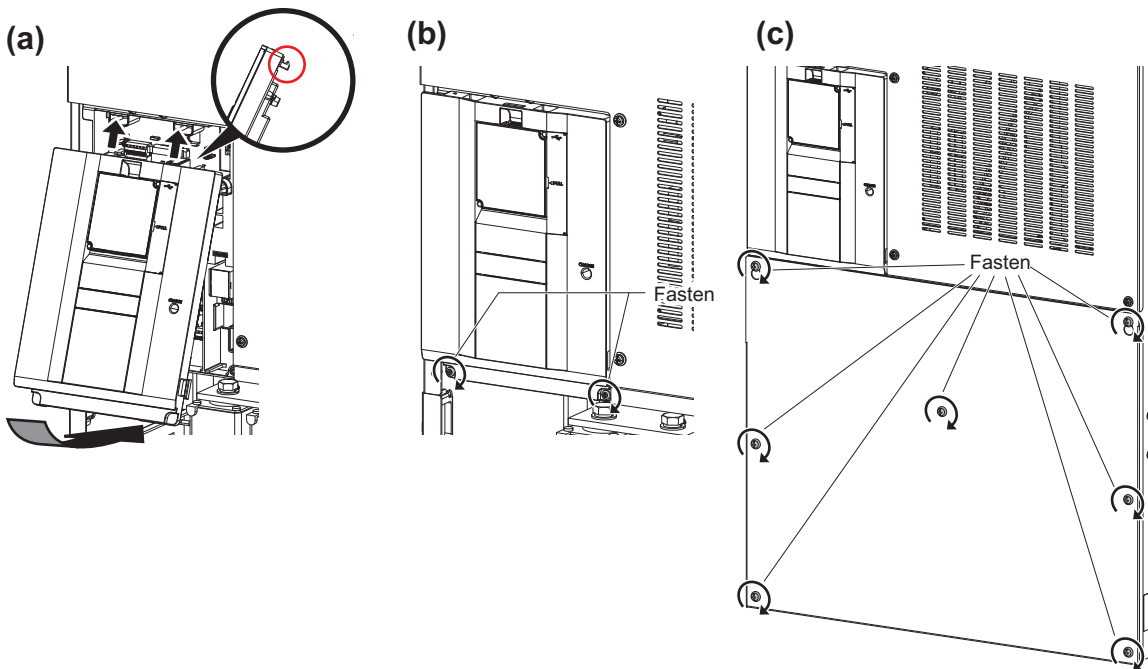
- (a) When the screws are removed, the lower front cover can be removed.
- (b) With the lower front cover removed, the main circuit can be wired.

◆ Removal of the upper front cover



- With the lower front cover removed, loosen the screws on the upper front cover. (These screws cannot be removed.)
- While holding the areas around the installation hooks on the sides of the upper front cover, pull out the cover using its upper side as a support.
- With the upper cover removed, the control circuit and the RS-485 terminals can be wired.

◆ Reinstallation of the front cover



- Insert the upper hooks of the upper front cover into the sockets of the inverter.
Securely install the cover to the inverter by fixing the hooks on the sides of the cover into place.
- Tighten the screws on the lower part of the cover.
- Fasten the lower front cover with the mounting screws.

NOTE

- Fully make sure that the front cover has been reinstalled securely. Always tighten the installation screws of the front cover.

2.3 Installation of the converter unit and enclosure design

When designing or manufacturing an enclosure to contain the converter unit, determine the structure, size, and device layout by fully considering the conditions such as heat generation of the contained devices and the operating environment. A converter unit uses many semiconductor devices. To ensure higher reliability and long period of operation, operate the converter in the ambient environment that completely satisfies the equipment specifications.

2.3.1 Converter unit installation environment

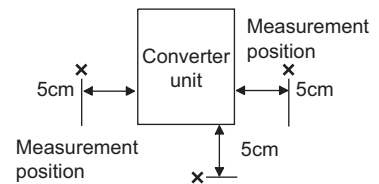
The following table lists the standard specifications of the converter unit installation environment. Using the converter unit in an environment that does not satisfy the conditions deteriorates the performance, shortens the life, and causes a failure. Refer to the following points, and take adequate measures.

◆ Standard environmental specifications of the converter unit

Item	Description
Surrounding air temperature	FR-CC2-H315K to H560K: -10°C to +50°C (non-freezing) FR-CC2-H630K: -10°C to +40°C (non-freezing)
Ambient humidity	95% RH or less (non-condensing)
Storage temperature	-20 to +65°C*1
Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
Altitude	Maximum 2500 m*2
Vibration	2.9 m/s ² or less at 10 to 55 Hz (in either X, Y, or Z direction)

*1 Temperature applicable for a short time, for example, in transit.

*2 For installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.



◆ Temperature

The permissible surrounding air temperature of the converter unit is between -10°C and +50°C (-10°C and +40°C for the FR-CC2-H630K). Always operate the converter unit within this temperature range. Operation outside this range will considerably shorten the service lives of the semiconductors, parts, capacitors and others. Take the following measures to keep the surrounding air temperature of the converter unit within the specified range.

■ Measures against high temperature

- Use a forced ventilation system or similar cooling system. (Refer to [page 27](#).)
- Install the enclosure in an air-conditioned electric chamber.
- Block direct sunlight.
- Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
- Ventilate the area around the enclosure well.

■ Measures against low temperature

- Provide a space heater in the enclosure.
- Do not power OFF the converter unit.

■ Sudden temperature changes

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

◆ Humidity

Normally operate the converter unit within the ambient air humidity of 45% to 95%. 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%.

■ Measures against high humidity

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

■ Measures against low humidity

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.

■ 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.

- Take the measures against high humidity.
- Do not power OFF the converter unit.

◆ 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.

■ Countermeasure

- Place the converter in a totally enclosed enclosure.
Take measures if the in-enclosure temperature rises. (Refer to [page 27](#).)
- 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 converter 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 the previous paragraph.

◆ Explosive, flammable gases

As the converter unit 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 converter in a non-hazardous place.

◆ High altitude

Use the converter unit at an altitude of within 2500 m. For use at an altitude above 1000 m, 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 converter unit is up to 2.9 m/s² at 10 to 55 Hz frequency and 1 mm amplitude in either X, Y, or Z direction. 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.

Especially when impacts are applied repeatedly, caution must be taken because such impacts may break the installation feet.

Countermeasure

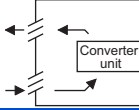
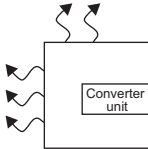
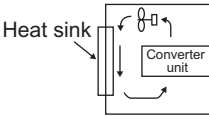
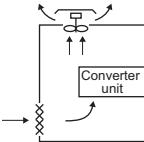
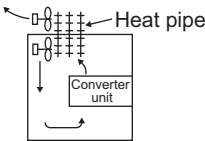
- Provide the enclosure with rubber vibration isolators.
- Strengthen the structure to prevent the enclosure from resonance.
- Install the enclosure away from the sources of the vibration.

2.3.2 Cooling system types for converter unit enclosure

From the enclosure that contains the converter unit, the heat of the converter unit and other equipment (transformers, lamps, resistors, etc.) and the incoming heat such as direct sunlight must be dissipated to keep the in-enclosure temperature lower than the permissible temperatures of the in-enclosure equipment including the converter unit.

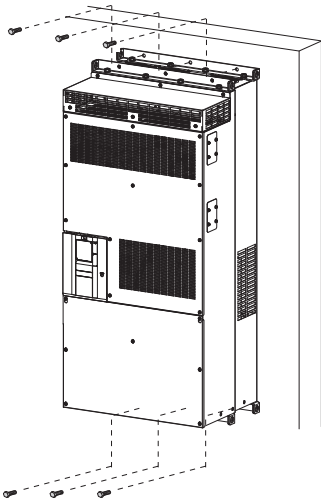
The cooling systems are classified as follows in terms of the cooling calculation method.

- Cooling by natural heat dissipation from the enclosure surface (totally enclosed type)
- Cooling by heat sink (aluminum fin, etc.)
- Cooling by ventilation (forced ventilation type, pipe ventilation type)
- Cooling by heat exchanger or cooler (heat pipe, cooler, etc.)

Cooling system		Enclosure structure	Comment
Natural	Natural ventilation (enclosed type / open type)		This system is low in cost and generally used, but the enclosure size increases as the converter unit capacity increases. This system is for relatively small capacities.
	Natural ventilation (totally enclosed type)		Being a totally enclosed type, this system is the most appropriate for hostile environment having dust, dirt, oil mist, etc. The enclosure size increases depending on the converter unit capacity.
Forced air	Heat sink cooling		This system has restrictions on the heat sink mounting position and area. This system is for relatively small capacities.
	Forced ventilation		This system is for general indoor installation. This is appropriate for enclosure downsizing and cost reduction, and often used.
	Heat pipe		This system is a totally enclosed type, and is appropriate for enclosure downsizing.

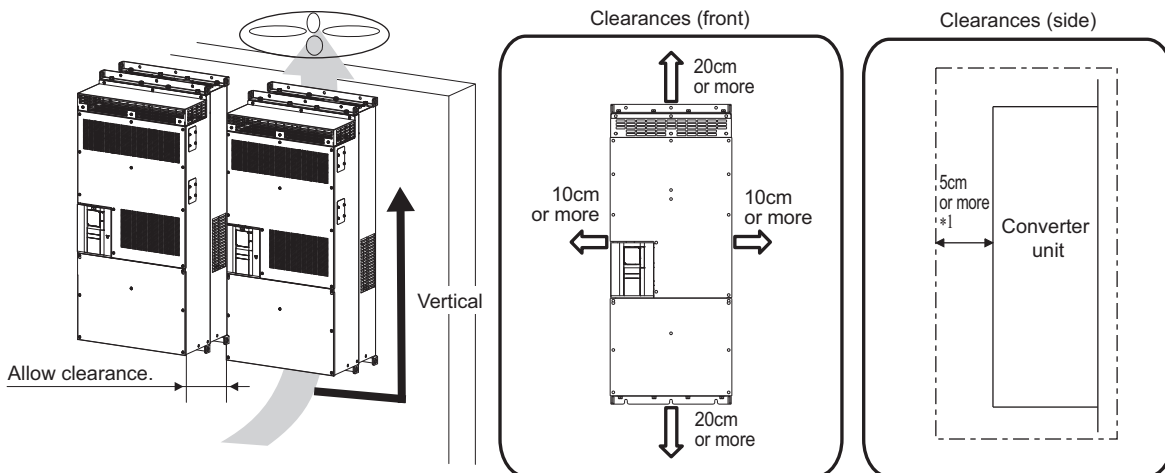
2.3.3 Installation of the converter unit

◆ Installation of the converter unit



Fix six positions.

- Install the converter unit on a strong surface securely with screws.
- Leave enough clearances and take cooling measures.
- Avoid places where the converter unit is subjected to direct sunlight, high temperature and high humidity.
- Install the converter unit on a nonflammable wall surface.
- When encasing multiple inverters in an enclosure, install them in parallel as a cooling measure.
- For heat dissipation and maintenance, keep clearance between the converter unit and the other devices or enclosure surface. The clearance below the converter unit is required as a wiring space, and the clearance above the converter unit is required as a heat dissipation space.
- When designing or building an enclosure for the converter unit, carefully consider influencing factors such as heat generation of the contained devices and the operating environment.



*1 For replacing the cooling fan, 30 cm of space is necessary in front of the converter. Refer to [page 175](#) for fan replacement.

◆ Installation orientation of the converter unit

Install the converter unit on a wall as specified. Do not mount it horizontally or in any other way.

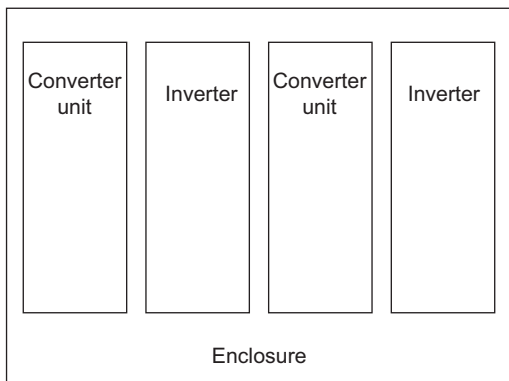
◆ Above the converter unit

Heat is blown up from inside the converter unit by the small fan built in the unit. Any equipment placed above the converter unit should be heat resistant.

◆ Encasing multiple inverters and converter units

When multiple inverters and converter units are placed in the same enclosure, arrange them horizontally as shown in the figure below. Do not place multiple products vertically. The exhaust air temperature of the inverter and the converter unit may be increased.

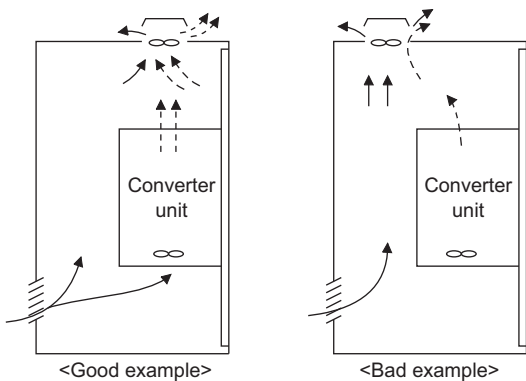
When mounting multiple inverters and converter units, fully take caution not to make the surrounding air temperature of the inverter and the converter unit higher than the permissible value by providing ventilation and increasing the enclosure size.



Arrangement of multiple inverters and converter units

◆ **Arrangement of the ventilation fan and the converter unit**

Heat generated in the converter unit is blown up from the bottom of the unit as warm air by the cooling fan. When installing a ventilation fan for that heat, determine the place of ventilation fan installation after fully considering an air flow. (Air passes through areas of low resistance. Make an airway and airflow plates to expose the converter unit to cool air.)



Arrangement of the ventilation fan and the converter unit

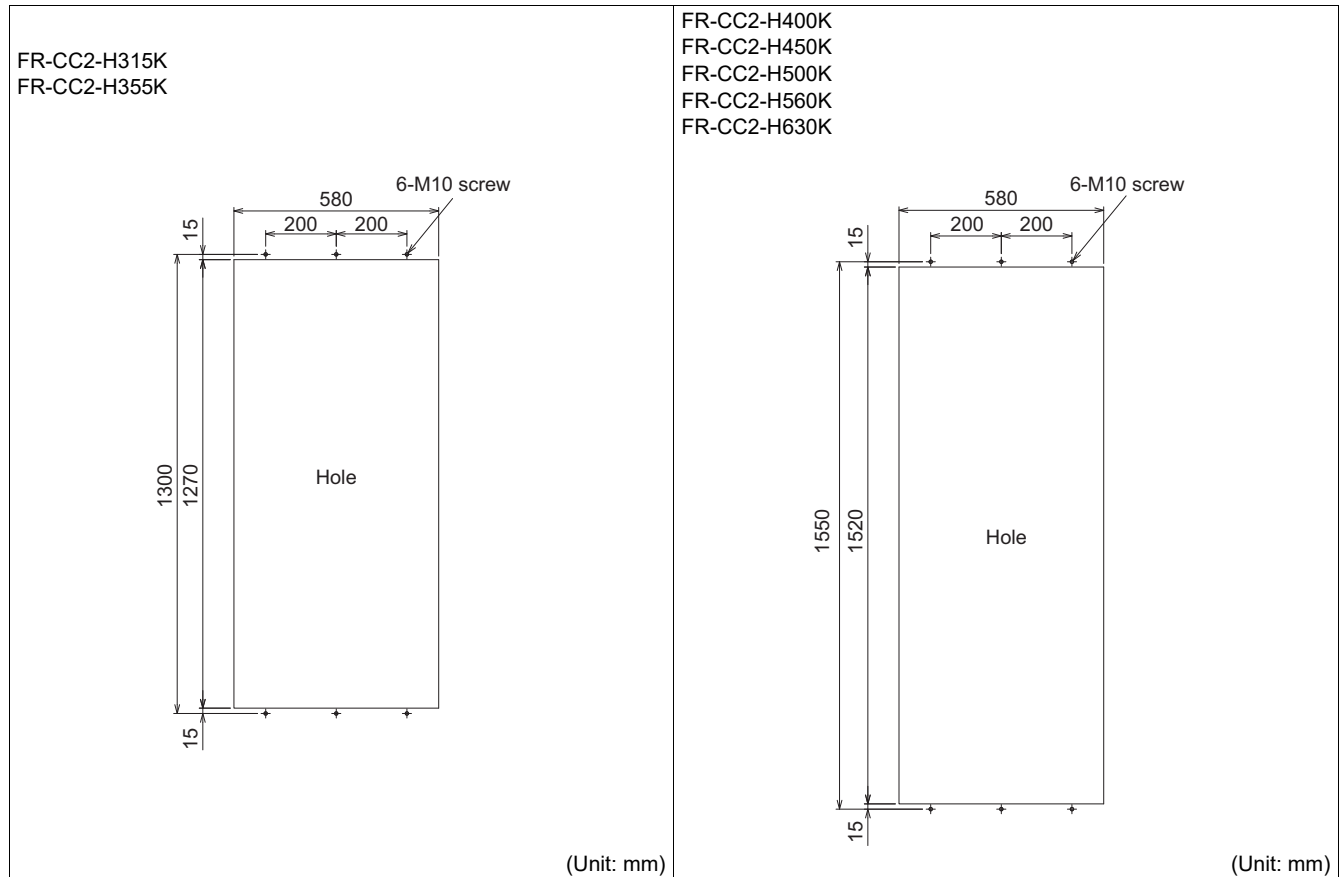
2.3.4 Protruding the heat sink through a panel

When encasing the converter unit to an enclosure, the heat generated in the enclosure can be greatly reduced by protruding its heat sink through the rear panel of the enclosure.

When installing the inverter in a compact enclosure, etc., this installation method is recommended.

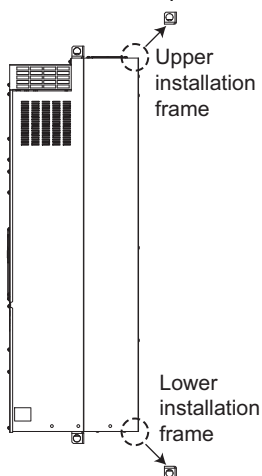
■ Panel cutting

Cut the panel of the enclosure according to the converter unit capacity.



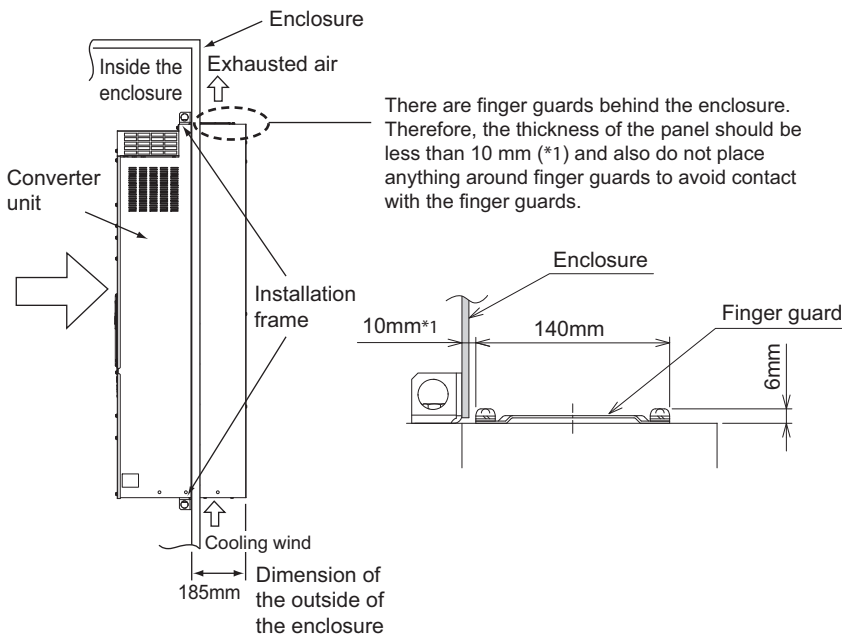
■ Removal of the rear installation frame

The upper and lower installation frames are attached on the converter unit (two for each position). Remove the rear installation frames on the top and bottom of the converter unit as follows.



■ Installation of the converter unit on the enclosure

Push the converter unit heat sink part outside the enclosure, and fix the converter unit to the panel with upper and lower installation frames.

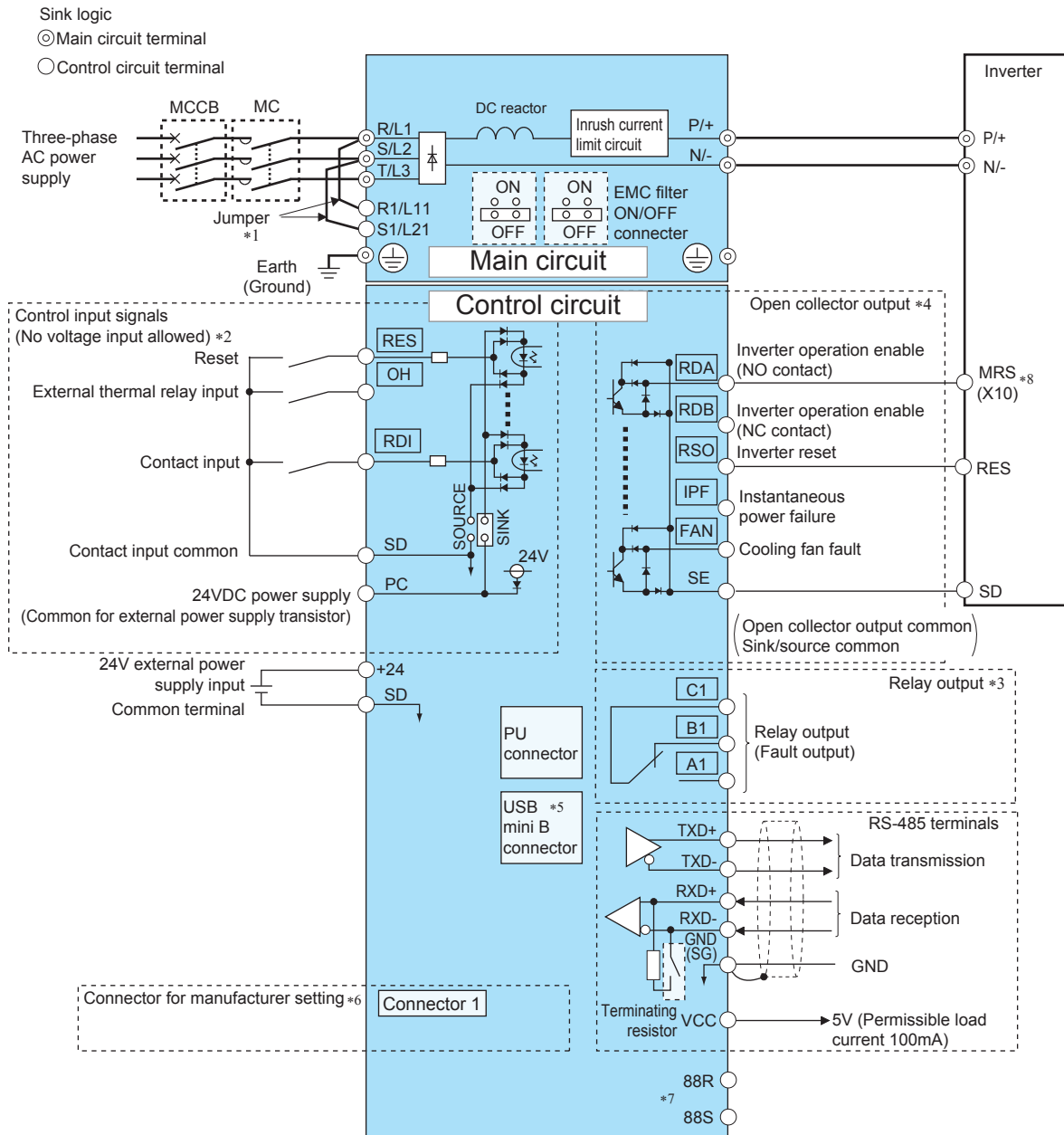


NOTE

- As the heat sink part protruded through the panel includes a cooling fan, this type of installation is not suitable for the environment of water drops, oil, mist, dust, etc.
- Be careful not to drop screws, dust etc. into the converter unit and cooling fan section.

2.4 Terminal connection diagrams

◆ When the sink logic is selected



*1 To use separate power supply for the control circuit, remove each jumper at terminal R1/L11 and terminal S1/L21.

*2 The function of these terminals can be changed using the Input terminal function selection (Pr.178, Pr.187, Pr.189).

*3 The function of these terminals can be changed using the Output terminal function selection (Pr.195).

*4 The function of these terminals can be changed using the Output terminal function selection (Pr.190 to Pr.194).

*5 This connector is for manufacturer setting. Do not use.

*6 Plug-in options cannot be used.

*7 For manufacturer setting. Do not use.

*8 To use the RDA signal of the converter unit, select the normally-closed contact input specification for the input logic of the MRS signal or X10 signal of the inverter.

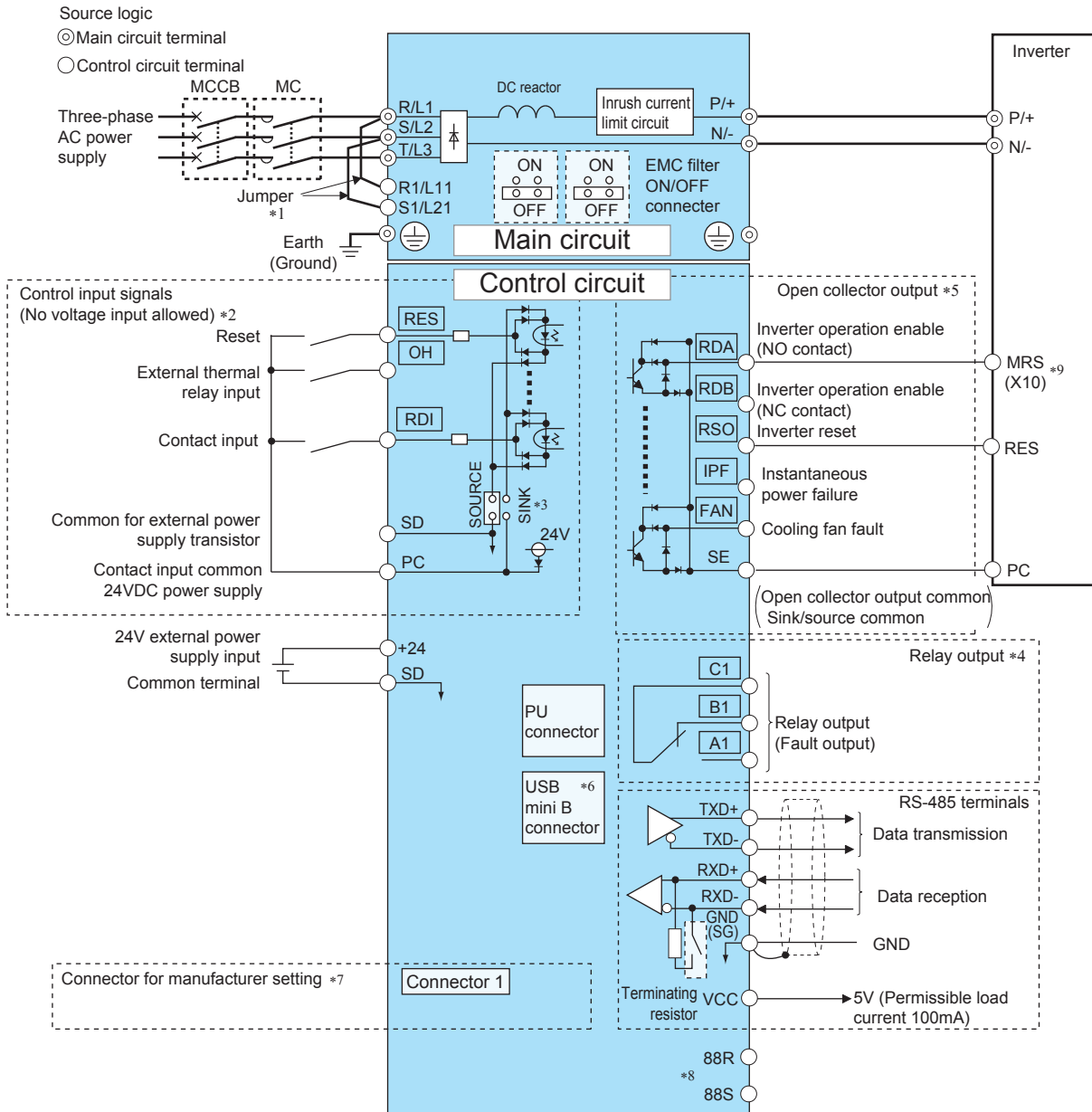
To use the RDB signal of the converter unit, select the normally-open contact input specification for the input logic of the MRS signal or X10 signal of the inverter.

(For changing the input logic, refer to the Instruction Manual of the inverter.)

 **NOTE**

- To prevent a malfunction due to noise, keep the signal cables 10 cm or more away from the power cables. Also, keep the cables of the main circuit for input and output separated.
- After wiring, do not leave wire offcuts in the inverter or the converter unit.
Wire offcuts can cause a fault, failure, or malfunction. Always keep the inverter and the converter unit clean.
When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter or the converter unit.
- The terminal connection diagram shows the wiring for 6-phase rectification. For 12-phase rectification, refer to [page 41](#) for wiring to the main circuit terminals.

◆ When the source logic is selected



- *1 To use separate power supply for the control circuit, remove each jumper at terminal R1/L11 and terminal S1/L21.
- *2 The function of these terminals can be changed using the Input terminal function selection (**Pr.178, Pr.187, Pr.189**).
- *3 The sink logic is initially set. The control logic can be changed with the jumper connector position.
- *4 The function of these terminals can be changed using the Output terminal function selection (**Pr.195**).
- *5 The function of these terminals can be changed using the Output terminal function selection (**Pr.190 to Pr.194**).
- *6 This connector is for manufacturer setting. Do not use.
- *7 Plug-in options cannot be used.
- *8 For manufacturer setting. Do not use.
- *9 To use the RDA signal of the converter unit, select the normally-closed contact input specification for the input logic of the MRS signal or X10 signal of the inverter.
To use the RDB signal of the converter unit, select the normally-open contact input specification for the input logic of the MRS signal or X10 signal of the inverter.
(For changing the input logic, refer to the Instruction Manual of the inverter.)

 **NOTE**

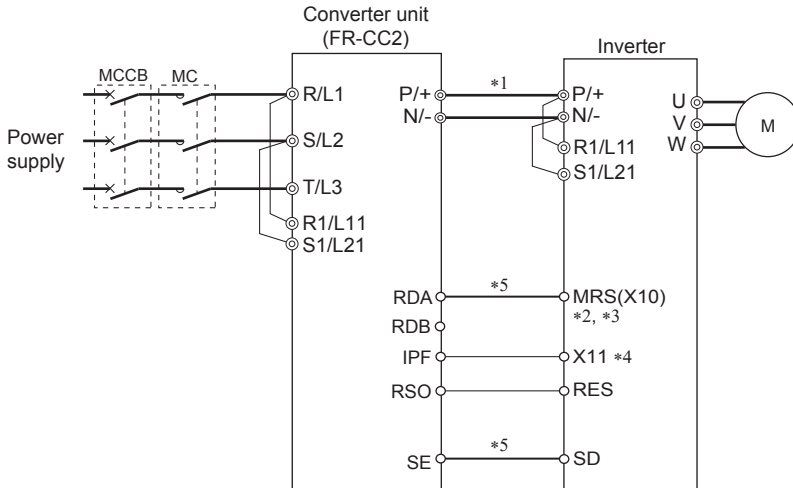
- To prevent a malfunction due to noise, keep the signal cables 10 cm or more away from the power cables. Also, keep the cables of the main circuit for input and output separated.
- After wiring, do not leave wire offcuts in the inverter or the converter unit.
Wire offcuts can cause a fault, failure, or malfunction. Always keep the inverter and the converter unit clean.
When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter or the converter unit.
- The terminal connection diagram shows the wiring for 6-phase rectification. For 12-phase rectification, refer to [page 41](#) for wiring to the main circuit terminals.

◆ Connection and wiring length between the converter unit and the inverter

- Perform wiring so that the commands sent from the converter unit are transmitted to the inverter without fail. Otherwise, the converter unit and the inverter may be damaged.
- For the wiring length, refer to the following tables.

Location	Wiring length
Across terminals P and P and terminals N and N	50 m or shorter
Other control signal cables	30 m or shorter


- For the wire gauge of the wire across the main circuit terminals P/+ and N/- (P and P, N and N), refer to [page 38](#).



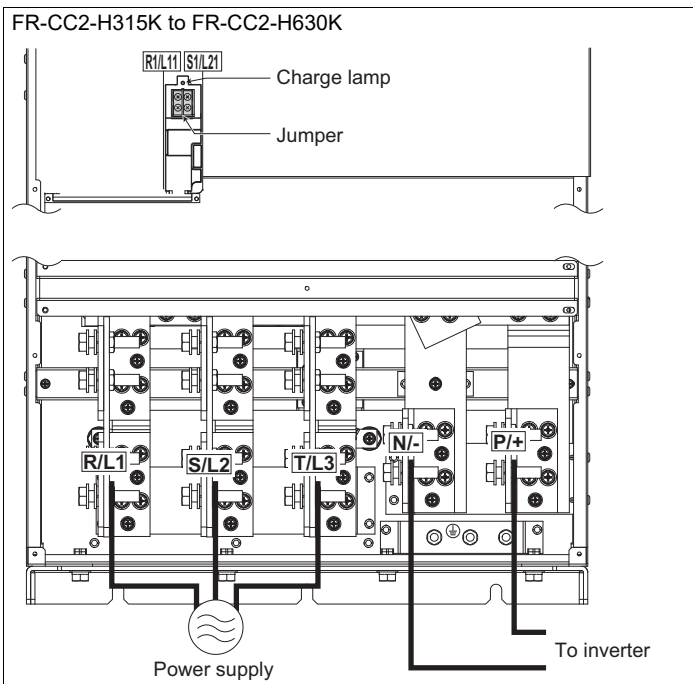
- *1 Do not install an MCCB across terminals P/+ and N/- (between terminals P and P/+ or between terminals N and N/-). Connecting the opposite polarity of terminals N/- and P/+ will damage the inverter.
- *2 For the X10 signal input, set "10" in any parameter from **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function.
- *3 To use the RDA signal of the converter unit, select the normally-closed contact input specification for the input logic of the MRS signal or X10 signal of the inverter.
To use the RDB signal of the converter unit, select the normally-open contact input specification for the input logic of the MRS signal or X10 signal of the inverter.
(For changing the input logic, refer to the Instruction Manual of the inverter.)
- *4 For the X11 signal input, set "11" in any parameter from **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function.
For RS-485 or any other communication where the start command is only transmitted once, use the X11 signal to save the operation mode at the time of an instantaneous power failure.
- *5 Always connect terminal RDA of the converter unit and terminal MRS (X10) of the inverter, and terminal SE of the converter unit and terminal SD (sink logic) of the inverter. Otherwise, the converter unit may be damaged.

2.5 Main circuit terminals (for 6-phase rectification)

2.5.1 Details on the main circuit terminals

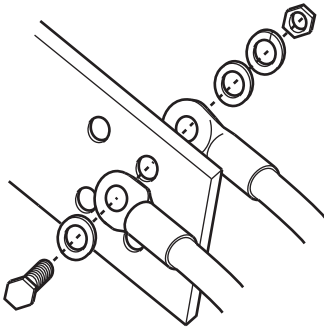
Terminal symbol	Terminal name	Terminal function description	Refer to page
R/L1, S/L2, T/L3	AC power input	Connect these terminals to the commercial power supply.	—
R1/L11, S1/L21	Power supply for the control circuit	Connected to the AC power supply terminals R/L1 and S/L2. To retain the fault display and fault output, remove the jumpers across terminals R/L1 and R1/L11 and across S/L2 and S1/L21, and apply external power to these terminals. When using a separate power supply connected to terminals R1/L11 and S1/L21, the required power capacity is 80 VA.	52
P/+, N/-	Inverter connection	Connect them to the inverter terminals P/+ and N/-.	32
	Earth (ground)	For earthing (grounding) the converter unit chassis. Be sure to earth (ground) the converter unit.	39

2.5.2 Terminal layout of the main circuit terminals, wiring of power supply and the inverter



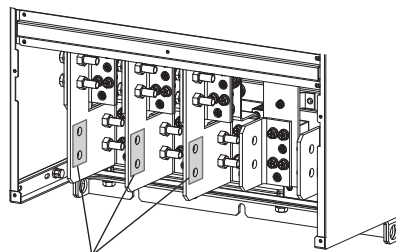
NOTE

- Make sure the power cables are connected to the R/L1, S/L2, and T/L3 of the converter unit. (Phase need not be matched.)
- When wiring cables to the main circuit conductor, tighten each nut from the right of the conductor as seen from the front of the unit.
When wiring two cables, place cables on both sides of the conductor. (Refer to the following figure.)
For wiring, use bolts (nuts) provided with the inverter.



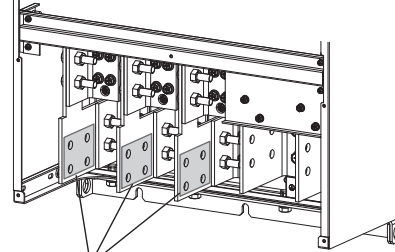
- When wiring cables to the main circuit conductor (R/L1, S/L2, T/L3) of the converter unit, use the bolts (nuts) for main circuit wiring, which are provided on the front side of the conductor.

FR-CC2-H315K, H355K



Connect the cables here.

FR-CC2-H400K to H630K



Connect the cables here.

2.5.3 Recommended cables

Select a recommended size cable to ensure that the voltage drop ratio is within 2%.

The following table indicates a selection example for the wiring length of 20 m (440 V input power supply, 150% overload current rating for 1 minute).

Converter unit model FR-CC2-[]	Terminal screw size ^{*4}	Tightening torque (N·m)	Crimp terminal	Cable gauge					
				HIV cables, etc. (mm ²) ^{*1}			AWG/MCM ^{*2}	PVC cables, etc. (mm ²) ^{*3}	
				R/L1, S/L2, T/L3	R/L1, S/L2, T/L3	P/+, N/-	Earthing (grounding) cable	R/L1, S/L2, T/L3	R/L1, S/L2, T/L3
H315K	M12 (M10)	46	150-12	2×150	2×150	100	2×300	2×150	150
H355K	M12 (M10)	46	C2-200	2×200	2×200	100	2×350	2×185	2×95
H400K	M12 (M10)	46	C2-200	2×200	2×200	100	2×400	2×185	2×95
H450K	M12 (M10)	46	C2-250	2×250	2×250	100	2×500	2×240	2×120
H500K	M12 (M10)	46	C2-200	3×200	3×200	2×100	2×500	2×240	2×120
H560K	M12 (M10)	46	C2-200	3×200	3×200	2×100	3×350	3×185	2×150
H630K	M12 (M10)	46	C2-200	3×200	3×200	2×100	3×400	3×185	2×150

*1 LMFC cable (heat resistant flexible cross-linked polyethylene insulated cable), etc. with a continuous maximum permissible temperature of 90°C or higher. It is assumed that the cables will be used in a surrounding air temperature of 50°C or less and housed in an enclosure.

*2 THHN cable with a continuous maximum permissible temperature of 90°C. It is assumed that the cables will be used in a surrounding air temperature of 40°C or less and housed in an enclosure. (For the use in the United States or Canada, refer to [page 193](#) and [page 195](#).)

*3 XLPE cable with a continuous maximum permissible temperature of 90°C. It is assumed that the cables will be used in a surrounding air temperature of 40°C or less and housed in an enclosure (mainly for use in Europe).

*4 The screw size for terminals R/L1, S/L2, T/L3, P/+, and N/-, and the earthing (grounding) terminal are shown. The screw size for earthing (grounding) is indicated in parentheses.

The line voltage drop can be calculated by the following formula:

$$\text{Line voltage drop [V]} = \frac{\sqrt{3} \times \text{wire resistance [m}\Omega\text{/m]} \times \text{wiring distance [m]} \times \text{current [A]}}{1000}$$

Use a larger diameter cable when the wiring distance is long or when it is desired to decrease the voltage drop (torque reduction) in the low speed range.

NOTE

- Tighten the terminal screw to the specified torque.
A screw that has been tightened too loosely can cause a short circuit or malfunction.
A screw that has been tightened too tightly can cause a short circuit or malfunction due to the unit breakage.
- Use crimp terminals with insulation sleeves to wire the power supply and motor.

2.5.4 Earthing (grounding) precautions

- Always earth (ground) the converter unit.

◆ Purpose of earthing (grounding)

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 purpose of earthing (grounding) the case of an electrical apparatus is to prevent operators from getting an electric shock from this leakage current when touching it.

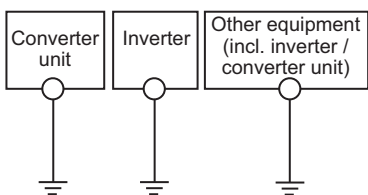
To avoid the influence of external noises, the earthing (grounding) is important to EMI-sensitive equipment that handle low-level signals or operate very fast such as audio equipment, sensors, computers.

◆ Earthing (grounding) system to be established

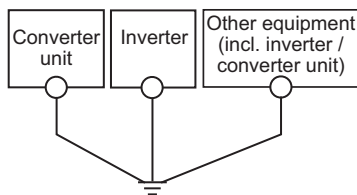
As described previously, the purpose of earthing (grounding) is roughly classified into the electrical shock prevention and the prevention of malfunction due to the influence of electromagnetic noise. Therefore, these two types should be clearly distinguished, and the following work must be done to prevent the leakage current having the converter unit's high frequency components from entering the malfunction prevention type earthing (grounding):

- Whenever possible, use the independent earthing (grounding) for the converter unit.
Establishing adequate common (single-point) earth (ground) system (II) shown in the following figure is allowed only in cases where the separate earth (ground) system (I) is not feasible. Do not make inadequate common (single-point) earth (ground) connection (III).
As leakage currents containing many high frequency components flows into the earthing (grounding) cables of the converter unit, the converter unit must also be earthed (grounded) separately from the EMI-sensitive equipment 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.
- 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 to be compliant with EN standard.
- 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 table on [page 38](#).
- The earthing (grounding) point should be as close as possible to the converter unit, and the earth (ground) wire length should be as short as possible.

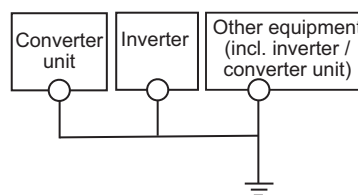
- Run the earthing (grounding) cable as far away as possible from the I/O wiring of the EMI-sensitive devices and run them in parallel in the minimum distance.



(I) Separate earthing (grounding): Good



(II) Common (single-point) earthing (grounding): OK




(III) Inadequate common (single-point) earthing (grounding): Bad

NOTE

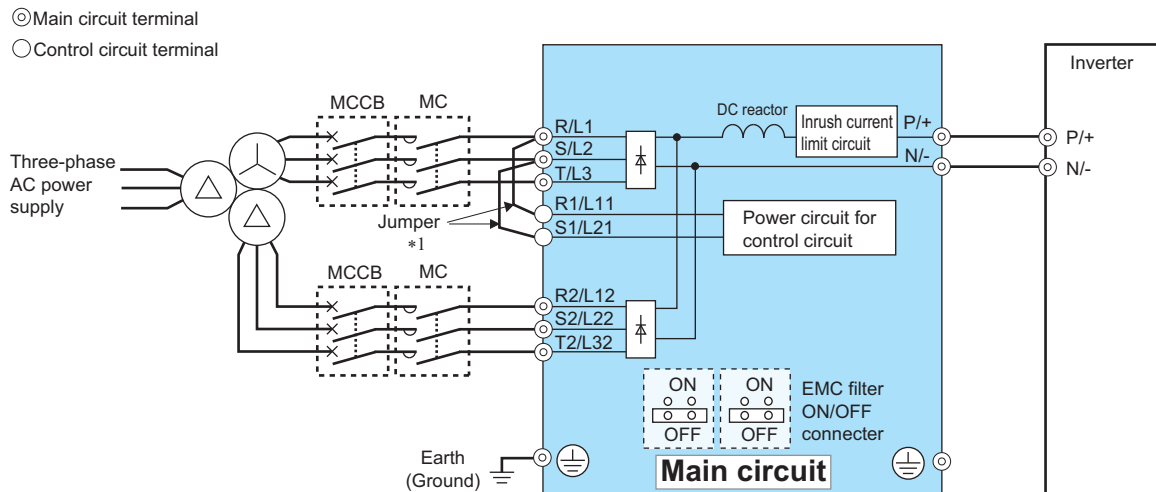
- To be compliant with the EU Directive (Low Voltage Directive), refer to [page 190](#).

2.6 Main circuit terminals (for 12-phase rectification)

2.6.1 Details on the main circuit terminals

Terminal symbol	Terminal name	Terminal function description	Refer to page
R/L1, S/L2, T/L3	AC power input	Connect these terminals to the output terminals in the wye connection of a 12-phase transformer (3-winding transformer).	42
R2/L12, S2/L22, T2/L32	AC power input	Connect these terminals to the output terminals in the delta connection of a 12-phase transformer (3-winding transformer).	42
R1/L11, S1/L21	Power supply for the control circuit	Connected to the AC power supply terminals R/L1 and S/L2. To retain the fault display and fault output, remove the jumpers across terminals R/L1 and R1/L11 and across S/L2 and S1/L21, and apply external power to these terminals. When using a separate power supply connected to terminals R1/L11 and S1/L21, the required power capacity is 80 VA.	52
P/+, N/-	Inverter connection	Connect them to the inverter terminals P/+ and N/-.	32
	Earth (ground)	For earthing (grounding) the converter unit chassis. Be sure to earth (ground) the inverter.	44

2.6.2 Connection diagram with 12-phase rectifier power transformer



*1 To use separate power supply for the control circuit, remove each jumper at terminal R1/L11 and terminal S1/L21.

NOTE

- For wiring to the main circuit terminals of the converter unit, refer to [page 32](#) (when the sink logic is selected) and [page 34](#) (when the source logic is selected).

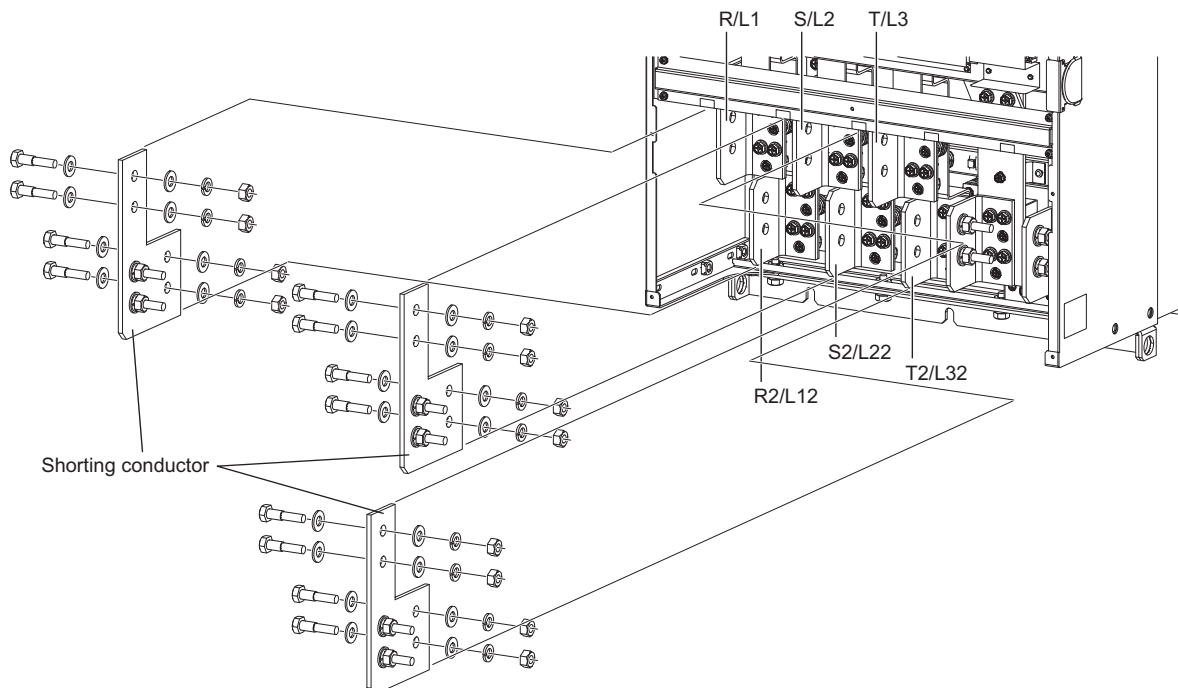
2.6.3 12-phase rectifier power transformer

For 12-phase rectification, a 12-phase transformer (3-winding transformer) is required (customer's purchase). To prevent imbalances in output current from the transformers, adjust the current as follows.

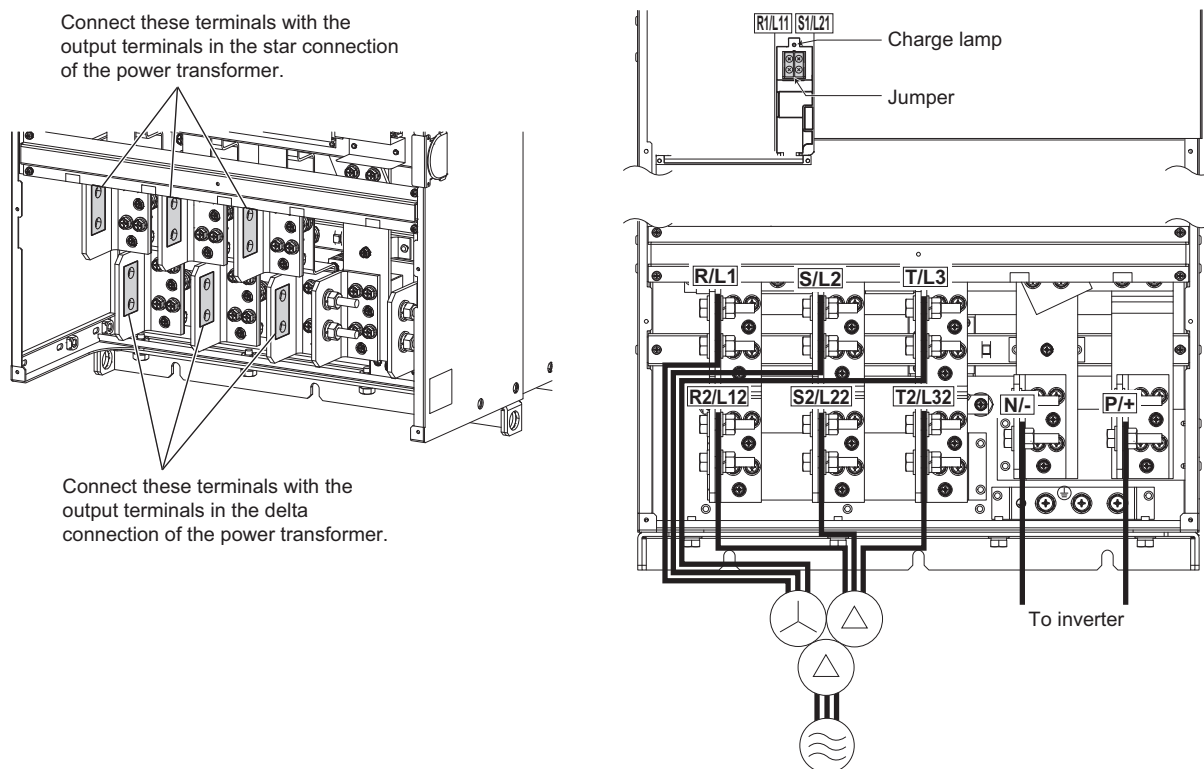
- Control imbalances in output voltage from the power transformers to within the range of $\pm 0.5\%$.
- Control an imbalance in power impedance to within the range of $\pm 10\%$.

2.6.4 Wiring method

- In the initial status, terminals R/L1 and R2/L12, S/L2 and S2/L22, and T/L3 and T2/L32 of the converter unit are respectively shorted with shorting conductors. For 12-phase rectification, remove the bolts and nuts shown in the figure below to remove the shorting conductors.

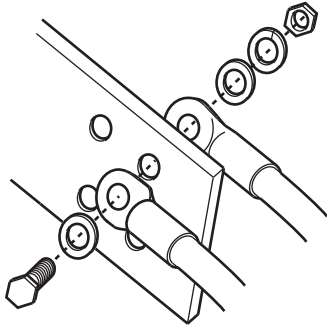


- As shown below, make sure to connect the output terminals in the wye connection of the 12-phase transformer (3-winding transformer) with terminals R/L1, S/L2, and T/L3 of the converter unit. Likewise, connect the output terminals in the delta connection of the transformer with terminals R2/L12, S2/L22, and T2/L32 of the converter unit. (Use the bolts and nuts removed earlier for these connections.)



NOTE

- Make sure to connect the power cables to the right terminals: one set to terminals R/L1, S/L2, and T/L3, and the other set to terminals R2/L12, S2/L22, and T2/L32.
- When wiring cables to the main circuit conductor, tighten each nut from the right of the conductor as seen from the front of the unit. When wiring two cables, place cables on both sides of the conductor. Use the bolts and nuts removed earlier for these connections. (Refer to the figure below.)



- For the installation of the noise filter on the power input line to the converter unit, install one common mode choke^{*1} per line between the wye/delta connection and the converter unit.

*1 Recommended common mode choke: FT-3KM F200160PB FINEMET common mode choke cores manufactured by Proterial, Ltd. FINEMET is a registered trademark of Proterial, Ltd.

CAUTION

- For 12-phase rectification, make sure to remove all of the shorting conductors between terminals R/L1 and R2/L12, between terminals S/L2 and S2/L22, and between terminals T/L3 and T2/L32 of the converter unit. If the power transformer is connected without removing these conductors, it may be burned.
- Check the correct connection between the output terminals in the wye/delta connection of the power transformer and the terminals of the converter unit. Otherwise an explosion or damage may occur in the converter unit or the power transformer.

2.6.5 Applicable cables

Select a recommended size cable to ensure that the voltage drop ratio is within 2%.

The following table indicates a selection example for the wiring length of 20 m (440 V input power supply, 150% overload current rating for 1 minute).

Converter unit model FR-CC2-[]	Terminal screw size ^{*4}	Tightening torque (N·m)	Crimp terminal	Cable gauge					
				HIV cables, etc. (mm ²) ^{*1}			AWG/MCM ^{*2}	PVC cables, etc. (mm ²) ^{*3}	
				R/L1, S/L2, T/L3 (per circuit) ^{*5}	R/L1, S/L2, T/L3 (per circuit) ^{*5}	P/+, N/-	Earthing (grounding) cable	R/L1, S/L2, T/L3 (per circuit) ^{*5}	R/L1, S/L2, T/L3 (per circuit) ^{*5}
H315K	M12 (M10)	46	100-12	2×100	2×150	100	2×3/0	2×95	150
H355K	M12 (M10)	46	100-12	2×100	2×200	100	2×3/0	2×95	2×95
H400K	M12 (M10)	46	150-12	2×150	2×200	100	2×4/0	2×95	2×95
H450K	M12 (M10)	46	150-12	2×150	2×250	100	2×250	2×120	2×120
H500K	M12 (M10)	46	150-12	2×150	3×200	2×100	2×300	2×150	2×120
H560K	M12 (M10)	46	C2-200	2×200	3×200	2×100	2×350	2×185	2×150
H630K	M12 (M10)	46	C2-200	2×200	3×200	2×100	2×400	2×185	2×150

*1 LMFC cable (heat resistant flexible cross-linked polyethylene insulated cable), etc. with a continuous maximum permissible temperature of 90°C or higher. It is assumed that the cables will be used in a surrounding air temperature of 50°C or less and housed in an enclosure.

*2 THHN cable with a continuous maximum permissible temperature of 90°C. It is assumed that the cables will be used in a surrounding air temperature of 40°C or less and housed in an enclosure. (For the use in the United States or Canada, refer to page 193 and page 195.)

*3 XLPE cable with a continuous maximum permissible temperature of 90°C. It is assumed that the cables will be used in a surrounding air temperature of 40°C or less and housed in an enclosure. (mainly for use in Europe).

*4 The screw size for terminals R/L1, S/L2, T/L3, P/+, and N/-, and the earthing (grounding) terminal are shown. The screw size for earthing (grounding) is indicated in parentheses.

*5 The crimp terminals are the same for R2/L12, S2/L22, and T2/L32.

The line voltage drop can be calculated by the following formula:

$$\text{Line voltage drop [V]} = \frac{\sqrt{3} \times \text{wire resistance [m}\Omega\text{/m]} \times \text{wiring distance [m]} \times \text{current [A]}}{1000}$$

Use a larger diameter cable when the wiring distance is long or when it is desired to decrease the voltage drop (torque reduction) in the low speed range.

NOTE

- Tighten the terminal screw to the specified torque.
A screw that has been tightened too loosely can cause a short circuit or malfunction.
A screw that has been tightened too tightly can cause a short circuit or malfunction due to the unit breakage.
- Use crimp terminals with insulation sleeves to wire the power supply and motor.

2.6.6 Earthing (grounding) precautions

- Always earth (ground) the converter unit.

◆ Purpose of earthing (grounding)

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 purpose of earthing (grounding) the case of an electrical apparatus is to prevent operators from getting an electric shock from this leakage current when touching it.

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

◆ 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. Therefore, these two types should be clearly distinguished, and the following work must be done to prevent the leakage current having the converter unit's high frequency components from entering the malfunction prevention type earthing (grounding):

- Whenever possible, use the independent earthing (grounding) for the converter unit.

Establishing adequate common (single-point) earth (ground) system (II) shown in the following figure is allowed only in cases where the separate earth (ground) system (I) is not feasible. Do not make inadequate common (single-point) earth (ground) connection (III).

As leakage currents containing many high frequency components flows into the earthing (grounding) cables of the converter unit, the converter unit must also be earthed (grounded) separately from the EMI-sensitive equipment described above.

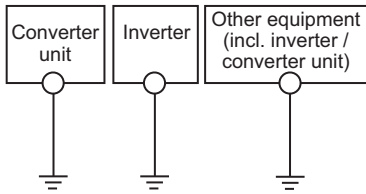
In a high building, it may be effective to use its iron structure frames as earthing (grounding) electrode for EMI prevention in order to separate from the earth (ground) system for electric shock prevention.

- 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).

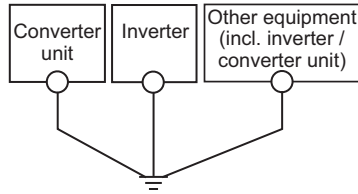
A neutral-point earthed (grounded) power supply must be used to be compliant with EN standard.

- Use the thickest possible earthing (grounding) cable. The earthing (grounding) cable should be the size indicated in the table on [page 43](#).
- The earthing (grounding) point should be as close as possible to the converter unit, and the earth (ground) wire length should be as short as possible.

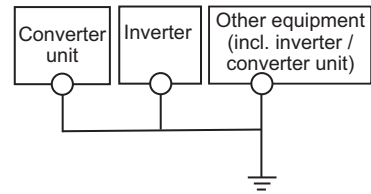
- Run the earthing (grounding) cable as far away as possible from the I/O wiring of the EMI-sensitive devices and run them in parallel in the minimum distance.



(I) Separate earthing (grounding): Good



(II) Common (single-point) earthing (grounding): OK



(III) Inadequate common (single-point) earthing (grounding): Bad

NOTE

- To be compliant with the EU Directive (Low Voltage Directive), refer to [page 190](#).

2.7 Control circuit

2.7.1 Details on the control circuit terminals

◆ Input signal

Type	Terminal symbol	Common	Terminal name	Terminal function description	Rated specification
Contact input	RES ^{*1}	SD (sink (negative common)) PC (source (positive common))	Reset	Use this signal to reset a fault output provided when a protective function is activated. Turn ON the RES signal for 0.1 second or longer, then turn it OFF. In the initial setting, reset is always enabled. Setting Pr.75 makes reset possible only after the occurrence of a converter unit fault. The converter unit will restart about 1 second after reset.	Input resistance: 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC, current when contacts are short-circuited: 4 to 6 mADC
	OH ^{*1}		External thermal relay input	The External thermal relay input (OH) signal is used when using the external thermal relay or the thermal protector built into the motor to protect the motor from overheating. When the thermal relay is activated, the inverter output is shut off by the external thermal relay operation (E.OHT).	
	RDI ^{*1}		Contact input	No function is assigned in the initial setting. Use Pr.178 to assign a function to the terminal.	
Power supply input	+24			24 V external power supply input	For connecting a 24 V external power supply. If a 24 V external power supply is connected, power is supplied to the control circuit while the main power circuit is OFF.

*1 Terminal functions can be selected using **Pr.178, Pr.187, or Pr.189 (Input terminal function selection)**. (Refer to [page 114](#).)

◆ Output signal

Type	Terminal symbol	Common	Terminal name	Terminal function description	Rated specification
Relay	A1, B1, C1 ^{*1}	—	Relay output 1 (fault output)	1 changeover contact output that indicates that the protective function of the converter unit has been activated and the outputs are stopped. Fault: discontinuity across B and C (continuity across A and C), Normal: continuity across B and C (discontinuity across A and C)	Contact capacity: 230 VAC 0.3 A (power factor = 0.4), 30 VDC 0.3 A
	88R, 88S	—	For manufacturer setting. Do not use.		
Open collector	RDA ^{*1}	SE	Inverter operation enable (NO contact)	Switched to LOW when the converter unit operation is ready. Connect this terminal to terminal MRS (X10) of the inverter. The inverter can be started when the RDA status is LOW.	Permissible load: 24 VDC (27 VDC at maximum) 0.1 A (The voltage drop is 2.8 V at maximum while the signal is ON.) The open collector transistor is ON (conductive) in LOW state. The transistor is OFF (not conductive) in HIGH state.
	RDB ^{*1}	SE	Inverter operation enable (NC contact)	Switched to LOW when a converter unit fault occurs or the converter is reset. The inverter can be started when the RDB status is HIGH.	
	RSO ^{*1}	SE	Inverter reset	Switched to LOW when the converter is reset (RES-ON). Connect this terminal to terminal RES of the inverter. The inverter is reset when it is connected with the RSO status LOW.	
	IPF ^{*1}	SE	Instantaneous power failure	Switched to LOW when an instantaneous power failure is detected.	
	FAN ^{*1}	SE	Cooling fan fault	Switched to LOW when a cooling fan fault occurs.	

*1 Terminal functions can be selected using **Pr.190 to Pr.195 (Output terminal function selection)**. (Refer to [page 109](#).)

◆ Common terminal

Terminal symbol	Common	Terminal name	Terminal function description	Rated specification
SD	—	Contact input common (sink)	Common terminal for the contact input terminal (sink logic).	—
		External transistor common (source)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable current.	
		24 VDC power supply common	Common terminal for the 24 VDC power supply (terminal PC, terminal +24). Isolated from terminals 5 and SE.	
PC	—	External transistor common (sink)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic to avoid malfunction by undesirable current.	Power supply voltage range: 19.2 to 28.8 VDC, permissible load current: 100 mA
		Contact input common (source)	Common terminal for contact input terminal (source logic).	
	SD	24 VDC power supply	Can be used as a 24 VDC 0.1 A power supply.	
SE	—	Open collector output common	Common terminal for terminals RDA, RDB, RSO, IPF, FAN	—

2

◆ Communication

Type	Terminal symbol	Terminal name	Terminal function description	
RS-485	—	PU connector	RS-485 communication can be made through the PU connector (For connection on a 1:1 basis only) Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 4800 to 115200 bps Wiring length: 500 m	
	RS-485 terminals	TXD+	Converter unit transmission terminal	RS-485 communication can be made through the RS-485 terminals. Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 300 to 115200 bps Overall length: 500 m
		TXD-		
		RXD+	Converter unit reception terminal	
		RXD-		
GND (SG)	Earthing (grounding)			

⚠ CAUTION

- Do not use the empty terminals (NC) of the control circuit. Doing so may lead to damage of the converter unit and the inverter.
- Always connect terminal RDA of the converter unit and terminal MRS (X10) of the inverter, and terminal SE of the converter unit and terminal SD (terminal PC in the source logic) of the inverter. Not doing so may lead to damage of the converter unit.

2.7.2 Control logic (sink/source) change

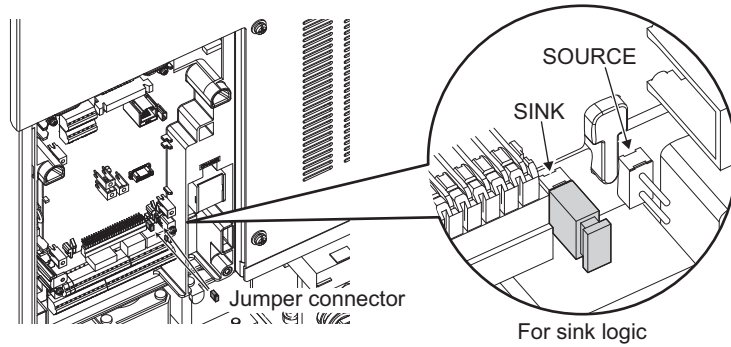
Switch the control logic of input signals as necessary.

To change the control logic, change the jumper connector position on the control circuit board.

Connect the jumper connector to the connector pin of the desired control logic.

The control logic of input signals is initially set to the sink logic (SINK).

(The output signals may be used in either the sink or source logic independently of the jumper connector position.)



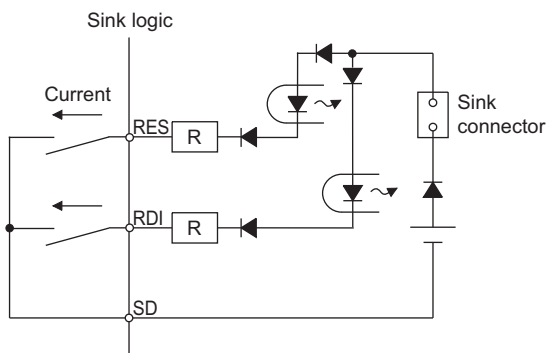
NOTE

- Make sure that the jumper connector is installed correctly.
- Never change the control logic while power is ON.

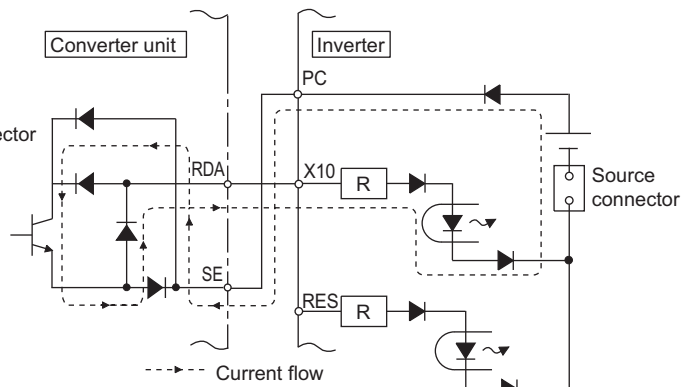
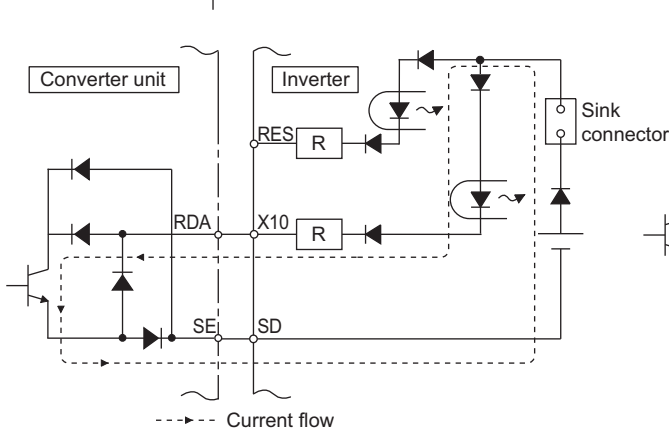
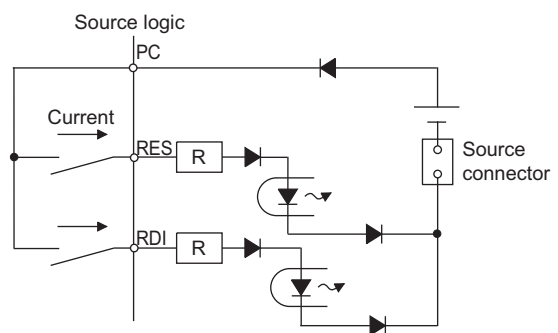
◆ Sink logic and source logic

- In the sink logic, a signal turns ON when a current exits from the corresponding signal input terminal. Terminal SD is common to the contact input signals. Terminal SE is common to the open collector output signals.
- In the source logic, a signal turns ON when a current enters into the corresponding signal input terminal. Terminal PC is common to the contact input signals. Terminal SE is common to the open collector output signals.

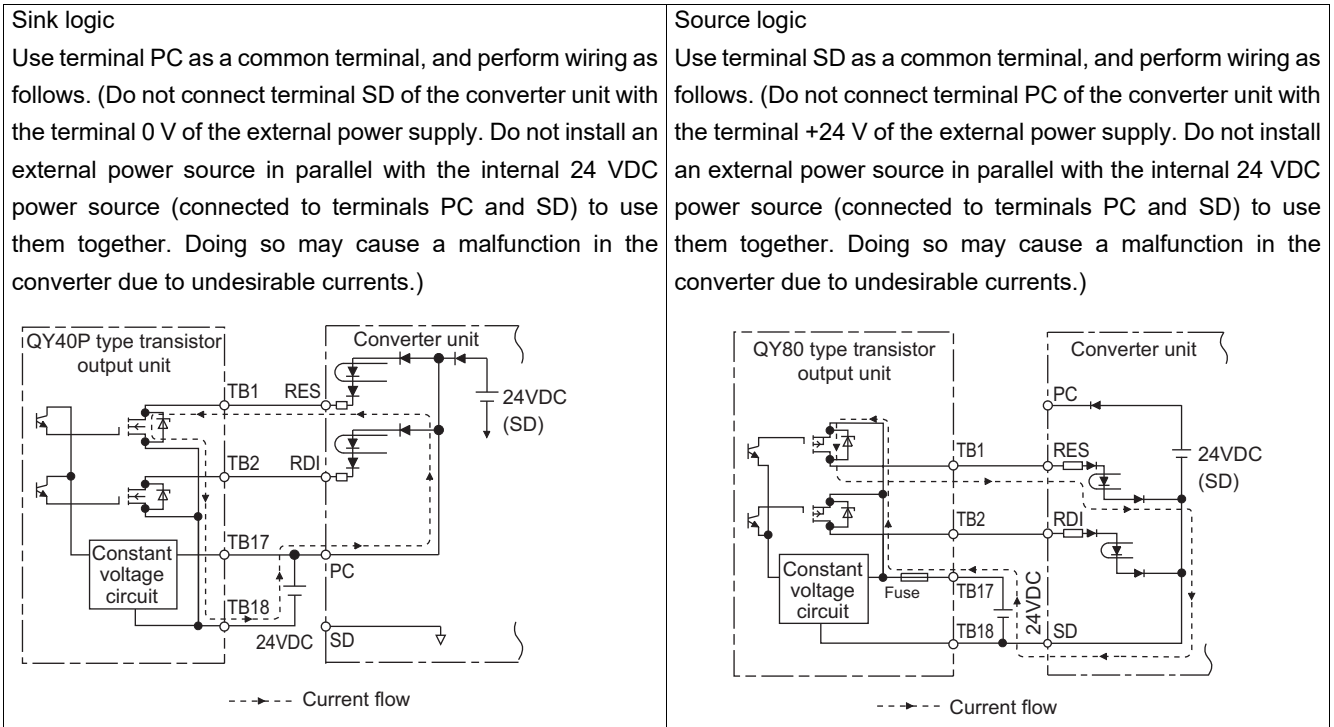
● Current flow concerning the input/output signal when sink logic is selected



● Current flow concerning the input/output signal when source logic is selected

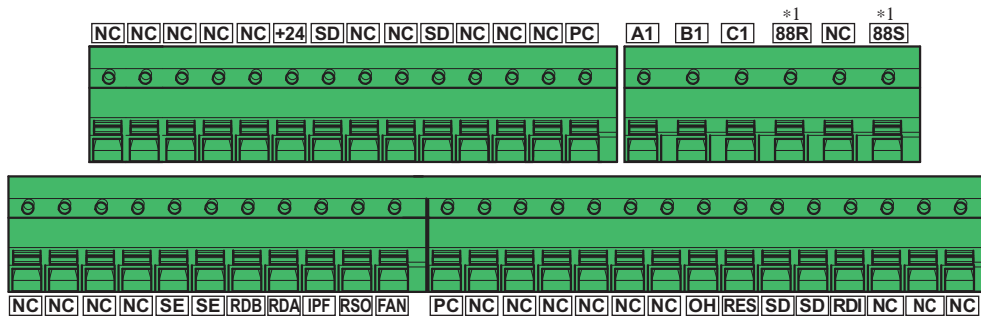


- When using an external power supply for transistor output



2.7.3 Wiring of control circuit

◆ Control circuit terminal layout



*1 For manufacturer setting. Do not use.

⚠ CAUTION

- Do not use the empty terminals (NC) of the control circuit. Doing so may lead to damage of the converter unit and the inverter.

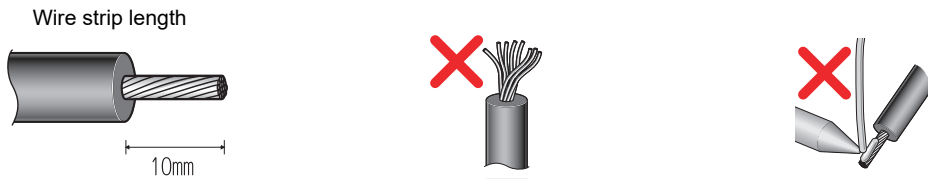
◆ Wiring method

■ Wiring connection

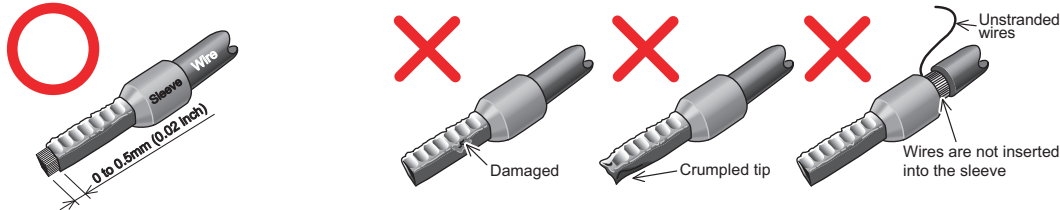
Use crimp terminals and stripped wire for the control circuit wiring. For single wire, the stripped wire can be used without crimp terminal.

Connect the end of wires (crimp terminal or stranded wire) to the terminal block.

- Strip the signal wires as shown below. If too much of the wire is stripped, a short circuit may occur with neighboring wires. If not enough of the wire is stripped, wires may become loose and fall out. Twist the stripped end of wires to prevent them from fraying. Do not solder them.



- Crimp the terminals on the wire. Insert the wire into a crimp terminal, making sure that 0 to 0.5 mm of the wire protrudes from the end of the sleeve. Check the condition of the crimp terminals after crimping. Do not use the crimp terminals of which the crimping is inappropriate, or the face is damaged.



Crimp terminals commercially available (as of October 2020)

- Phoenix Contact Co., Ltd.

Wire gauge (mm ²)	Ferrule part No.			Crimping tool model No.
	With insulation sleeve	Without insulation sleeve	For UL wire ^{*1}	
0.3	AI 0,34-10TQ	—	—	CRIMPFOX 6
0.5	AI 0,5-10WH	—	AI 0,5-10WH-GB	
0.75	AI 0,75-10GY	A 0,75-10	AI 0,75-10GY-GB	
1	AI 1-10RD	A 1-10	AI 1-10RD/1000GB	
1.25, 1.5	AI 1,5-10BK	A 1,5-10	AI 1,5-10BK/1000GB ^{*2}	
0.75 (two-wire product)	AI-TWIN 2×0,75-10GY	—	—	

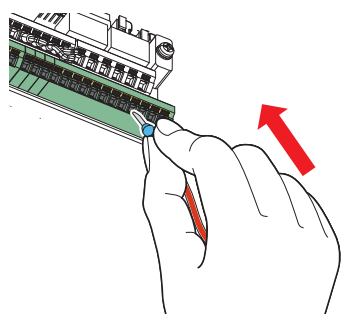
*1 A ferrule terminal with an insulation sleeve compatible with the MTW wire which has a thick wire insulation.

*2 Applicable for terminals A1, B1, C1.

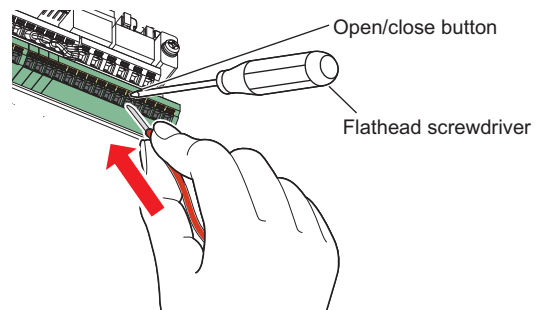
- NICHIFU Co., Ltd.

Wire gauge (mm ²)	Blade terminal part No.	Insulation cap part No.	Crimping tool product number
0.3 to 0.75	BT 0.75-11	VC 0.75	NH 69

- Insert the wires into a socket.



When using single wire or stranded wire without crimp terminal, push an open/close button all the way down with a flathead screwdriver, and insert the wire.

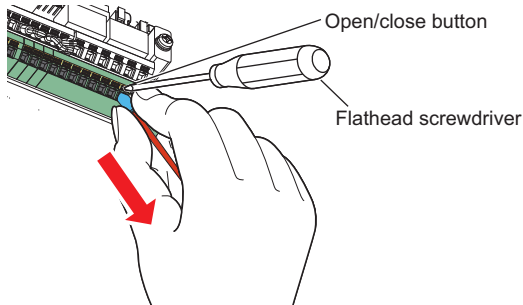


NOTE

- When using stranded wires without a blade terminal, twist enough to avoid short circuit with a nearby terminals or wires.
- Never change the control logic while power is ON.
- Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause an inverter damage or injury.

■ Wire removal

Pull the wire while pushing the open/close button all the way down firmly with a flathead screwdriver.



NOTE

- Pulling out the wire forcefully without pushing the open/close button all the way down may damage the terminal block.
- Use a small flathead screwdriver (tip thickness: 0.4 mm, tip width: 2.5 mm).
If a flathead screwdriver with a narrow tip is used, terminal block may be damaged.
Commercially available products (as of October 2020)

Product name	Model	Manufacturer
Screwdriver	SZF 0- 0,4 × 2,5	Phoenix Contact Co., Ltd.

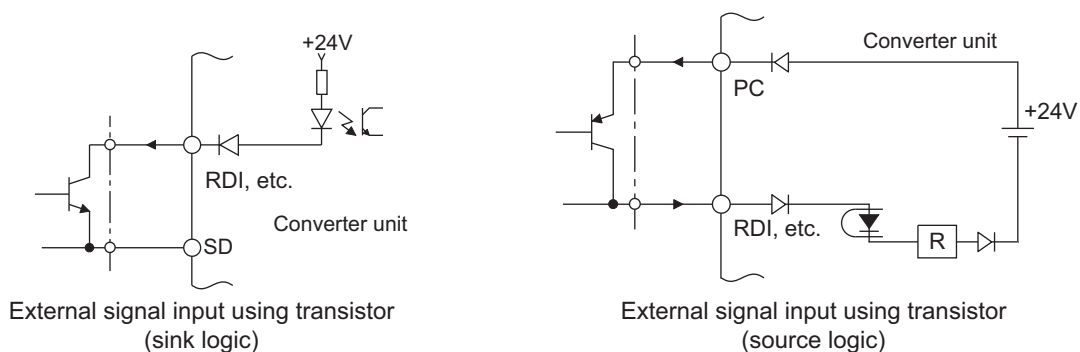
- Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause an inverter damage or injury.

◆ Common terminals of the control circuit (SD, PC, SE)

- Terminals SD (sink logic), PC (source logic), and SE are common terminals (0 V) for I/O signals. (All common terminals are isolated from each other.) Do not earth (ground) these terminals.
- In the sink logic, terminal SD is a common terminal for the contact input terminals (RES, OH, RDI). The open collector circuit is isolated from the internal control circuit by photocoupler.
- In the source logic, terminal PC is a common terminal for the contact input terminals (RES, OH, RDI). The open collector circuit is isolated from the internal control circuit by photocoupler.
- Terminal SE is a common terminal for the open collector output terminals (RDA, RDB, RSO, IPF, FAN). The contact input circuit is isolated from the internal control circuit by photocoupler.

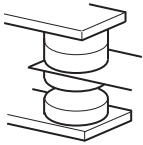
◆ Signal inputs by contactless switches

The contact input terminals of the converter unit (RES, OH, RDI) can be controlled using a transistor instead of a contact switch as shown in the following figure.

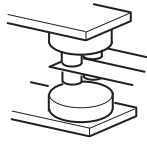


2.7.4 Wiring precautions

- It is recommended to use a cable of 0.3 to 0.75 mm² for the connection to the control circuit terminals.
- The wiring length should be 30 m at the maximum.
- Use two or more parallel micro-signal contacts or twin contacts to prevent contact faults when using contact inputs since the control circuit input signals are micro-currents.

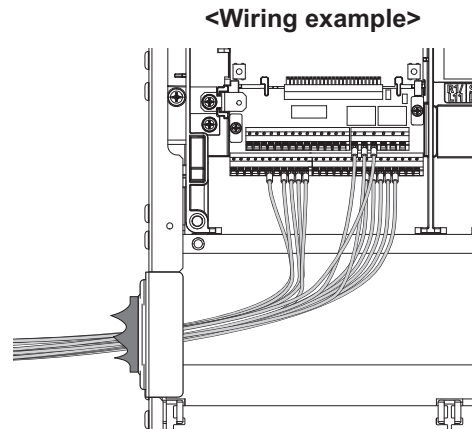
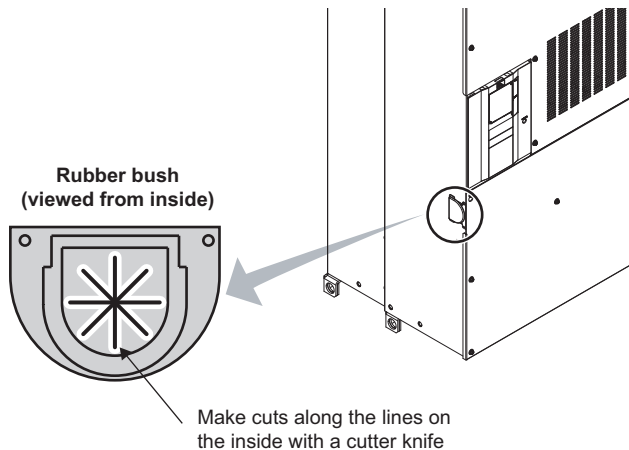


Micro signal contacts



Twin contacts

- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main circuit (except for terminals R1/L11 and S1/L21) and power circuits (including the 200 V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A1, B1, and C1) via a relay coil, lamp, etc.
- Separate the wiring of the control circuit away from the wiring of the main circuit (except for terminals R1/L11 and S1/L21). Make cuts in rubber bush of the converter unit side and lead the wires through the cuts.



2.7.5 When using separate power supplies for the control circuit and the main circuit

◆ Cable size for the control circuit power supply (terminals R1/L11 and S1/L21)

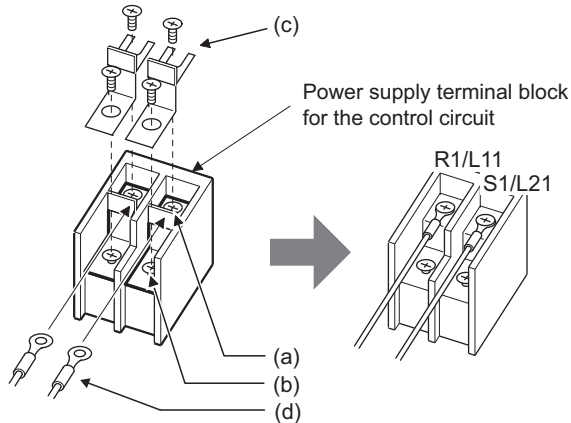
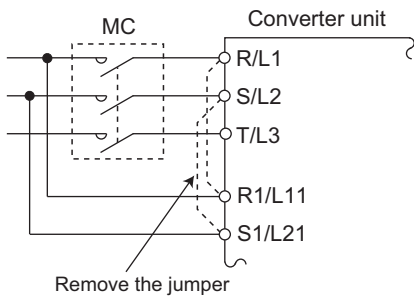
- Terminal screw size: M4
- Cable gauge: 0.75 to 2 mm²
- Tightening torque: 1.5 N·m

◆ Connection method

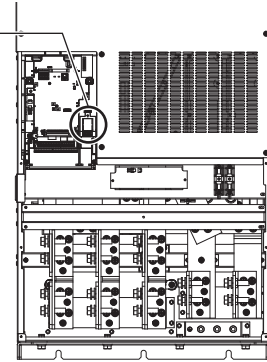
When the protection circuit is activated, opening of the electromagnetic contactor (MC) on the input side of the converter unit results in power loss in the control circuit of the converter unit, disabling the fault output signal retention. Terminals R1/L11 and S1/L21 of the control circuit are provided to keep outputting the fault signals in such a case. Follow the following steps to wire terminals R1/L11 and S1/L21 on the inverter to the power input lines of the MC.

Do not connect the power cable to incorrect terminals. Doing so may damage the converter unit.

Connection diagram



Power supply
terminal block
for the control circuit



- (a) Remove the upper screws.
- (b) Remove the lower screws.
- (c) Pull the jumper toward you to remove.
- (d) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).

NOTE

- When using separate power supplies, always remove the jumpers connected to terminals R1/L11 and S1/L21. Failure to do so may lead to damage of the converter unit.
- When the control circuit power is supplied from other than the input line of the MC, the voltage of the separate power supply must be the same as that of the main control circuit.
- When using a separate power supply connected to terminals R1/L11 and S1/L21, the required power capacity is 80 VA.
- If the main circuit power is switched OFF (for 0.1 second or more) then ON again, the converter unit is reset and a fault output will not be held.

2.7.6 When supplying 24 V external power to the control circuit

Connect the 24 V external power supply across terminals +24 and SD to turn ON/OFF the I/O terminal, keep the operation panel ON, and carry out communication with other devices even at power-OFF state of converter unit's main circuit power supply. When the main circuit power supply is turned ON, the power supply is switched from the 24 V external power supply to the main circuit power supply.

◆ Specification of the applied 24 V external power supply

Item	Rated specification
Input voltage	23 to 25.5 VDC
Input current	1.4 A or less

Commercially available products (as of October 2020)

Model	Product overview	Manufacturer
S8FS-G05024C ^{*1}	Specifications: Capacity 50 W, output voltage 24 VDC, output current 2.2 A Installation method: Direct installation, screw type terminal block with cover Input: Single-phase 100 to 240 VAC	OMRON Corporation
S8VK-S06024 ^{*1}	Specifications: Capacity 60 W, output voltage 24 VDC, output current 2.5 A Installation method: DIN rail, push-in (spring) type terminal block Input: Single-phase 100 to 240 VAC	
S8VK-WA24024 ^{*1}	Specifications: Capacity 240 W, output voltage 24 VDC, output current 10 A Installation method: DIN rail, push-in (spring) type terminal block Input: Three-phase 200 to 240 VAC	

^{*1} For the latest information about OMRON power supply, contact OMRON corporation.

◆ Starting and stopping the 24 V external power supply operation

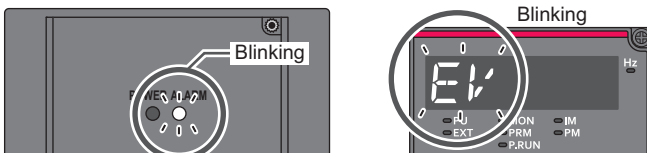
- Supplying 24 V external power across terminals +24 and SD while the main circuit power is OFF starts the 24 V external power supply operation. Likewise, turning OFF the main circuit power while supplying 24 V external power starts the 24 V external power supply operation.
- Turning ON the main circuit power stops the 24 V external power supply operation and enables the normal operation.

NOTE

- When the 24 V external power is supplied while the main circuit power supply is OFF, the converter unit operation is disabled.
- In the initial setting, when the main power supply is turned ON during the 24 V external power supply operation, a reset is performed in the converter unit, then the power supply changes to the main circuit power supply.

◆ Confirming the 24 V external power supply input

- During 24 V external power supply operation, the ALARM LED of the accessory cover blinks. When the operation panel (FR-DU08) is installed, "EV" blinks.



- During 24 V external power supply operation, the 24 V external power supply operation signal (EV) is output. To use the EV signal, set "68 (positive logic) or 168 (negative logic)" in any of **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function to the output terminal.

◆ Operation while the 24 V external power is supplied

- Fault records and parameters can be read and parameters can be written using the operation panel keys.
- During the 24 V external power supply operation, the monitor items and signals related to inputs to main circuit power supply, such as input current and converter output voltage, are invalid.
- The alarms, which have occurred when the main circuit power supply is ON, continue to be output after the power supply is changed to the 24 V external power supply. Perform the converter reset or turn OFF then ON the power to reset the faults.

NOTE

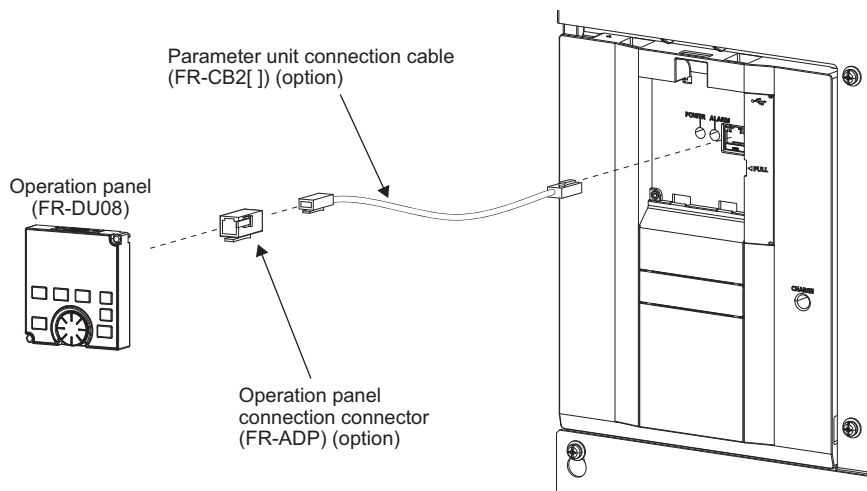
- Inrush current equal to or higher than the 24 V external power supply specification may flow at power-ON. Confirm that the power supply and other devices are not affected by the inrush current and the voltage drop caused by it. Depending on the power supply, the inrush current protection may be activated to disable the power supply. Select the power supply and capacity carefully.
- When the wiring length between the external power supply and the converter unit is long, the voltage often drops. Select the appropriate wiring size and length to keep the voltage in the rated input voltage range.
- In a serial connection of several converter units, the current increases when it flows through the converter unit wiring near the power supply. The increase of the current causes voltage to drop further. Use the converter units after confirming that the input voltage of each converter unit is within the rated input voltage range. Depending on the power supply, the inrush current protection may be activated to disable the power supply. Select the power supply and capacity carefully.
- When an external 24 V power supply is used, "E.P24" may appear if the power supply start-up time is too long (less than 1.5 V/s).
- "E.P24" may appear when the 24 V external power supply input voltage is low. Check the external power supply input.
- Do not touch the control circuit terminal block (circuit board) during the 24 V power supply operation (when conducted). Doing so may cause an electric shock or burn.

2.8 Communication connectors and terminals

2.8.1 PU connector

◆ Mounting the operation panel on the enclosure surface

- With a connection cable, you can mount the operation panel on the enclosure surface, and connect it to the converter unit. Use the option FR-CB2[], or connectors and cables available on the market.
(To mount the operation panel, the optional connector (FR-ADP) is required.)
Securely insert one end of the cable into the PU connector and the other end into the connection connector on the parameter unit or the FR-ADP attached on the operation panel until the stoppers are fixed.



NOTE

- Refer to the following table when fabricating the cable on the user side. Keep the total cable length within 20 m.

Name	Remarks
Communication cable	Cable compliant with EIA-568 (such as 10BASE-T cable)

◆ Communication operation

- Using the PU connector as a computer network port enables communication operation from a personal computer, etc. When the PU connector is used for connection between the converter unit and a personal, FA, or some other computer with a communication cable, a user program can run to monitor the converter unit or read and write parameters. Communication can be performed with the Mitsubishi inverter protocol (computer link operation).
For the details, refer to [page 120](#).

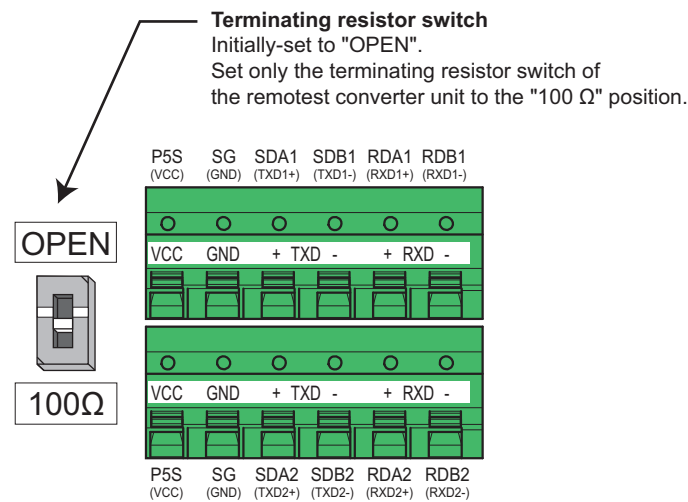
2.8.2 RS-485 terminal block

◆ Communication operation

Conforming standard	EIA-485 (RS-485)
Transmission format	Multidrop link
Communication speed	Maximum 115200 bps
Overall length	500 m
Connection cable	Twisted pair cable (4 pairs)

The RS-485 terminals enable communication operation from a personal computer, etc. When the PU connector is used for connection between the converter unit and a personal, FA, or other computer with a communication cable, a user program can run to monitor the converter unit or read and write parameters.

Communication can be performed with the Mitsubishi inverter protocol (computer link operation) and MODBUS RTU protocol. For the details, refer to [page 122](#).



NOTE

- To avoid malfunction, keep the RS-485 terminal wires away from the control circuit board.

MEMO

CHAPTER 3 PRECAUTIONS FOR USE OF THE CONVERTER UNIT

3.1	Electro-magnetic interference (EMI) and leakage currents	60
3.2	Power supply harmonics.....	66
3.3	Installation of a reactor	70
3.4	Power shutdown and magnetic contactor (MC).....	71
3.5	Checklist before starting operation	73

3 PRECAUTIONS FOR USE OF THE CONVERTER UNIT

This chapter explains the precautions for use of this product.
Always read the instructions before use.

3.1 Electro-magnetic interference (EMI) and leakage currents

3.1.1 Leakage currents and countermeasures

Capacitance exists between the I/O cables or other cables of the inverter or the converter unit 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.

◆ To-earth (ground) leakage currents

Leakage currents may flow not only into the power system of the inverter and converter unit but also into the power systems through the earthing (grounding) cable, etc. These leakage currents may operate earth leakage circuit breakers and earth leakage relays unnecessarily.

■ Precautions

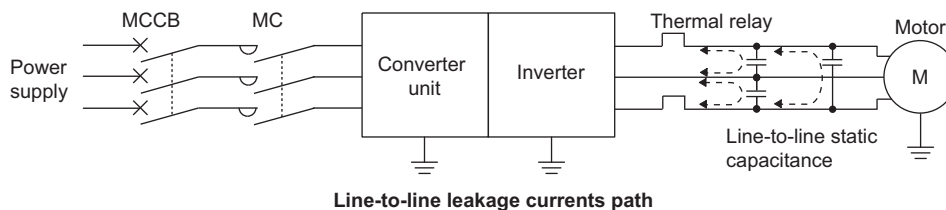
- If the carrier frequency setting is high, decrease the **Pr.72 PWM frequency selection** setting.
Note that motor noise increases. Selecting **Pr.240 Soft-PWM operation selection** makes the sound inoffensive.
- By using earth leakage circuit breakers designed to suppress harmonics and surge voltage in the power system of the converter unit and other devices, operation can be performed with the carrier frequency kept high (with low noise).

■ To-earth (ground) leakage currents

- Take caution as long wiring will increase the leakage current. Decreasing the carrier frequency of the inverter reduces the leakage current.
- High motor capacity will increase the leakage current.

◆ Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacitance between the output cables of the inverter or the converter unit may operate the external thermal relay unnecessarily.



■ Precautions

- Use **Pr.9 Electronic thermal O/L relay**.
- If the carrier frequency setting is high, decrease the **Pr.72 PWM frequency selection** setting.
Note that motor noise increases. Selecting **Pr.240 Soft-PWM operation selection** makes the sound inoffensive.
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.

■ Installation and selection of the molded case circuit breaker

Install a molded case circuit breaker (MCCB) on the power receiving side to protect the wiring at the input side of the inverter or the converter unit. Select an MCCB according to the inverter input side power factor, which depends on the power supply voltage, output frequency and load. Especially for a completely electromagnetic MCCB, a slightly large capacity must be selected since its operation characteristic varies with harmonic currents. (Check it in the data of the corresponding breaker.) As an earth leakage current breaker, use the Mitsubishi earth leakage current breaker designed for harmonics and surge suppression.

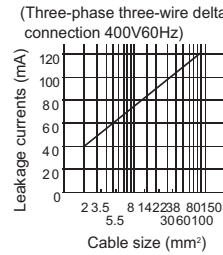
◆ Selecting the rated sensitivity current for the earth leakage circuit breaker

When using an earth leakage circuit breaker with the circuit of the inverter or the converter unit, select its rated sensitivity current as follows, independently of the PWM carrier frequency.

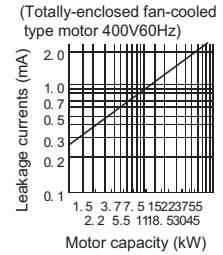
- Breaker designed for harmonic and surge suppression
Rated sensitivity current
 $I\Delta n \geq 10 \times (I_{g1} + I_{gn} + I_{gi} + I_{g2} + I_{gm})$
- Standard breaker
Rated sensitivity current
 $I\Delta n \geq 10 \times \{I_{g1} + I_{gn} + I_{gi} + 3 \times (I_{g2} + I_{gm})\}$

I_{g1}, I_{g2} : Leakage currents in wire path during commercial power supply operation
 I_{gn} : Leakage current from noise filters on the input side of the inverter
 I_{gm} : Leakage current from the motor during commercial power supply operation
 I_{gi} : Leakage current of inverter unit (When the converter unit is connected, add the leakage current of converter unit.)

Example of leakage current per 1km during the commercial power supply operation when the CV cable is routed in metal conduit



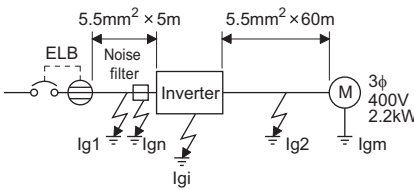
Leakage current example of three-phase induction motor during the commercial power supply operation



For "Δ" connection, the amount of leakage current is approx. 1/3 of the above value.



- Selection example for the Δ connection of the 400 V class

Example




Item	Breaker designed for harmonic and surge suppression	Standard breaker
Leakage current I_{g1} (mA)	$\frac{1}{3} \times 66 \times \frac{5m}{1000m} = 0.11$	
Leakage current I_{gn} (mA)	0 (without noise filter)	
Leakage current I_{gi} (mA)	1 (without EMC filter). For the leakage current of the inverter, refer to the following table.	
Leakage current I_{g2} (mA)	$\frac{1}{3} \times 66 \times \frac{60m}{1000m} = 1.32$	
Motor leakage current I_{gm} (mA)	0.36	
Total leakage current (mA)	2.79	6.15
Rated sensitivity current (mA) ($\geq I_g \times 10$)	30	100

- Leakage currents of the inverter and the converter unit with a 6-phase transformer
400 V class (input power condition: 440 V/60 Hz, power supply imbalance within 3%)

Inverter / converter unit	FR-A800/FR-F800 (Standard model)		FR-A802/FR-F802 (Separated converter type)	Converter unit (FR-CC2)	
	ON	OFF	—	ON	OFF
Phase earthing (grounding) 	35	2	2	70	2
Earthed-neutral system 	2	1	1	2	1

(mA)

- Leakage currents of the converter unit with a 12-phase transformer
400 V class (input power condition: 440 V/60 Hz, power supply imbalance within 3%)

EMC filter	ON	OFF
Earthed-neutral system  *1	20	2

(mA)

*1 To use a 12-phase transformer, ground (earth) a system from the neutral point of the wye connection.

NOTE

- Install the earth leakage circuit breaker (ELB) on the input side of the converter unit.
- In the Δ connection earthed-neutral system, the sensitivity current is blunt against a ground fault in the inverter output side. 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)
- When the breaker is installed on the output side of the inverter, it may be unnecessarily operated by harmonics even if the effective value is within the rating.
In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.
- The following models and products are standard breakers: BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, and NV-2F earth leakage relay (except NV-ZHA), and NV with AA neutral wire open-phase protection.
The other models are designed for harmonic and surge suppression: NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, and NV-H.
- For the leakage current of a 75 kW or higher motor, contact the motor manufacturer.

3.1.2 Techniques and measures for electromagnetic compatibility (EMC)

Some electromagnetic noises enter the inverter or the converter unit to cause the inverter/converter malfunction, and others are radiated by the converter to cause the peripheral devices to malfunction. (The former is called EMS problem, the latter is called EMI problem, and both is called EMC problem.) Though the inverter or the converter unit is designed to have high immunity performance, it handles low-level signals, so it requires the following basic techniques. Pay attention to the electromagnetic noises that could be generated by the inverter since the inverter chops outputs at high carrier frequency. For prevention of malfunction of peripheral devices caused by electromagnetic noises EMI precautions should be taken to suppress noises. These techniques differ slightly depending on EMI paths.

◆ Basic measures

- Do not run the power cables (I/O cables) and signal cables of the inverter or the converter unit in parallel with each other and do not bundle them.
- Use shielded twisted pair cables for the detector connecting and control signal cables and connect the sheathes of the shielded cables to terminal SD.
- Ground (Earth) the inverter or the converter unit, motor, etc. at one point.

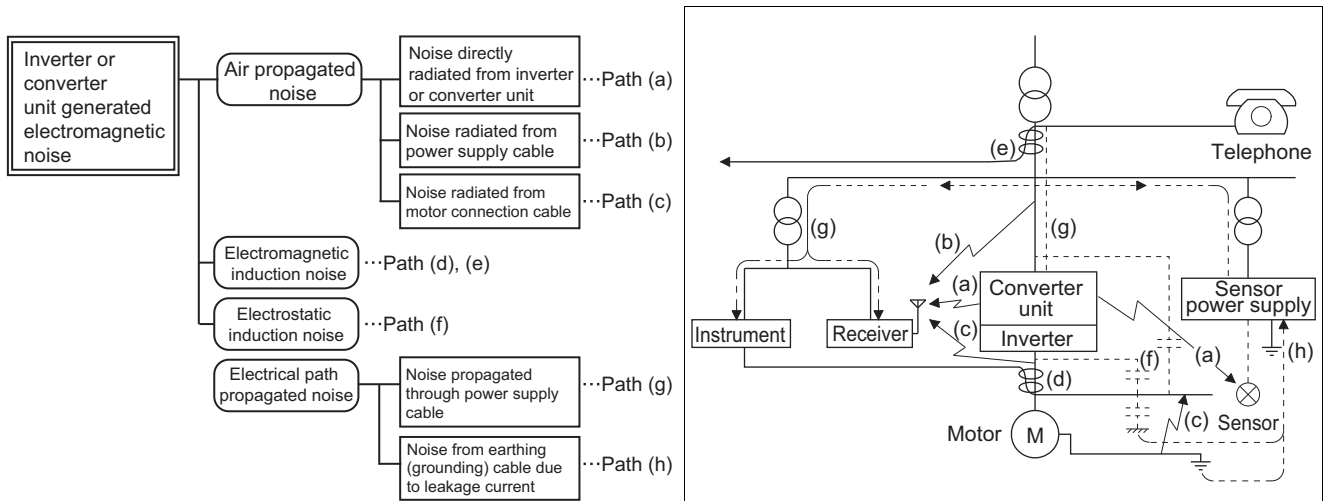
◆ EMS measures to reduce electromagnetic noises that enter the inverter or the converter unit and cause it to malfunction

When devices that generate many electromagnetic noises (which use magnetic contactors, electromagnetic brakes, many relays, for example) are installed near the inverter or the converter and it may malfunction due to electromagnetic noises, the following measures must be taken:

- Provide surge suppressors for devices that generate many electromagnetic noises to suppress electromagnetic noises.
- Install data line filters to signal cables (refer to [page 64](#)).
- Ground (Earth) the shields of the detector connection and control signal cables with cable clamp metal.

◆ EMI measures to reduce electromagnetic noises that are radiated by the inverter or the converter unit to cause the peripheral devices to malfunction

Noises generated from the inverter or the converter unit are largely classified into those radiated by the cables connected to the inverter or the converter unit and its 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.



Noise propagation path	Countermeasure
(a), (b), (c)	<p>When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or the converter unit, or when their signal cables are run near the inverter or the converter unit, the devices may malfunction due to by air-propagated electromagnetic noises. The following countermeasures must be taken:</p> <ul style="list-style-type: none"> • Install easily affected devices as far away as possible from the inverter or the converter unit. • Run easily affected signal cables as far away as possible from the inverter or the converter unit, and its I/O cables. • Do not run the signal cables and power cables (inverter or converter unit I/O cables) in parallel with each other, and do not bundle them. • Set the EMC filter ON/OFF connector of the converter unit to the ON position. (Refer to page 64.) • Inserting a line noise filter into the output suppresses the radiated noise from the cables. • Use shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(d), (e), (f)	<p>When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables to cause malfunction of the devices and the following countermeasures must be taken:</p> <ul style="list-style-type: none"> • Install easily affected devices as far away as possible from the inverter or the converter unit. • Run easily affected signal cables as far away as possible from the inverter or the converter unit, and its I/O cables. • Do not run the signal cables and power cables (inverter or converter unit I/O cables) in parallel with each other, and do not bundle them. • Use shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(g)	<p>When the peripheral devices use the power system of the inverter or the converter unit, its generated noises may flow back through the power supply cables to cause malfunction of the devices and the following countermeasures must be taken:</p> <ul style="list-style-type: none"> • Set the EMC filter ON/OFF connector of the converter unit to the ON position. (Refer to page 64.) • Install the line noise filter to the power cables (output cables) of the inverter.

Noise propagation path	Countermeasure
(h)	When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter or the converter unit, leakage currents may flow through the earthing (grounding) cable of the inverter or the converter unit to cause the device to malfunction. In that case, disconnecting the earthing (grounding) cable from the device may stop the malfunction of the device.

■ Data line filter

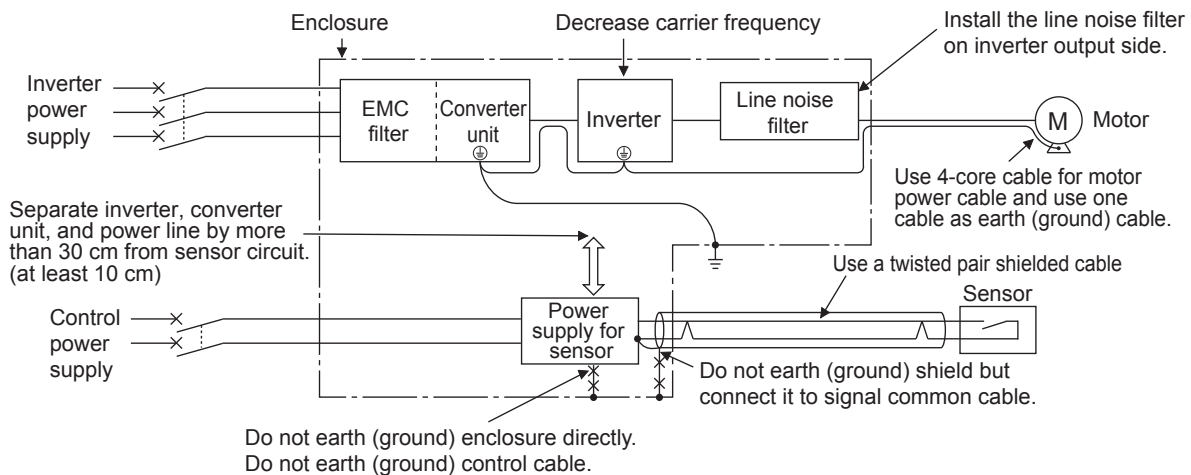
Data line filter is effective as an EMI countermeasure. Provide a data line filter for the detector cable, etc.

- Commercially available data line filter: ZCAT3035-1330 (by TDK), ESD-SR-250 (by TOKIN)
- Specification example (ZCAT3035-1330 manufactured by TDK)

Item	Description	
Impedance (Ω)	10 to 100 MHz	80
	100 to 500 MHz	150
Outline dimension drawings (mm)		

The impedance values above are reference values, and not guaranteed values.

■ EMI measure example



NOTE

- For compliance with the EU EMC Directive, refer to [page 190](#).

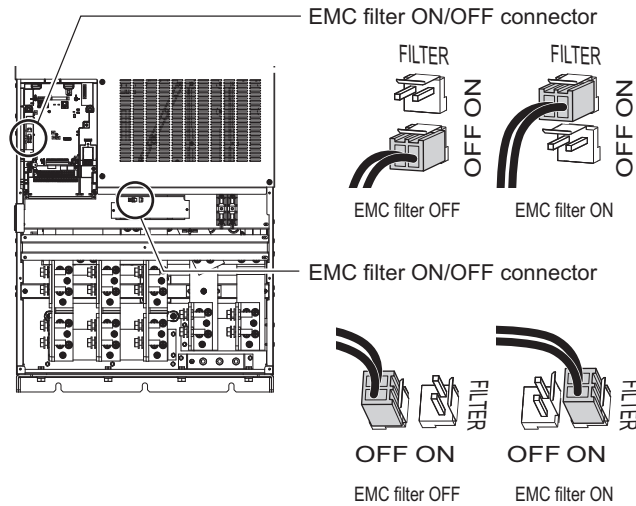
3.1.3 Built-in EMC filter

The converter unit is equipped with a built-in EMC filter (capacitive filter).

These filters are effective in reducing air-propagated noise on the input side of the converter unit.

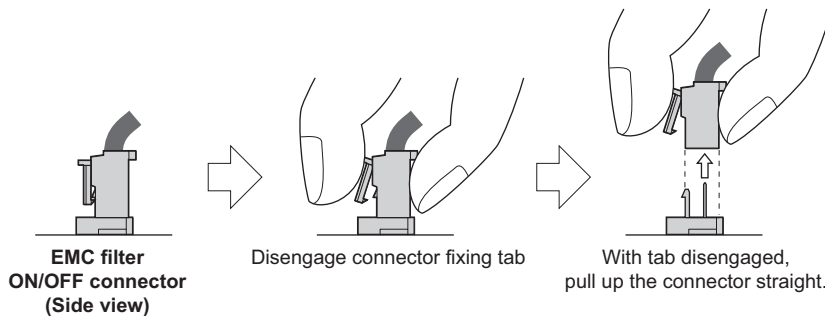
Two EMC filter ON/OFF connectors are provided. Both connectors are initially set to the "disabled" (OFF) position.

To enable the EMC filter, fit both of the EMC filter ON/OFF connectors to the "enabled" (ON) position.



◆ How to enable or disable the filter

- Before removing a front cover, check to make sure that the indication of the inverter operation panel is OFF, wait for at least 10 minutes after the power supply has been switched OFF, and check that there is no residual voltage using a digital multimeter or the like.
- When disconnecting the connector, push the fixing tab and pull the connector straight without pulling the cable or forcibly pulling the connector with the tab fixed.
When installing the connector, also engage the fixing tab securely.
(If it is difficult to disconnect the connector, use a pair of needle-nose pliers, etc.)



NOTE

- Fit the connector to either ON or OFF position.
- Enabling (turning ON) the EMC filter increases leakage current. (Refer to [page 61.](#))

⚠ WARNING

- While power is ON, do not open the front cover. Doing so may cause an electric shock.

3.2 Power supply harmonics

3.2.1 Power supply harmonics

The inverter or the converter unit may generate power supply harmonics from its converter circuit to affect the power generator, power factor correction capacitor, etc. Power supply harmonics are different from noise and leakage currents in source, frequency band and transmission path. Take the following countermeasures.

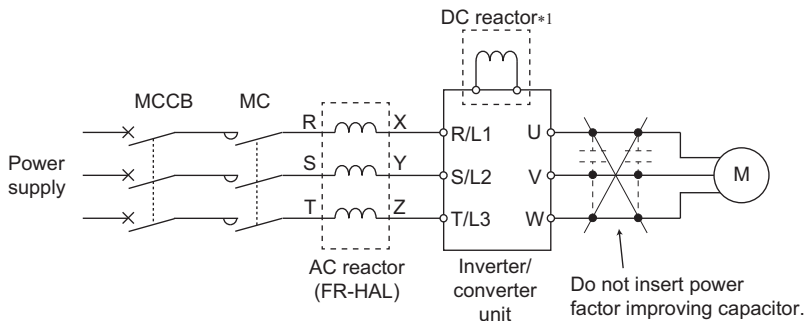
- Differences between harmonics and noises

Item	Harmonics	Noise
frequency	Normally 40th to 50th degrees or less (3 kHz or less).	High frequency (several 10 kHz to 1 GHz order).
Location	To-electric channel, power impedance.	To-space, distance, wiring path.
Quantitative understanding	Theoretical calculation possible.	Random occurrence, quantitative grasping 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.	Increase distance.

- Countermeasures

The harmonic current generated from the inverter or the converter unit to the input side differs according to the following factors: wiring impedance, use of a reactor, 6-phase/12-phase rectification, and the frequency/current output on the load side.

For the output frequency and output current, we understand that this should be calculated in the conditions under the rated load at the maximum operating frequency.



*1 The converter unit (FR-CC2) has a built-in DC reactor.

NOTE

- The power factor improving capacitor and surge suppressor on the inverter output side may be overheated or damaged by the harmonic components of the inverter output. Also, since an excessive current flows in the inverter to activate overcurrent protection, do not provide a capacitor and surge suppressor on the inverter output side when the motor is driven by the inverter. For power factor improvement, install a reactor on the input side of the inverter or the converter unit, or in the DC circuit.

3.2.2 Harmonic suppression guidelines in Japan

Harmonic currents flow from the inverter or the converter unit to a power receiving point via a power transformer. The Harmonic Suppression Guidelines was 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 capacity and all models of general-purpose inverter used by specific consumers are now covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage" (hereinafter referred to as "the Specific Consumer Guidelines").

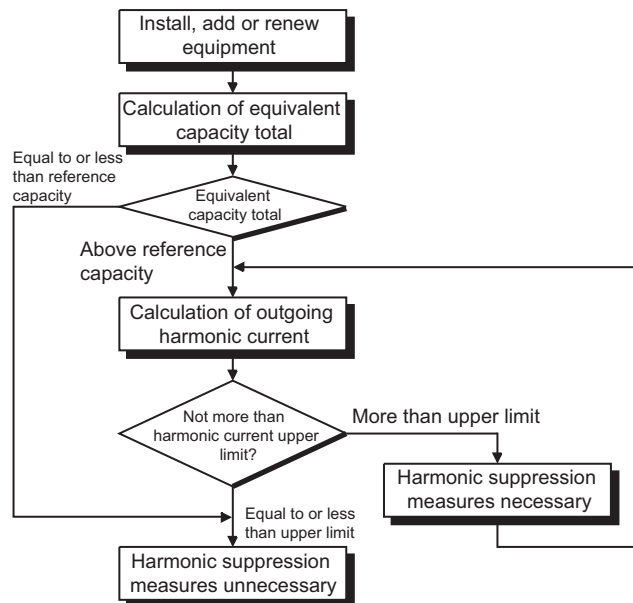
- "Specific Consumer Guidelines"

This guideline sets 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, this guideline requires that consumer to take certain suppression measures.

- Maximum values of outgoing harmonic currents per 1 kW contract power

Received power voltage	5th	7th	11th	13th	17th	19th	23rd	Over 23rd
6.6 kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22 kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33 kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24

◆ Application of the specific consumer guidelines



■ Conversion factor for 6-phase rectification

Classification	Circuit type		Conversion factor Ki
3	Three-phase bridge (capacitor smoothing)	With reactor (DC side)	K33 = 1.8
		With reactors (AC, DC sides)	K34 = 1.4
5	Self-excitation three-phase bridge	When a high power factor converter is used	K5 = 0

■ Conversion factor for 12-phase rectification

Classification	Circuit type		Conversion factor Ki
3	Three-phase bridge (capacitor smoothing)	12-pulse converter With reactor (DC side)	K37 = 0.8

■ Equivalent capacity limit

Received power voltage	Reference capacity
6.6 kV	50 kVA
22/33 kV	300 kVA
66 kV or more	2000 kVA

■ Harmonic contents for 6-phase rectification (values of the fundamental current are 100%)

Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Used (DC side)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
Used (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

■ Harmonic contents for 12-phase rectification (values of the fundamental current is 100%)

Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Used (DC side)	1.4	1.5	7.2	4.1	0.8	0.7	1.6	1.4

■ Calculation of equivalent capacity P0 of harmonic generating equipment

"Equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated by the following equation. If the sum of equivalent capacities is higher than the limit (refer to [page 67](#)), harmonics must be calculated by the equation in next subheading.

$$P0 = \sum (Ki \times Pi) \text{ [kVA]}$$

???Ki: Conversion factor (Refer to [page 67](#).)

???Pi: Rated capacity of harmonic generating equipment*1 [kVA]

???i: Number indicating the conversion circuit type

*1 Rated capacity: Determined by the capacity of the applied motor and found in the following table. The rated capacity used here is used to calculate the generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

■ Calculation of outgoing harmonic current

Outgoing harmonic current = fundamental wave current (value converted from received power voltage) × operation ratio × harmonic content

- Operation ratio: actual load factor × operation time ratio during 30 minutes
- Harmonic content: Refer to [page 67](#).

■ Rated capacities and outgoing harmonic currents of inverter-driven motors

Applicable motor (kW)	Fundamental wave current (A)	Fundamental wave current converted from 6.6 kV (mA)	Rated capacity (kVA)	Outgoing harmonic current converted from 6.6 kV (mA) (with a DC reactor, 100% operation ratio)							
	400 V			5th	7th	11th	13th	17th	19th	23rd	25th
75	123	7455	87.2	2237	969	626	373	350	239	224	164
90	147	8909	104	2673	1158	748	445	419	285	267	196
110	179	10848	127	3254	1410	911	542	510	347	325	239
132	216	13091	153	3927	1702	1100	655	615	419	393	288
160	258	15636	183	4691	2033	1313	782	735	500	469	344
220	355	21515	252	6455	2797	1807	1076	1011	688	645	473
250	403	24424	286	7327	3175	2052	1221	1148	782	733	537
280	450	27273	319	8182	3545	2291	1364	1282	873	818	600
315	506	30667	359	9200	3987	2576	1533	1441	981	920	675
355	571	34606	405	10382	4499	2907	1730	1627	1107	1038	761
400	643	38970	456	11691	5066	3274	1949	1832	1247	1169	857
450	723	43818	512	13146	5696	3681	2191	2060	1402	1315	964
500	804	48727	570	14618	6335	4093	2436	2290	1559	1462	1072
560	900	54545	638	16364	7091	4582	2727	2564	1746	1636	1200
630	1013	61394	718	18418	7981	5157	3070	2886	1965	1842	1351

■ Determining if a countermeasure is required

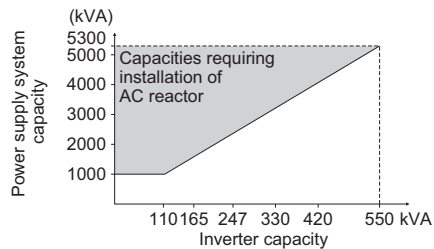
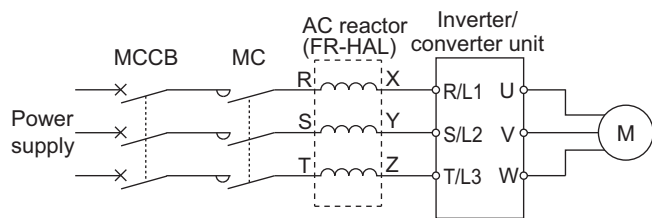
A countermeasure for harmonics is required if the following condition is satisfied: outgoing harmonic current > maximum value per 1 kW contract power × contract power.

■ Harmonic suppression techniques

Item	Description
Reactor installation (FR-HAL)	With the DC reactor equipped on its DC side, the converter unit can suppress the outgoing harmonic current. Install an AC reactor (FR-HAL) on the AC side of the inverter to further suppress outgoing harmonic currents.
High power factor converter (FR-HC2)	This converter trims the current waveform to be a sine waveform by switching the rectifier circuit (converter module) with transistors. Doing so suppresses the generated harmonic amount significantly. Connect it to the DC area of an inverter. Use the high power factor converter (FR-HC2) with the accessories that come as standard.
Power factor improving static capacitor	When used with a reactor connected in series, the power factor improving correction capacitor can absorb harmonic currents.
Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° in combinations of λ to Δ and Δ to Δ , to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
Passive filter (AC filter)	A capacitor and a reactor are used together to reduce impedances at specific frequencies. Harmonic currents are expected to be absorbed greatly by using this technique.
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. Harmonic currents are expected to be absorbed greatly by using this technique.
12-phase rectification	Using a 12-phase transformer is one way of suppressing harmonics.

3.3 Installation of a reactor

When the inverter is connected near a large-capacity power transformer (1000 kVA or more) or when a power factor correction capacitor is to be switched over, an excessive peak current may flow in the power input circuit, damaging the converter circuit. To prevent this, always install an AC reactor (FR-HAL), which is available as an option.



3.4 Power shutdown and magnetic contactor (MC)

◆ Converter unit input side magnetic contactor (MC)

On the converter unit input side, it is recommended to provide an MC for the following purposes.

(Refer to [page 19](#) for selection.)

- To disconnect the inverter from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.).
- To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure.
- To separate the inverter from the power supply to ensure safe maintenance and inspection work.

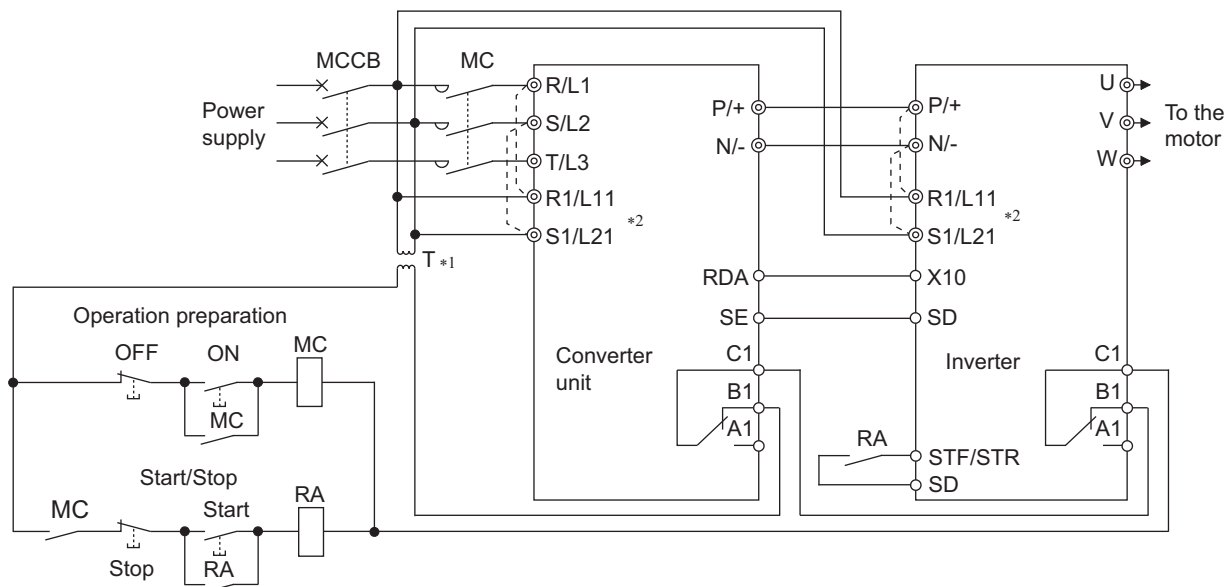
Use the converter unit input current as a reference for selection of an MC to perform an emergency stop during operation, and select the MC conforming to JEM 1038-AC-3 class rated operational current.

NOTE

- Since repeated inrush currents at power ON will shorten the life of the converter circuit (switching life is about 1,000,000 times), frequent starts and stops of the magnetic contactor must be avoided. Turn ON or OFF the start (STF/STR) signal for the inverter start control to run or stop the inverter.

• Inverter start/stop circuit example

As shown in the following figure, always use the start signal (turn ON or OFF the STF/STR signal) to make a start or stop.



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

*2 Connect the power supply terminals R1/L11, S1/L21 of the control circuit to the input side of the MC to hold an alarm signal when the inverter's protective circuit is activated. At this time, remove the jumpers connected to terminals R1/L11 and S1/L21. (Refer to [page 52](#) for removal of the jumper.)

◆ Handling of the magnetic contactor on the inverter's output side

Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned ON while the inverter is operating, overcurrent protection of the inverter and such will activate. When an MC is provided to switch to a commercial power supply, for example, it is recommended to use the commercial power supply-inverter switchover function **Pr.135 to Pr.139**. (The commercial power supply operation is not available with Vector control dedicated motors nor with PM motors.)

◆ Handling of the manual contactor on the inverter's output side

A PM motor is a synchronous motor with high-performance magnets embedded inside. High-voltage is generated at the motor terminals while the motor is running even after the inverter power is turned OFF. In an application where the PM motor is driven by the load even after the inverter is powered OFF, a low-voltage manual contactor must be connected at the inverter's output side.

 **NOTE**

- Before wiring or inspection for a PM motor, confirm that the PM motor is stopped. In an application, such as fan and blower, where the motor is driven by the load, a low-voltage manual contactor must be connected at the inverter's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.
- Do not open or close the contactor while the inverter is running (outputting).

3.5 Checklist before starting operation

This product is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product.

Before starting operation, always recheck the following points.

Checkpoint	Countermeasure	Refer to page	Check by user
Crimp terminals are insulated.	Use crimp terminals with insulation sleeves to wire the power supply and the inverter.	—	
No wire offcuts are left from the time of wiring.	Wire offcuts can cause an alarm, failure or malfunction. Always keep the converter unit clean. When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the converter unit.	—	
The main circuit cable gauge is correctly selected.	Use an appropriate cable gauge to suppress the voltage drop to 2% or less.	38, 43	
The total wiring length is within the specified length.	Keep the total wiring length within the specified length. In long distance wiring, charging currents due to stray capacitance in the wiring may cause the equipment on the converter unit's output side to malfunction. Pay attention to the total wiring length.	38	
Countermeasures are taken against EMI.	The input/output (main circuit) of the converter unit includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the converter unit. In such case, enable the EMC filter (turn ON the EMC filter ON/OFF connector) to minimize interference.	64	
When performing an inspection or rewiring on the product that has been energized, the operator has waited long enough after shutting off the power supply.	For a short time after the power-OFF, a high voltage remains in the smoothing capacitor, and it is dangerous. Before performing an inspection or rewiring, wait 10 minutes or longer after the power supply turns OFF, then confirm that the voltage across the main circuit terminals P/+ and N/- of the converter unit is low enough using a digital multimeter, etc.	—	
The voltage applied to the converter unit I/O signal circuits is within the specifications.	Application of a voltage higher than the permissible voltage to the converter unit I/O signal circuits or opposite polarity may damage the I/O devices. Check the wiring beforehand.	46	
A magnetic contactor (MC) is installed on the converter unit's input side.	On the converter unit's input side, connect an MC for the following purposes: <ul style="list-style-type: none"> To disconnect the converter unit from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.). To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure. To separate the converter unit from the power supply to ensure safe maintenance and inspection work. Use the converter unit input current as a reference for selection of an MC to perform an emergency stop during operation, and select the MC conforming to JEM 1038-AC-3 class rated operational current.	71	
The specifications and rating match the system requirements.	Make sure that the specifications and rating match the system requirements.	—	
The converter unit and the inverter are correctly connected.	<ul style="list-style-type: none"> Make sure that terminal P/+ of the converter unit and terminal P/+ of the inverter, and terminal N/- of the converter unit and terminal N/- of the inverter are correctly connected. Connecting the opposite polarity of terminals N/- and P/+ will damage the inverter. Also, do not install an MCCB across terminals P/+ and N/- (across terminals P and P/+ or across N and N/-). Always connect terminal RDA of the converter unit and terminal MRS (X10) of the inverter, and terminal SE of the converter unit and terminal SD (terminal PC for source logic) of the inverter. Not doing so may lead to damage of the converter unit. 	36	
The converter unit and the inverter are correctly connected.	<ul style="list-style-type: none"> For 12-phase rectification, make sure to remove all of the shorting conductors between terminals R/L1 and R2/L12, between terminals S/L2 and S2/L22, and between terminals T/L3 and T2/L32 of the converter unit. If the power transformer is connected without removing these conductors, it may be burned. Check the correct connection between the output terminals in the wye/delta connection and the power transformer with the terminals of the converter unit. Otherwise an explosion or damage may occur in the converter unit or the power transformer. 	41	

MEMO

CHAPTER 4 BASIC OPERATION

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4.2	Monitoring the converter unit status.....	80

4 BASIC OPERATION

4.1 Operation panel

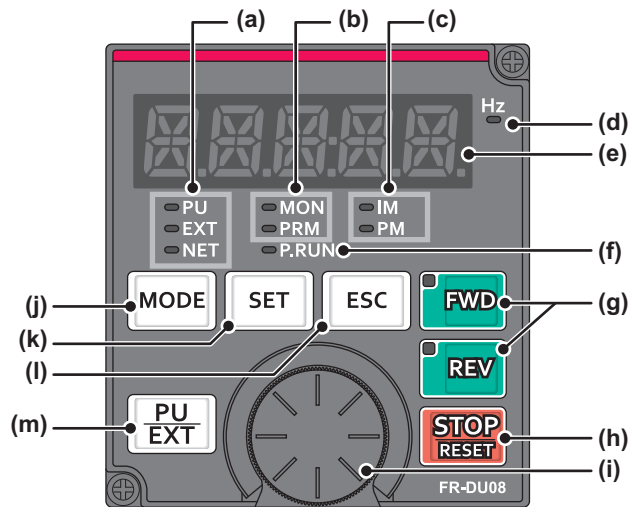
This chapter explains the basic operation of this product.

Always read the instructions before use.

4.1.1 Components of the operation panel

Install the operation panel of the inverter on the converter unit.

To mount the operation panel on the enclosure surface, refer to [page 56](#).

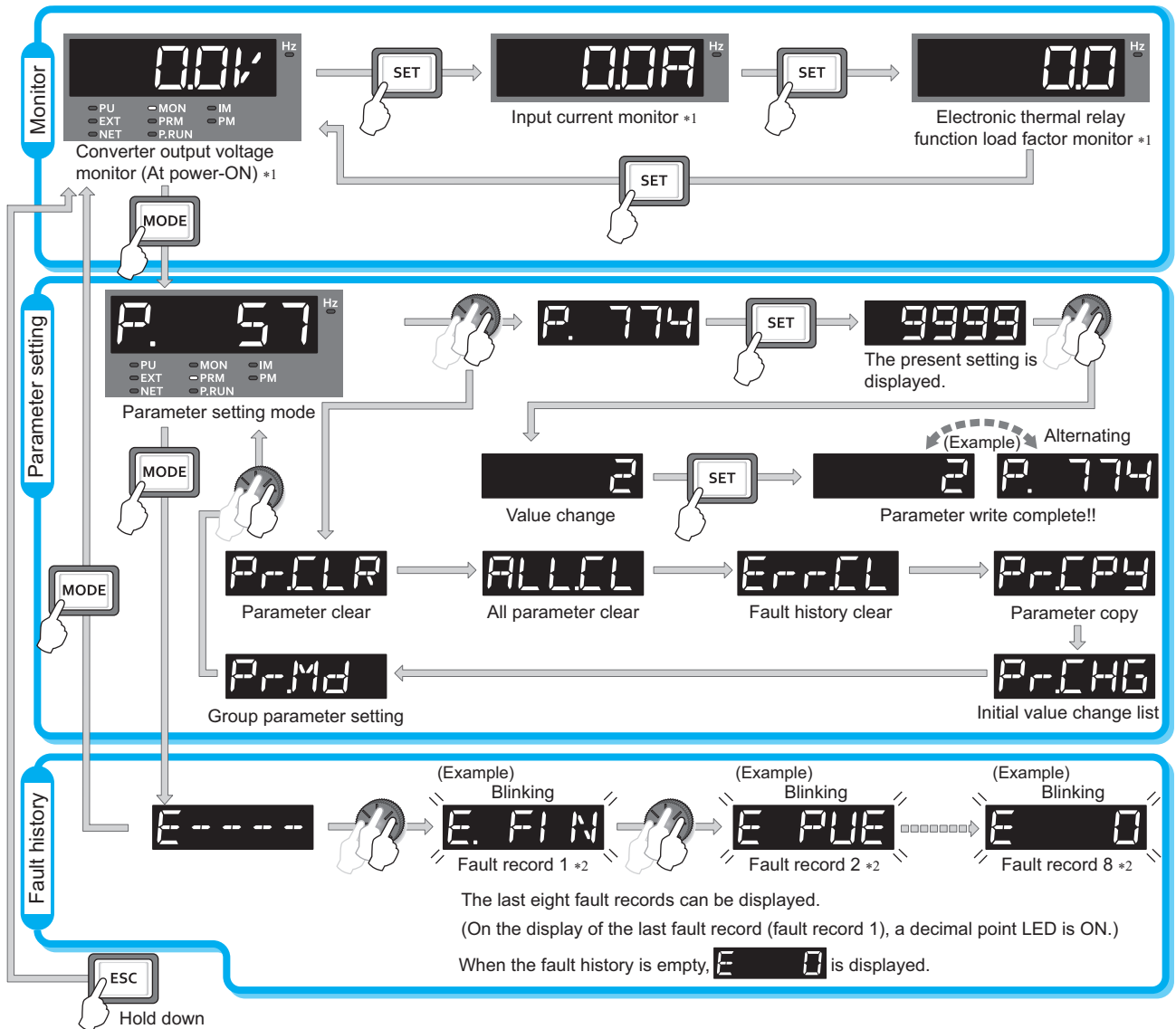


No.	Appearance	Name	Description
(a)		—	Not available for the converter unit.
(b)		Operation panel mode LED indicator	MON: ON when the operation panel is in the monitor mode. Quickly blinks twice intermittently while the protective function is activated. Slowly blinks when the display-off function of the operation panel is valid. PRM: ON when the operation panel is in the parameter setting mode.
(c)		—	Not available for the converter unit.
(d)		—	Not available for the converter unit.
(e)		Monitor (5-digit LED)	Shows a numeric value (readout) of a monitor item such as the frequency or a parameter number. (The monitor item on each screen can be changed according to the settings of Pr.774 to Pr.776 .)
(f)		—	Not available for the converter unit.
(g)		—	Not available for the converter unit.
(h)		STOP/RESET key	Used to reset the converter unit when the protective function is activated.
(i)		Setting dial	Turn the setting dial to change the parameter settings. Press the setting dial to perform the following operations: <ul style="list-style-type: none"> • To display a monitor item set in Pr.992. • To display a fault record number in the fault history mode.
(j)		MODE key	Switches the operation panel to a different mode. Every key on the operation panel becomes inoperable by holding this key for 2 seconds. The key inoperable function is invalid when Pr.161 = "0 (initial setting)". (Refer to page 91 .)

No.	Appearance	Name	Description
(k)		SET key	Confirms each selection. When this key is pressed during inverter operation, the monitor item changes. (The monitor item on each screen can be changed according to the settings of Pr.774 to Pr.776.) When the initial setting is set <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px auto;"> Converter output voltage → Input current → Electric thermal relay function load factor </div>
(l)		ESC key	Goes back to the previous display. Holding this key for a longer time changes the display back to the monitor mode.
(m)		—	Not available for the converter unit.

4.1.2 Basic operation of the operation panel

◆ Basic operation



*1 The monitor item can be changed. (Refer to page 106.)
 *2 For details on fault history, refer to page 162.

◆ Parameter setting mode

In the parameter setting mode, converter unit functions (parameters) are set.

The following table explains the indications in the parameter setting mode.

Operation panel indication	Function name	Description	Refer to page
P.	Parameter setting mode	Under this mode, the set value of the displayed parameter number is read or changed.	78
PrCLR	Parameter clear	Clears and resets parameter settings to the initial values. However, parameters such as terminal function selection parameters are not cleared. For details on the uncleared parameters, refer to page 188 .	149
ALLCL	All parameter clear	Clears and resets parameter settings to the initial values. Terminal function selection parameters are also cleared. For details on the uncleared parameters, refer to page 188 .	149
ErrCL	Fault history clear	Deletes the fault history.	158
PrCPY	Parameter copy	Copies the parameter settings saved in the converter unit to the operation panel. The parameters copied to the operation panel can be also copied to other converter units.	150
PrCHG	Initial value change list	Identifies the parameters that have been changed from their initial settings.	153
PrMd	Group parameter setting	Displays parameter numbers by function groups.	84

4.1.3 Digital characters and their corresponding printed equivalents


Digital characters displayed on the operation panel display are as follows.

0	1	2	3	4	5	6	7	8	9	A	B(b)	C	c	D(d)
0	1	2	3	4	5	6	7	8	9	A	b	C	c	d
E(e)	F(f)	G(g)	H	h	I(i)	J(j)	K(k)	L(l)	M(m)	N	n	O	o	P(p)
E	F	G	H	h	I	J	K	L	M	N	n	O	o	P
Q(q)	R	r	S(s)	T(t)	U	u	V	v	W	w	X(x)	Y(y)	Z(z)	
Q	R	r	S	T	U	u	V	v	W	w	X	Y	Z	



4.1.4 Changing the parameter setting value





The following shows the procedure to change the setting of **Pr.774 Operation panel monitor selection 1**.

Operating procedure

- Turning ON the power of the converter unit
The operation panel is in the monitor mode.
- Selecting the parameter setting mode
Press **MODE** to choose the parameter setting mode. (The parameter number read previously appears.)
- Selecting the parameter
Turn  until "P. 774" (**Pr.774**) appears. Press **SET** to read the present set value.
"9999" (initial value) appears.

4. Changing the setting value

Turn  to change the set value to "P. 774". Press  to confirm the selection. "P. 774" and "P. 774" are displayed alternately.

- Turn  to read another parameter.
- Press  to show the setting again on the LCD display.
- Press  twice to show the next parameter.
- Press  twice to return the monitor display to the first screen in the monitor mode (output voltage monitoring screen in the initial setting).

NOTE


- If a parameter write condition is not satisfied, a parameter write error appears. (Refer to [page 162.](#))

Error indication	Description
Er-1	Parameter write error




4.2 Monitoring the converter unit status

4.2.1 Monitoring of converter output voltage and input current

Point

- Press  on the operation panel in the monitor mode to switch the monitor item between converter output voltage, input current, and electronic thermal relay function load factor.
-

Operating procedure

1. Press  to monitor the converter output voltage. The unit of voltage "V" appears.
2. Press  to monitor the input current. The unit of current "A" appears.
3. Press  to monitor the electronic thermal relay function load factor.

NOTE

- Use Pr.774 to Pr.776 Operation panel monitor selection 1 to 3 to change the monitor item. (Refer to [page 106.](#))
-


4.2.2 First priority monitor screen

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

To set it, press  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 input 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 input current can be monitored.
2. Press  for a while (1 second). The input current monitor screen is set as the first priority monitor screen.
3. When the operation panel is in the monitor mode next time, the input current monitored value is displayed first.

NOTE

- Use Pr.774 Operation panel monitor selection 1 to change the monitor item. (Refer to [page 106.](#))
-

CHAPTER 5 PARAMETERS

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5 PARAMETERS

This chapter explains the function setting for use of this product.

Always read the instructions before use.

5.1 Parameter List

5.1.1 Parameter list (by parameter number)

Set the necessary parameters to meet the load and operational specifications. Parameter setting, change, and check can be made on the operation panel. Install the operation panel of the inverter on the converter unit.

NOTE

- Refer to [page 188](#) for instruction codes for communication and availability of Parameter clear, All parameter clear, and Parameter copy.

Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
30	E300	Reset selection during power supply to main circuit	0, 100	1	0	116	
57	A702	Restart selection	0, 9999	1	9999	118	
65	H300	Retry selection	0 to 4	1	0	98	
67	H301	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	98	
68	H302	Retry waiting time	0.1 to 600 s	0.1 s	1 s	98	
69	H303	Retry count display erase	0	1	0	98	
75	—	Reset selection/disconnected PU detection/reset limit	14 to 17, 114 to 117	1	14	89	
	E100	Reset selection	0, 1		0		
	E101	Disconnected PU detection					
	E107	Reset limit					
77	E400	Parameter write selection	1, 2	1	2	91	
117	N020	PU communication station number	0 to 31	1	0	125	
118	N021	PU communication speed	48, 96, 192, 384, 576, 768, 1152	1	192	125	
119	—	PU communication stop bit length / data length	0, 10	1	1	125	
	N022	PU communication data length	0, 1		0		
	N023	PU communication stop bit length	0, 1		1		
120	N024	PU communication parity check	0 to 2	1	2	125	
121	N025	PU communication retry count	0 to 10, 9999	1	1	125	
122	N026	PU communication check time interval	0, 0.1 to 999.8 s, 9999	0.1 s	9999	125	
123	N027	PU communication waiting time setting	0 to 150 ms, 9999	1 ms	9999	125	
124	N028	PU communication CR/LF selection	0 to 2	1	1	125	
161	E200	Key lock operation selection	0, 10	1	0	91	
168	E000	Parameter for manufacturer setting. Do not set.					
	E080						
169	E001						
	E081						
170	M020	Watt-hour meter clear	0, 10, 9999	1	9999	106	

Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting	
178	T700	RDI terminal function selection	7, 21, 62, 84, 9999	1	9999	114		
187	T709	OH terminal function selection		1	7	114		
189	T711	RES terminal function selection		1	62	114		
190	M400	RDB terminal function selection	2, 8, 11, 17, 25, 26, 64 to	1	111	109		
191	M401	RDA terminal function selection	66, 68, 90, 94, 95, 98, 99,	1	11	109		
192	M402	IPF terminal function selection	102, 108, 111, 125, 126,	1	2	109		
193	M403	RSO terminal function selection	164 to 166, 168, 190, 194,	1	209	109		
194	M404	FAN terminal function selection	195, 198, 199, 206, 207,	1	25	109		
195	M405	ABC1 terminal function selection	209, 210, 214, 306, 307,	1	99	109		
244	H100	Cooling fan operation selection	309, 310, 9999	1	0	100		
248	A006	Self power management selection	0, 2	1	0	116		
255	E700	Life alarm status display	(0 to 15)	1	0	94		
256	E701	Inrush current limit circuit life display	(0 to 100%)	1%	100%	94		
257	E702	Control circuit capacitor life display	(0 to 100%)	1%	100%	94		
261	A730	Power failure stop selection	0, 1, 2, 21, 22	1	0	118		
268	M022	Monitor decimal digits selection	0, 1, 9999	1	9999	106		
269	E023	Parameter for manufacturer setting. Do not set.						
290	M044	Monitor negative output selection	0, 2, 4, 6	1	0	106		
296	E410	Password lock level	0 to 3, 5, 6, 100 to 103, 105, 106, 9999	1	9999	92		
297	E411	Password lock/unlock	(0 to 5), 1000 to 9998, 9999	1	9999	92		
331	N030	RS-485 communication station number	0 to 31 (0 to 247)	1	0	125, 137		
332	N031	RS-485 communication speed	3, 6, 12, 24, 48, 96, 192, 384, 576, 768, 1152	1	96	125, 137		
333	—	RS-485 communication stop bit length / data length	0, 1, 10, 11	1	1	125		
	N032	RS-485 communication data length	0, 1	1	0			
	N033	RS-485 communication stop bit length	0, 1	1	1			
334	N034	RS-485 communication parity check selection	0 to 2	1	2	125, 137		
335	N035	RS-485 communication retry count	0 to 10, 9999	1	1	125		
336	N036	RS-485 communication check time interval	0 to 999.8 s, 9999	0.1 s	0 s	125		
337	N037	RS-485 communication waiting time setting	0 to 150 ms, 9999	1 ms	9999	125		
341	N038	RS-485 communication CR/LF selection	0 to 2	1	1	125		
342	N001	Communication EEPROM write selection	0, 1	1	0	124		
343	N080	Communication error count	—	1	0	137		
503	E710	Maintenance timer 1	0 (1 to 9998)	1	0	95		
504	E711	Maintenance timer 1 warning output set time	0 to 9998, 9999	1	9999	95		
514	H324	Emergency drive dedicated retry waiting time	0.1 to 600 s, 9999	0.1 s	9999	102		
515	H322	Emergency drive dedicated retry count	1 to 200, 9999	1	1	102		
523	H320	Emergency drive mode selection	100, 200, 9999	1	9999	102		
539	N002	MODBUS RTU communication check time interval	0 to 999.8 s, 9999	0.1 s	9999	137		
549	N000	Protocol selection	0, 1	1	0	125, 137		
563	M021	Energization time carrying-over times	(0 to 65535)	1	0	106		
598	H102	Undervoltage level	350 to 430 V, 9999	0.1 V	9999	97		
663	M060	Control circuit temperature signal output level	0°C to 100°C	1°C	0°C	113		

Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
686	E712	Maintenance timer 2	0 (1 to 9998)	1	0	95	
687	E713	Maintenance timer 2 warning output set time	0 to 9998, 9999	1	9999	95	
688	E714	Maintenance timer 3	0 (1 to 9998)	1	0	95	
689	E715	Maintenance timer 3 warning output set time	0 to 9998, 9999	1	9999	95	
774	M101	Operation panel monitor selection 1	2, 8, 13, 20, 25, 43, 44, 55, 62, 68, 98, 9999	1	9999	106	
775	M102	Operation panel monitor selection 2		1	9999	106	
776	M103	Operation panel monitor selection 3		1	9999	106	
872	H201	Input phase loss protection selection	0, 1	1	0	97	
876	T723	OH input selection	0 to 2	1	0	114	
888	E420	Free parameter 1	0 to 9999	1	9999	93	
889	E421	Free parameter 2	0 to 9999	1	9999	93	
891	M023	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	106	
990	E104	PU buzzer control	0, 1	1	1	90	
992	M104	Operation panel setting dial push monitor selection	2, 8, 13, 20, 25, 43, 44, 55, 62, 68, 98	1	8	106	
997	H103	Fault initiation	0 to 255, 9999	1	9999	97	
1006	E020	Clock (year)	2000 to 2099	1	2000	88	
1007	E021	Clock (month, day)	Jan. 1 to Dec. 31	1	101	88	
1008	E022	Clock (hour, minute)	0:00 to 23:59	1	0	88	
1048	E106	Display-off waiting time	0 to 60 min	1 min	0	90	
Pr.CLR		Parameter clear	(0), 1	1	0	149	
ALL.CL		All parameter clear	(0), 1	1	0	149	
Err.CL		Fault history clear	(0), 1	1	0	158	
Pr.CPY		Parameter copy	(0), 1 to 3	1	0	150	
Pr.CHG		Initial value change list	—	1	0	153	
Pr.MD		Group parameter setting	(0), 1, 2	1	0	84	

5.1.2 The function group number is used for the identification of parameters, and displayed in alphanumeric order.

A parameter identification number shown on the PU can be switched from a parameter number to a function group number. As parameters are grouped by function and displayed by the group, the related parameters can be set continually at a time.


◆ Changing a parameter identification number to a function group number


Pr.MD setting	Description
0	The setting of parameter identification number remains the same as the last setting.
1	The parameter number is used for the identification of parameters, and displayed in numerical order.
2	The function group number is used for the identification of parameters, and displayed in alphanumeric order.

Operating procedure



- Turning ON the power of the converter unit
The operation panel is in the monitor mode.
- Selecting the parameter setting mode
Press to choose the parameter setting mode. (The parameter number read previously appears.)

3. Selecting the parameter

Turn  until "Pr.Md" (Group parameter setting) appears.

Press  to confirm the selection. The setting "0" (initial value) will appear.

4. Selecting the use of the function group number

Turn  to change the set value to "2" (function group number). Press  to select the Group parameter setting. "2" and "Pr.Md" are displayed alternately after the setting is completed.

◆ Selecting a parameter by function group number to change its setting


The following shows the procedure to change the setting of **P.M101 (Pr.774) Operation panel monitor selection 1**.

Operating procedure


1. Turning ON the power

The operation panel is in the monitor mode.



2. Selecting the parameter setting mode

Press  to choose the parameter setting mode. (The parameter number read previously appears.)



3. Enabling the function group selection

Press  several times until "P.A0 . ." appears. Parameter groups can now be selected.


4. Enabling the function group selection

Turn  until "PM 1 . ." (monitor parameter 1) appears. Press  to confirm the selection. "PM 1- -" will appear, which shows that the operation panel is ready for selection of a number in the group of monitor parameter 1.

5. Selecting a parameter

Turn  until "PM 10 1" (P.M101 Operation panel monitor selection 1) appears. Press  to display the present set value. "9999 (initial value)" appears.

6. Changing the setting value

Turn  to change the set value to "2". Press  to confirm the selection. "2" and "PM 10 1" are displayed alternately after the setting is completed.

5.1.3 Parameter list (by function group number)

◆ E: Environment setting parameters

Parameters for the converter unit operating environment.

Pr. group	Pr.	Name	Refer to page
E000	168	Parameter for manufacturer setting. Do not set.	
E001	169		
E020	1006	Clock (year)	88
E021	1007	Clock (month, day)	88
E022	1008	Clock (hour, minute)	88
E023	269	Parameter for manufacturer setting. Do not set.	
E080	168		
E081	169		
E100	75	Reset selection	89
E101	75	Disconnected PU detection	89
E104	990	PU buzzer control	90
E106	1048	Display-off waiting time	90
E107	75	Reset limit	89
E200	161	Key lock operation selection	91
E300	30	Reset selection during power supply to main circuit	116
E400	77	Parameter write selection	91
E410	296	Password lock level	92
E411	297	Password lock/unlock	92
E420	888	Free parameter 1	93
E421	889	Free parameter 2	93
E700	255	Life alarm status display	94
E701	256	Inrush current limit circuit life display	94
E702	257	Control circuit capacitor life display	94
E710	503	Maintenance timer 1	95
E711	504	Maintenance timer 1 warning output set time	95
E712	686	Maintenance timer 2	95
E713	687	Maintenance timer 2 warning output set time	95
E714	688	Maintenance timer 3	95
E715	689	Maintenance timer 3 warning output set time	95

◆ H: Protective function parameter

Parameters to protect the converter unit.

Pr. group	Pr.	Name	Refer to page
H100	244	Cooling fan operation selection	100
H102	598	Under voltage level	97
H103	997	Fault initiation	97
H201	872	Input phase loss protection selection	97
H300	65	Retry selection	98
H301	67	Number of retries at fault occurrence	98
H302	68	Retry waiting time	98
H303	69	Retry count display erase	98

Pr. group	Pr.	Name	Refer to page
H320	523	Emergency drive mode selection	102
H322	515	Emergency drive dedicated retry count	102
H324	514	Emergency drive dedicated retry waiting time	102

◆ M: Item and output signal for monitoring

Parameters for the settings regarding the monitoring to check the converter unit's operating status and the output signals for the monitoring.

Pr. group	Pr.	Name	Refer to page
M020	170	Watt-hour meter clear	106
M021	563	Energization time carrying-over times	106
M022	268	Monitor decimal digits selection	106
M023	891	Cumulative power monitor digit shifted times	106
M044	290	Monitor negative output selection	106
M060	663	Control circuit temperature signal output level	113
M101	774	Operation panel monitor selection 1	106
M102	775	Operation panel monitor selection 2	106
M103	776	Operation panel monitor selection 3	106
M104	992	Operation panel setting dial push monitor selection	106
M400	190	RDB terminal function selection	109
M401	191	RDA terminal function selection	109
M402	192	IPF terminal function selection	109
M403	193	RSO terminal function selection	109
M404	194	FAN terminal function selection	109
M405	195	ABC1 terminal function selection	109

◆ T: Multi-function input terminal parameters

Parameters for the setting of the input terminals via which commands are given to the converter unit.

Pr. group	Pr.	Name	Refer to page
T700	178	RDI terminal function selection	114
T709	187	OH terminal function selection	114
T711	189	RES terminal function selection	114
T723	876	OH input selection	114

◆ A: Application parameters

Parameters for the setting of a specific application.

Pr. group	Pr.	Name	Refer to page
A006	248	Self power management selection	116
A702	57	Restart selection	118
A730	261	Power failure stop selection	118

◆ N: Communication operation parameters

Parameters for the setting of communication operation such as the communication specifications or operating characteristics.

Pr. group	Pr.	Name	Refer to page
N000	549	Protocol selection	124, 137
N001	342	Communication EEPROM write selection	124
N002	539	MODBUS RTU communication check time interval	137
N020	117	PU communication station number	125
N021	118	PU communication speed	125
N022	119	PU communication data length	125
N023	119	PU communication stop bit length	125
N024	120	PU communication parity check	125
N025	121	PU communication retry count	125
N026	122	PU communication check time interval	125
N027	123	PU communication waiting time setting	125
N028	124	PU communication CR/LF selection	125
N030	331	RS-485 communication station number	125, 137
N031	332	RS-485 communication speed	125, 137
N032	333	RS-485 communication data length	125
N033	333	RS-485 communication stop bit length	125
N034	334	RS-485 communication parity check selection	125, 137
N035	335	RS-485 communication retry count	125
N036	336	RS-485 communication check time interval	125
N037	337	RS-485 communication waiting time setting	125
N038	341	RS-485 communication CR/LF selection	125
N080	343	Communication error count	137

5.2 (E) Environment setting parameters

Purpose	Parameter to set			Refer to page
To set the time	Simple clock function	P.E020 to P.E022	Pr.1006 to Pr.1008	88
To set a limit for the reset function. To shut off output if the operation panel disconnects.	Reset selection / disconnected PU detection / reset limit	P.E100, P.E101, P.E107	Pr.75	89
To control the buzzer of the operation panel	PU buzzer control	P.E104	Pr.990	90
To turn OFF the operation panel when not using it for a certain period of time	Display-off setting	P.E106	Pr.1048	90
To disable the operation panel.	Operation panel operation selection	P.E200	Pr.161	91
To prevent parameter rewriting	Parameter write disable selection	P.E400	Pr.77	91
To restrict parameters with a password	Password	P.E410, P.E411	Pr.296, Pr.297	92
To use parameters freely	Free parameter	P.E420, P.E421	Pr.888, Pr.889	93
To understand the maintenance time of converter unit parts and peripheral devices	Converter unit parts life display	P.E700 to P.E702	Pr.255 to Pr.257	94
	Maintenance output function	P.E710 to P.E715	Pr.503, Pr.504, Pr.686 to Pr.689	95

5.2.1 Simple clock function

The time can be set. The time can only be updated while the converter unit power is ON.

Pr.	Name	Initial value	Setting range	Description
1006 E020	Clock (year)	2000 years	2000 to 2099	Set the year.
1007 E021	Clock (month, day)	101 (January 1)	101 to 131, 201 to 228, (229), 301 to 331, 401 to 430, 501 to 531, 601 to 630, 701 to 731, 801 to 831, 901 to 930, 1001 to 1031, 1101 to 1130, 1201 to 1231	Set the month and day. 1000's and 100's digits: Month (1 (January) to 12 (December)). 10's and 1's digits: Day (1 to the last day of the month (28, 29, 30, or 31)). For December 31, set "1231".
1008 E022	Clock (hour, minute)	0 (00:00)	0 to 59, 100 to 159, 200 to 259, 300 to 359, 400 to 459, 500 to 559, 600 to 659, 700 to 759, 800 to 859, 900 to 959, 1000 to 1059, 1100 to 1159, 1200 to 1259, 1300 to 1359, 1400 to 1459, 1500 to 1559, 1600 to 1659, 1700 to 1759, 1800 to 1859, 1900 to 1959, 2000 to 2059, 2100 to 2159, 2200 to 2259, 2300 to 2359	Set the hour and minute using the 24-hour clock. 1000's and 100's digits: 0 to 23 hours, 10's and 1's digits: 0 to 59 minutes. For 23:59, set "2359".

- When the year, month, day, time and minute are set in **Pr.1006 to Pr.1008**, the converter unit counts the date and time. The date and time can be checked by reading **Pr.1006 to Pr.1008**.

NOTE

- The time data of the internal clock is saved in the converter unit's EEPROM every 10 minutes.
- The clock does not count up while the control circuit power supply is OFF. The clock function must be reset after turning ON the power supply. Use a separate power supply, such as an external 24 V power supply, for the control circuit of the simple clock function, and supply power continuously to this control circuit.
- Converter reset is performed if supplying power to the main circuit power supply is started with power supplied only to the control circuit power supply. Thus, the clock information stored in the EEPROM is restored. To prevent the clock from resetting, set **Pr.30 Reset selection during power supply to main circuit**. (Refer to [page 116](#).)
- The date set in **Pr.1006 to Pr.1008** is also used for the function in the fault history (refer to [page 158](#)), etc.

5.2.2 Reset selection / disconnected PU detection / reset limit

The acceptance of reset command, the operation in the event of detection of the operation panel disconnected, and the reset limit function can be selected.

Pr.	Name	Initial value	Setting range	Description
75	Reset selection/ disconnected PU detection/reset limit	14	14 to 17, 114 to 117	In the initial setting, the reset command input is always enabled, the operation continues when PU disconnection is detected, and the reset limit function is disabled.
E100	Reset selection	0	0	Reset input is always enabled.
			1	Reset input is enabled only when the protective function is activated.
E101	Disconnected PU detection	0	0	Operation continues even when the operation panel is disconnected.
			1	The inverter output is shut off when the operation panel is disconnected.
E107	Reset limit	0	0	Reset limit is disabled.
			1	Reset limit is enabled.

The parameters above do not return to their initial values even if parameter (all) clear is executed.

Pr.75 setting	Reset selection	Disconnected PU detection	Reset limit function
14 (initial value)	Reset input always enabled	Operation continues even when the operation panel is disconnected.	Disabled
15	Reset input enabled only when the protective function activated.		
16	Reset input always enabled		
17	Reset input enabled only when the protective function activated.	The inverter output is shut off when the operation panel is disconnected.	Enabled
114	Reset input always enabled	Operation continues even when the operation panel is disconnected.	
115	Reset input enabled only when the protective function activated.		
116	Reset input always enabled	The inverter output is shut off when the operation panel is disconnected.	
117	Reset input enabled only when the protective function activated.		

◆ Reset selection (P.E100)

- When **P.E100** = "1" or **Pr.75** = "15, 17, 115, or 117" is set, the reset command input is enabled (using the RES signal or through communication) only when the protective function is activated.

NOTE

- When the RES signal is input during operation, the inverter is also reset. The motor coasts since the inverter being reset shuts off the output. Also, the cumulative value of the electronic thermal relay is cleared.
- The input of the operation panel reset key is only enabled when the protective function is activated, regardless of the **P.E100** and **Pr.75** settings.

◆ Disconnected PU detection (P.E101)

- If the converter unit detects that the operation panel has been disconnected for 1 second or longer while **P.E101** = "1" or **Pr.75** = "16, 17, 116 or 117", the protective function (E.PUE) is activated and the inverter output is shut off.

NOTE

- If the operation panel is disconnected before power-ON, the output is not shut off.
- To restart, confirm that the operation panel is connected and then reset the converter unit.
- During operation commanded through RS-485 communication, the reset selection function is enabled but the "disconnected PU detection" function is disabled. (The communication is checked according to **Pr.122 PU communication check time interval**.)

◆ Reset limit (P.E107)

- Setting **P.E107** = "1" or **Pr.75** = any of "114 to 117" will make the converter unit to refuse any reset operation (RES signal input, etc.) for 3 minutes after the first activation of an electronic thermal O/L relay function (E.THC).

NOTE

- Resetting the converter unit power (turning OFF the control power) clears the accumulated thermal value.
- When the retry function is set enabled (**Pr.67 Number of retries at fault occurrence** ≠ "0"), the reset limit function is disabled.

⚠ CAUTION

- **Do not reset the converter unit while the inverter start signal is being input. Doing so will cause a sudden start of the motor, which is dangerous.**

Parameters referred to

Pr.67 Number of retries at fault occurrence [page 98](#)

5.2.3 Buzzer control

The operation panel key sound and buzzer can be turned ON/OFF.

Pr.	Name	Initial value	Setting range	Description
990 E104	PU buzzer control	1	0	Turns the key sound and buzzer OFF.
			1	Turns the key sound and buzzer ON.

NOTE

- When the buzzer is set to ON, a warning sound will be audible when a fault occurs.

5.2.4 Display-off setting

The LED display of the operation panel (FR-DU08) can be turned OFF when the operation panel has not been used for a certain period of time.



Pr.	Name	Initial value	Setting range	Description
1048 E106	Display-off waiting time	0	0	Display-off setting is disabled.
			1 to 60 min	Set time until the LED of the operation panel is turned OFF.

- When the operation panel has not been operated for the time set in **Pr.1048**, the display-off setting is activated and the LED display turns OFF.
- In the display-off state, the [MON] indicator blinks slowly.
- The time interval counting for display-off is reset at removal/reinstallation of the operation panel, power-ON/OFF of the converter unit, or converter reset.
- Display-off mode end condition
 - Operation of the operation panel
 - Occurrence of a warning, alarm, or fault
 - Installation/removal of the operation panel, power-ON/OFF of the converter unit, or converter reset


5.2.5 Disabling the setting dial and keys on the operation panel

The keys on the operation panel can be disabled.

Pr.	Name	Initial value	Setting range	Description
161 E200	Key lock operation selection	0	0	The key are operable.
			10	The key are inoperable.

- The setting dial and keys on the operation panel can be disabled to prevent unexpected parameter changes.
- Set **Pr.161** to "10" and then press  for 2 seconds to disable setting dial or key operations.
- When setting dial and key operations are disabled, "HOLD" appears on the operation panel. If setting dial or key operation is attempted while dial and key operations are disabled, "HOLD" appears. (When a setting dial or key operation is not performed for 2 seconds, the monitor display appears.)
- To enable the setting dial and key operation again, press  for 2 seconds.

NOTE

- Even if setting dial and key operations are disabled, the monitor indicator and  are enabled.

5.2.6 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	2	1	Parameter writing is disabled.
			2	Parameter writing is enabled

- **Pr.77** can be set any time. (Setting through communication is unavailable.)

◆ Disabling parameter write (Pr.77 = "1")

- Parameter write, Parameter clear, and All parameter clear are disabled. (Parameter read is enabled.)
- The following parameters can be written even if **Pr.77** = "1".

Pr.	Name
75	Reset selection/disconnected PU detection/reset limit
77	Parameter write selection
296	Password lock level
297	Password lock/unlock
997	Fault initiation

◆ Writing parameters (Pr.77 = "2")

- These parameters can always be written.

5.2.7 Password

Registering a 4-digit password can restrict access to parameters (reading/writing).

Pr.	Name	Initial value	Setting range	Description
296 E410	Password lock level	9999	0 to 3, 5, 6, 100 to 103, 105, 106	Password protection enabled. Setting the access (reading/writing) restriction level to parameters locked with a password enables writing to Pr.297.
			9999	No password protection
297 E411	Password lock/unlock	9999	1000 to 9998	Input a 4-digit password to lock parameters, or input the valid password to unlock the locked parameters.
			(0 to 5) ^{*1}	Number of failed password attempts (read only, displayed after any of "100 to 103, 105, or 106" is set in Pr.296 and a password to lock parameters is input).
			9999 ^{*1}	No password protection

*1 Although "0 or 9999" can be input in Pr.297, the value is invalid. (The display cannot be changed.)

◆ Parameter reading/writing restriction level (Pr.296)

- The level of access (reading/writing) using the operation panel or via RS-485 communication can be restricted with Pr.296.

Pr.296 setting	Operation panel		RS-485 communication	
	Read	Write ^{*1}	Read	Write ^{*1}
9999	○	○	○	○
0, 100	×	×	×	×
1, 101	○	×	○	×
2, 102	○	×	○	○
3, 103	○	○	○	×
5, 105	×	×	○	○
6, 106	○	○	×	×

○: Enabled, ×: Disabled

*1 If the parameter writing is restricted by the Pr.77 Parameter write selection setting, those parameters are unavailable for writing even when "○" is indicated.

◆ Locking parameters with a password (Pr.296, Pr.297)

- The procedure of locking parameters with a password is as follows.

- Set the parameter reading/writing restriction level to enable the password protection. (Set a value other than "9999" in Pr.296.)

Pr.296 setting	Allowable number of failed password attempts	Pr.297 readout
0 to 3, 5, 6	Unlimited	Always 0
100 to 103, 105, 106 ^{*1}	Limited to 5 times	Number of failed password attempts (0 to 5)

*1 If an invalid password is input 5 times while any of "100 to 103, 105, or 106" is set in Pr.296, the locked parameters cannot be unlocked afterward even with the valid password. All parameter clear can unlock the restriction. (In this case, the parameters are returned to their initial values.)

- Write a four-digit number (1000 to 9998) to Pr.297 as a password (writing is disabled when Pr.296 = "9999"). After a password is set, parameters are locked and access (reading/writing) to the parameters is limited at the level set in Pr.296 until the valid password is input to unlock the locked parameters.

NOTE

- After a password is set, the Pr.297 readout is always any of "0 to 5".
- "LOEd" appears when a password-protected parameter is attempted to be read/written.
- Even if a password is set, the parameters which are written by the converter unit, such as parameters related to the life check of converter parts, are overwritten as needed.

◆ Unlocking the locked parameters (Pr.296, Pr.297)

- There are two ways to unlock the locked parameters.

- Enter the password in **Pr.297**. When a valid password is input, the locked parameters can be unlocked. When an invalid password is input, an error indication appears and the parameters cannot be unlocked. If an invalid password is input 5 times while any of "100 to 103, 105, or 106" is set in **Pr.296**, the locked parameters cannot be unlocked afterward even with the valid password (the password is locked up).
- Perform All parameter clear.

NOTE

- If the password is forgotten, it can be unlocked with all parameter clear, but doing so will also clear the other parameters.
- All parameter clear cannot be performed during the operation.
- For the all parameter clear method, refer to the following.
(For the operation panel, refer to [page 149](#). For RS-485 communication using the Mitsubishi inverter protocol, refer to [page 127](#). For RS-485 communication using the MODBUS RTU communication protocol, refer to [page 137](#).)

◆ Parameter operations during password locking/unlocking

Operation	Password unlocked		Password locked	Password lock in operation
	Pr.296 = "9999", Pr.297 = "9999"	Pr.296 ≠ "9999", Pr.297 = "9999"	Pr.296 ≠ "9999", Pr.297 = "0 to 4" (read value)	Pr.296 = "100 to 103, 105, 106" Pr.297 = "5" (read value)
Pr.296	Read	○	○	○
	Write	○	×	×
Pr.297	Read	○	○	○
	Write	×	○	○ ^{*1}
Parameter clear	○	○	×	×
All parameter clear	○	○	○	○
Parameter copy	○	○	×	×

○: Enabled, ×: Disabled

*1 Inputting a password is possible but the locked-up password cannot be unlocked or reset even with the valid password.

NOTE

- When a password has been set and parameters are locked, Parameter copy cannot be performed using the operation panel.

◀◀ **Parameters referred to** ▶▶

Pr.77 Parameter write selection  [page 91](#)

5.2.8 Free parameter

Any number within the setting range of 0 to 9999 can be input.

For example, these numbers can be used:

- As a unit number when multiple units are used.
- As a pattern number for each operation application when multiple units are used.
- As the year and month of introduction or inspection.

Pr.	Name	Initial value	Setting range	Description
888 E420	Free parameter 1	9999	0 to 9999	Any value can be input. The settings are retained even if the converter unit power is turned OFF.
889 E421	Free parameter 2	9999	0 to 9999	

NOTE

- **Pr.888** and **Pr.889** do not influence the operation of the converter unit.

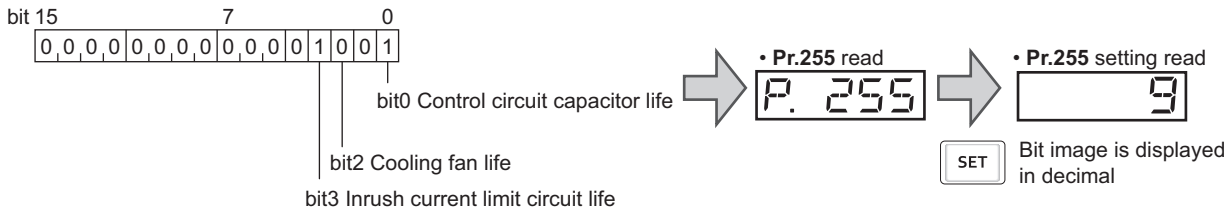
5.2.9 Converter unit parts life display

The degrees of deterioration of main circuit capacitor, cooling fan, and inrush current limit circuit can be diagnosed on the monitor. When a part approaches the end of its life, an alarm 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.)

Pr.	Name	Initial value	Setting range	Description
255 E700	Life alarm status display	0	(0 to 15)	Displays whether or not the parts of the control circuit capacitor, cooling fan, and inrush current limit circuit have reached the life alarm output level. Read-only.
256 E701	Inrush current limit circuit life display	100%	(0 to 100%)	Displays the deterioration degree of the inrush current limit circuit. Read-only.
257 E702	Control circuit capacitor life display	100%	(0 to 100%)	Displays the deterioration degree of the control circuit capacitor. Read-only.

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

- Whether or not the parts of the control circuit capacitor, cooling fan, or inrush current limit circuit have reached the life alarm output level can be checked with **Pr.255 Life alarm status display** and the Life alarm (Y90) signal.



Pr.255		bit 3	bit 2	bit 0
Decimal	Binary			
13	1101	○	○	○
12	1100	○	○	×
9	1001	○	×	○
8	1000	○	×	×
5	0101	×	○	○
4	0100	×	○	×
1	0001	×	×	○
0	0000	×	×	×

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

- The Life alarm (Y90) signal turns ON when any of the control circuit capacitor, cooling fan, and inrush current limit circuit reaches the life alarm output level.
- For the terminal used for the Y90 signal, set "90" (positive logic) or "190" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**.

NOTE

- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

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

- The life of the inrush current limit circuit (relay, contactor and inrush resistor) is displayed in **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 **Pr.255** is turned ON (set to 1) and the Y90 signal is also output as an alert.

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

- The deterioration degree of the control circuit capacitor is displayed in **Pr.257**.
- The control circuit capacitor life calculated from the operating conditions (energization time and temperature) is counted down from 100%. When the control circuit capacitor life goes down from 10%, bit 0 of **Pr.255** is turned ON (set to 1) and the Y90 signal is also output as an alert.

◆ Life display of the cooling fan

- When a cooling fan speed less than the specified speed is detected, the Fan alarm indication "**FN**" (FN) appears on the operation panel. As an alert output, bit 2 of **Pr.255** is turned ON (set to 1), and the Y90 signal, Alarm (LF) signal, and Fan fault output (FAN) signal are also output.
- For the terminal used for the LF signal, set "98" (positive logic) or "198" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**.
- For the terminal used for the FAN signal, set "25" (positive logic) or "125" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**.

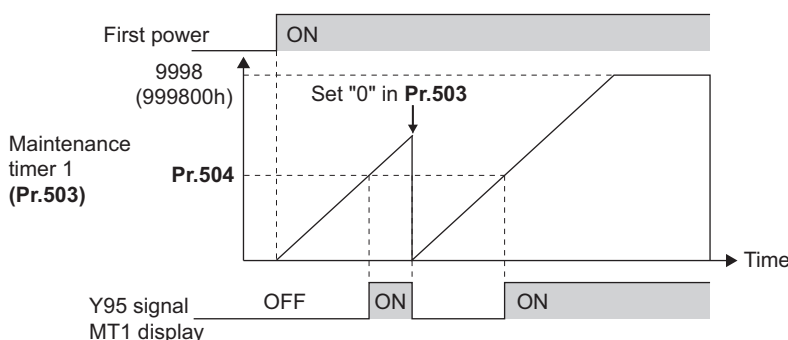
NOTE

- When the converter unit is mounted with two or more cooling fans, "FN" is displayed even only one of the fans is detected.
- Changing the terminal assignment using **Pr.190 to Pr.195 (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 Electric FA center.

5.2.10 Maintenance timer alarm

The Maintenance timer (Y95) signal is output when the converter unit's cumulative energization time reaches the time period set with the parameter. MT1, MT2 or MT3 is displayed on the operation panel. This can be used as a guideline for the maintenance time of peripheral devices.

Pr.	Name	Initial value	Setting range	Description
503 E710	Maintenance timer 1	0	0 (1 to 9998)	Displays the converter unit's cumulative energization time in increments of 100 hours (read-only). Writing the setting of "0" clears the cumulative energization time while Pr.503 = "1 to 9998". (Writing is disabled when Pr.503 = "0".)
504 E711	Maintenance timer 1 warning output set time	9999	0 to 9998	Set the time until the Maintenance timer (Y95) signal is output. "MT1" is displayed on the operation panel.
			9999	Function disabled.
686 E712	Maintenance timer 2	0	0 (1 to 9998)	The same function as Pr.503 .
687 E713	Maintenance timer 2 warning output set time	9999	0 to 9998	The same function as Pr.504 .
			9999	"MT2" is displayed on the operation panel.
688 E714	Maintenance timer 3	0	0 (1 to 9998)	The same function as Pr.503 .
689 E715	Maintenance timer 3 warning output set time	9999	0 to 9998	The same function as Pr.504 .
			9999	"MT3" is displayed on the operation panel.




Operation example of the maintenance timer 1 (**Pr.503, Pr.504**) (with both MT2 and MT3 OFF)

- The cumulative energization time of the converter unit is stored in the EEPROM every hour and displayed in **Pr.503 (Pr.686, Pr.688)** in 100 hours increments. The number indication on **Pr.503 (Pr.686, Pr.688)** stops at 9998 (999800 hours).
- When the value in **Pr.503 (Pr.686, Pr.688)** reaches the time (100 h increments) set in **Pr.504 (Pr.687, Pr.689)**, the Maintenance timer (Y95) signal is output, and also "**MT 1**" (MT1), "**MT 2**" (MT2), or "**MT 3**" (MT3) is displayed on the operation panel.
- For the terminal used for the Y95 signal output, assign the function by setting "95" (positive logic) or "195" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**.

 **NOTE**

- The Y95 signal turns ON when any of MT1, MT2 or MT3 is activated. It does not turn OFF unless all of MT1, MT2 and MT3 are cleared.
- If all of MT1, MT2 and MT3 are activated, they are displayed in the priority of "MT1 > MT2 > MT3".
- The cumulative energization time is counted every hour. Energization time of less than 1 h is not counted.
- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

« **Parameters referred to** »

Pr.190 to Pr.195 (Output terminal function selection)  [page 109](#)

5.3 (H) Protective function parameter

Purpose	Parameter to set			Refer to page
To vary the operating level of the undervoltage protective function	Undervoltage level	P.H102	Pr.598	97
To initiate an inverter protective function	Fault initiation	P.H103	Pr.997	97
To disable the input phase loss protective function	Input phase loss protection selection	P.H201	Pr.872	97
To restart using the retry function when the protective function is activated	Retry operation	P.H300 to P.H303	Pr.65, Pr.67 to Pr.69	98
To operate without activating protective functions in case of emergency	Emergency drive	P.H301, P.H320, P.H322, P.H324	Pr.67, Pr.514, Pr.515, Pr.523	102

5.3.1 Varying the activation level of the undervoltage protective function

If the undervoltage protection (E.UVT) activates due to unstable voltage in the power supply, the undervoltage level (DC bus voltage value) can be changed.

Pr.	Name	Initial value	Setting range	Description
598 H102	Undervoltage level	9999	350 to 430 VDC	Set the DC voltage value at which E.UVT occurs.
			9999	E.UVT occurs at 430 VDC.

5.3.2 Initiating a protective function

A fault (protective function) is initiated by setting the parameter.

This function can be used to check how the system operates at activation of a protective function.

Pr.	Name	Initial value	Setting range	Description
997 H103	Fault initiation	9999	16 to 253	The setting range is the same with the one for fault data codes of the converter unit (which can be read through communication). Written data is not stored in EEPROM.
			9999	The read value is always "9999". The protective function is not activated with this setting.

- To initiate a fault (protective function), set the assigned number of the protective function to be initiated in **Pr.997**.
- The value set in **Pr.997** is not stored in EEPROM.
- When the protective function is activated, the inverter output is shut off and the converter unit displays a fault to output a Fault (ALM, ALM2) signal.
- The latest fault in the fault history is displayed while the fault initiation function is in operation. After a reset, the fault history goes back to the previous status. (The protective function generated by the fault is not saved in the fault history.)
- Perform converter reset to cancel the protective function.
- For the selectable parameter by **Pr.997** and the corresponding protective functions, refer to [page 160](#).

NOTE

- If a protective function is already operating, no fault can be activated by **Pr.997**.
- The retry function is disabled when a protective function has been initiated by the fault initiation function.
- If a fault occurs after a protective function has been activated, the protective function indication does not change. The fault is not saved in the fault history either.

5.3.3 Input phase loss protection selection

The input phase loss protective function on the converter unit input side (R/L1, S/L2, T/L3) can be enabled.

Pr.	Name	Initial value	Setting range	Description
872 H201	Input phase loss protection selection	0	0	Input phase loss protection disabled
			1	Input phase loss protection enabled

- When **Pr.872** is set to "1", Input phase loss (E.ILF) protection is activated if one of three phases is continuously lost for one second.

NOTE

- In the case of R/L1, S/L2 phase loss, the input phase loss protection does not operate, and the inverter output is shut off.
- If an input phase loss continues for a long time, the life of the capacitor of the converter unit become shorter.

5.3.4 Retry function

This function allows the converter unit to reset itself and restart at activation of the protective function (fault indication). The retry generating protective functions can also be selected.

When the automatic restart after instantaneous power failure function is selected (**Pr.57 Restart selection** ≠ 9999), the restart operation is also performed after a retry operation as well as after an instantaneous power failure. (For restart operation, refer to [page 118](#).)

Pr.	Name	Initial value	Setting range	Description
65 H300	Retry selection	0	0 to 4	Faults which trigger the retry operation can be selected.
67 H301	Number of retries at fault occurrence	0	0	The retry function disabled.
			1 to 10	Set the number of retries at a fault occurrence. A fault output is not provided during the retry operation.
			101 to 110	Set the number of retries at a fault occurrence. (The setting value minus 100 is the number of retries.) A fault output is provided during the retry operation.
68 H302	Retry waiting time	1 s	0.1 to 600 s	Set the time delay from when a converter fault occurs until the retry operation starts.
69 H303	Retry count display erase	0	0	Setting "0" clears the retry success counter ("retry success" means that the converter successfully restarts).

◆ Setting the retry function (Pr.67, Pr.68)

- When the converter unit protective function is operating (fault indication), the retry function automatically cancels (resets) the protective function after the time set in **Pr.68**.
- The retry function is enabled when the **Pr.67** setting is other than "0". Set the number of retries at activation of the protective function in **Pr.67**.

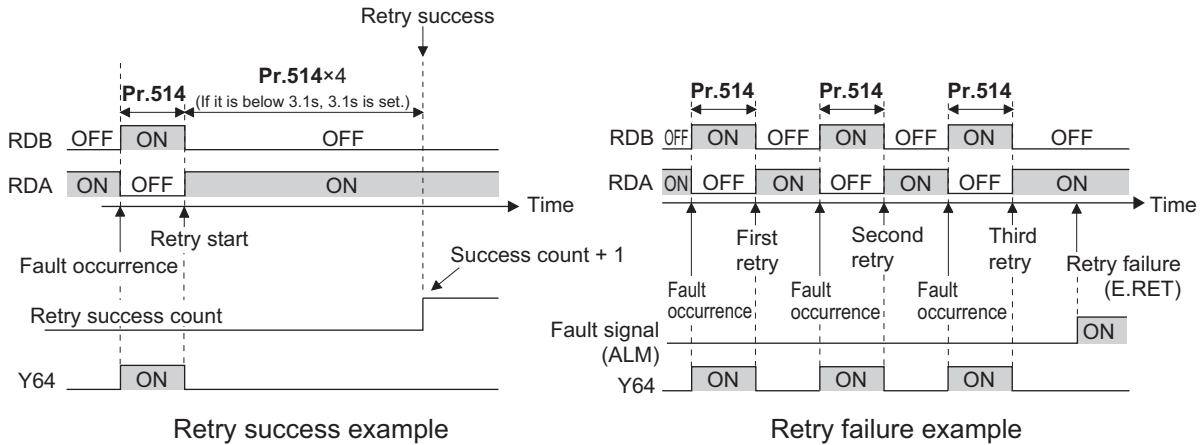
Pr.67 setting	Fault output during retry operation	Retry count
0	—	No retry function
1 to 10	Not available	1 to 10 times
101 to 110	Available	1 to 10 times

- When retries fail consecutively more than the number of times set in **Pr.67**, a retry count excess (E.RET) occurs. (Refer to the Retry failure example.)
- Use **Pr.68** to set the waiting time from a protective function activation to a retry in the range of 0.1 to 600 s.
- During retry operation, the During retry (Y64) signal is ON. For the Y64 signal, set "64" (positive logic) or "164" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function.

◆ Retry count check (Pr.69)

- Reading the **Pr.69** value provides the cumulative number of successful restart times made by retries. The cumulative count in **Pr.69** increases by 1 when a retry is successful. Retry is regarded as successful when normal operation continues without a fault for the **Pr.68** setting multiplied by four or longer (3.1 seconds at the shortest). (When retry is successful, the cumulative number of retry failures is cleared.)

- Writing "0" in Pr.69 clears the cumulative count.



◆ Selecting retry generating faults (Pr.65)

- Using Pr.65, the fault that causes a retry is selectable. No retry is made for the fault not indicated. (For the fault details, refer to page 162.) • indicates the faults selected for retry.

Retry-making fault	Pr.65 setting				
	0	1	2	3	4
E.OVT	•		•	•	•
E.THC	•				
E.IPF	•				•
E.UVT	•				•

Retry-making fault	Pr.65 setting				
	0	1	2	3	4
E.OHT	•				
E. PE	•				•
E.SER	•				•
E.ILF	•				•

NOTE

- Use the retry function only when the operation can be resumed after resetting a protective function activation. Making a retry against the protective function, which is activated by an unknown condition, will lead the converter unit to be faulty. Identify and remove the cause of the protective function activation before restarting the operation.
- Only the first fault is recorded in the fault history during retries.
- The reset by the retry function does not clear the accumulated data of the electronic thermal O/L relay. (This is different from power supply reset or reset by RES signal.)
- When the parameter storage device fault (E.PE) is occurring and reading of the retry-function-related parameters is not possible, retry cannot be operated.
- Changing the terminal assignment using Pr.190 to Pr.195 (Output terminal function selection) may affect the other functions. Set parameters after confirming the function of each terminal.

CAUTION

- When the retry function is set enabled, stay away from the motor and machine in the case of an output shutoff. The motor and machine will start suddenly (after the reset time has elapsed) after the shutoff. When the retry function has been selected, apply the CAUTION sticker(s), which are supplied with the inverter, to easily visible places.

Parameters referred to

Pr.57 Restart selection [page 118](#)

5.3.5 Cooling fan ON/OFF control

Cooling fan operation can be stopped by signal input.

◆ Cooling fan operation selection (Pr.244)

- Cooling fan operation is selected by setting **Pr.244 Cooling fan operation selection**. The same operation is applied regardless of the number of cooling fans.

Pr.	Name	Initial value	Setting range	Description
244 H100	Cooling fan operation selection	0	0	Cooling fan ON/OFF control is disabled. (The cooling fan is always ON at power ON) A cooling fan operates at power ON.
			2	Cooling fan ON/OFF control is enabled. While the Cooling fan operation input (X21) signal is OFF, the cooling fan is always ON. While the X21 signal is ON, the converter unit status is monitored and the fan switches ON/OFF according to the temperature.

- Cooling fan operation is selected by setting **Pr.244 Cooling fan operation selection**. When multiple cooling fans are used, the selected operation is applied to all the fans.
- When **Pr.244 = "0"**
Turning ON the converter unit power starts cooling fan operation except during resetting.

Mode	Fan operation
Resetting	Cooling fan OFF
Except during resetting	Cooling fan ON

- When **Pr.244 = "2"**
When the Cooling fan operation input (X21) signal is ON, the converter unit internal temperature is monitored and the fan switches ON/OFF according to the temperature. To assign the X21 signal, set "21" in any of **Pr.178, Pr.187, or Pr.189 (Input terminal function selection)**.

Resetting status while power is ON	Converter unit internal temperature	X21*1	Cooling fan operation
Except during resetting	Less than the specified value	ON	OFF
		OFF	ON
	Specified value or more	—	ON
Resetting	—	—	OFF

*1 Fan operation when the X21 signal is turned ON/OFF is as follows.

X21	Description
ON	When the converter unit internal temperature is less than the specified value, cooling fan operation is stopped.
OFF	Cooling fan operation starts.

NOTE

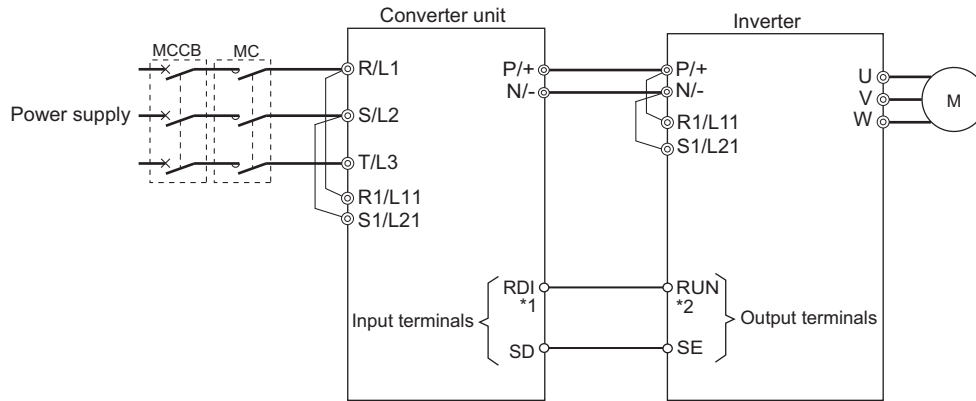
- When the terminal assignment is changed using **Pr.178, Pr.187, or Pr.189 (Input terminal function selection)**, wiring may be mistaken due to different terminal name and signal contents, or may affect other functions. Set parameters after confirming the function of each terminal.
- Cooling fan operation is OFF during resetting while power is ON regardless of the Pr.244 setting.

- Application examples

Use the Cooling fan operation input (X21) signal in combination with a certain inverter output signal to control fan operation in conjunction with the inverter operation.

Example 1: When the Inverter running (RUN) signal of the inverter is used, the converter unit cooling fan can be operated only during inverter operation.

Example 2: When the Cooling fan operation command (Y206) signal of the inverter is used, the converter unit fan can be operated in conjunction with the inverter cooling fan. The following connection diagram shows the example using the RUN signal of the inverter.



*1 To use the Cooling fan operation input (X21) signal, assign the function to an input terminal of the converter unit.

*2 To turn ON/OFF the Cooling fan operation input (X21) signal in conjunction with inverter operation, assign the Cooling fan operation command (Y206) signal or the Inverter running (RUN) signal in negative logic to an output terminal of the inverter.

5.3.6 Emergency drive (Fire mode)

The converter unit can continue driving the motor in case of emergency such as a fire, since protective functions are not activated even if the converter unit detects a fault. Using this function may damage the motor, the converter unit, or the inverter because driving the motor is given the highest priority. Use this function for emergency operation only.

To enable the emergency drive function, the function must be set in both the converter unit and the inverter.

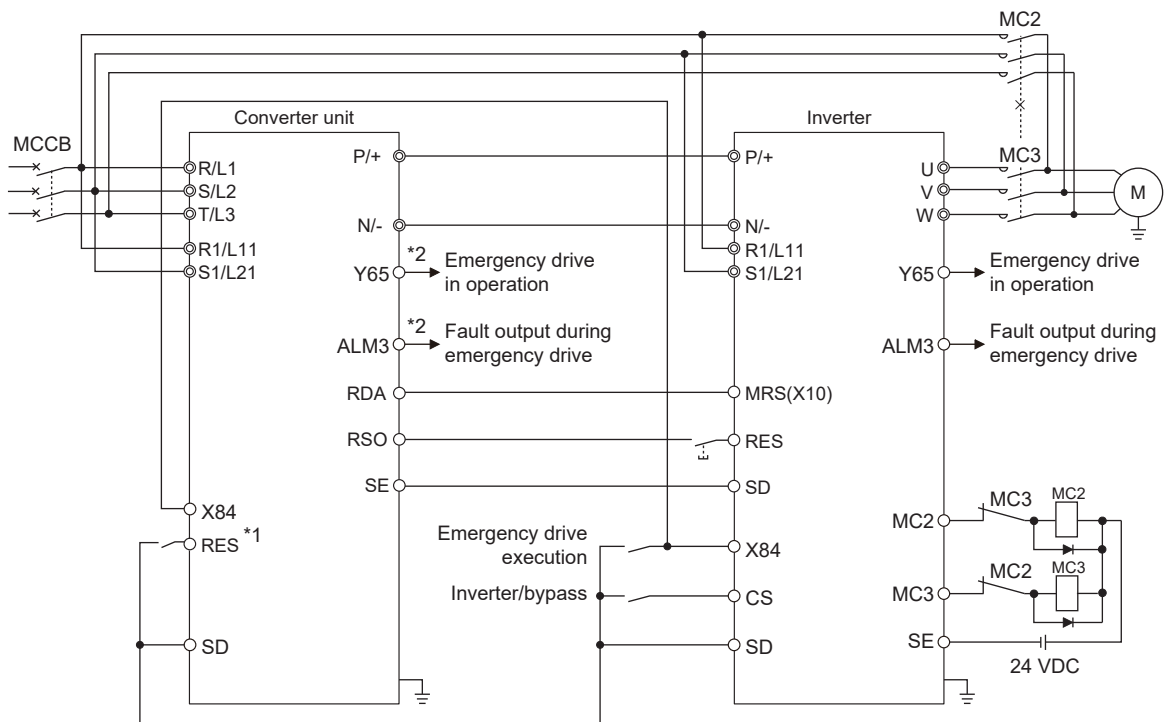
By setting the emergency drive function in the inverter, the operation can be switched to the commercial power supply operation at the occurrence of a fault which may cause damage of the inverter. The inverter does not detect faults in the converter unit.

When faults occur frequently in the converter unit, modify the wiring to enable switchover to the commercial power supply operation using a programmable controller.

Pr.	Name	Initial value	Setting range	Description
67 H301	Number of retries at fault occurrence	0	0 to 10, 101 to 110	Select whether to output the Fault (ALM) signal during the retry operation while the emergency drive operation is performed. 0 to 10: The ALM signal is not output during retry. 101 to 110: The ALM signal is output during retry.
68 H302	Retry waiting time	1 s	0.1 to 600 s	Set the time delay from when a converter fault occurs until the retry operation starts.
69 H303	Retry count display erase	0	0	Setting "0" clears the retry success counter ("retry success" means that the converter successfully restarts).
523 H320	Emergency drive mode selection	9999	100, 200 9999	Select the operation mode of the emergency drive. Emergency drive disabled.
515 H322	Emergency drive dedicated retry count	1	1 to 200 9999	Set the retry count during emergency drive operation. Without retry count excess (no restriction on the number of retries)
514 H324	Emergency drive dedicated retry waiting time	9999	0.1 to 600 s 9999	Set the retry waiting time during emergency drive operation. Waiting time: According to Pr.68 setting
57 A702	Restart selection	9999	0 9999	Restart selected Restart not selected

◆ Connection diagram

A connection diagram of the emergency drive is as follows.



*1 The applied terminals differ by the settings of Pr.178, Pr.187, and Pr.189 (Input terminal function selection).

*2 The applied terminals differ by the settings of Pr.190 to Pr.195 (Output terminal function selection).

NOTE

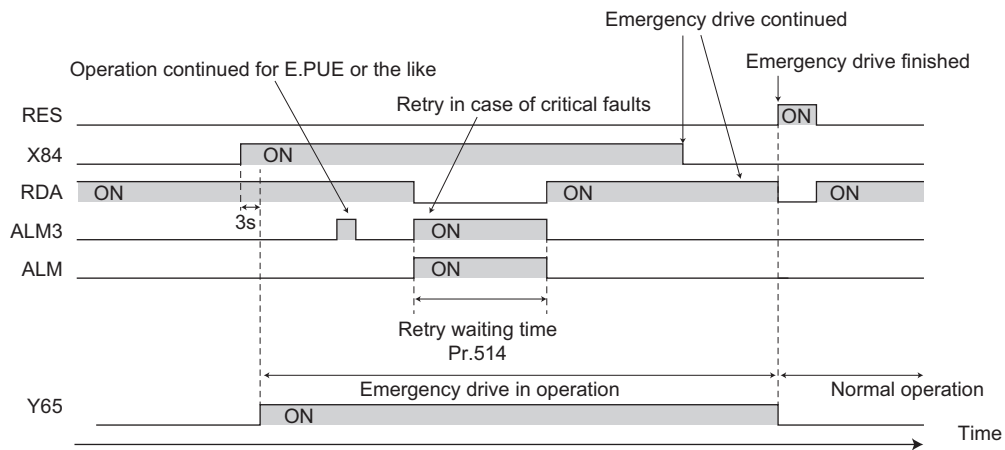
- Settings in the inverter is also required to enable the emergency drive function.

◆ Emergency drive execution sequence

Point

- When the X84 signal is ON for three seconds, the emergency drive is activated.
- The Y65 signal turns ON during emergency drive operation.
- "ED" appears on the operation panel during emergency drive operation.
- The ALM3 signal turns ON when a fault occurs during emergency drive operation.
- For protective functions (faults) valid during emergency drive operation, refer to [page 104](#).

- Operation of the emergency drive function (when the retry in case of faults is selected)



◆ Emergency drive operation selection (Pr.523)

- Use **Pr.523 Emergency drive mode selection** to select the emergency drive operation.

Pr.523 setting	Description
100	When a fault occurs, the RDA signal is turned OFF and the RDB signal is turned ON to disable inverter operation.
200	Retry operation when a fault occurs. When a fault for which retry is not permitted occurs or when the retry count is exceeded, the RDA signal is turned OFF and the RDB signal is turned ON to disable inverter operation.
9999	Emergency drive disabled.

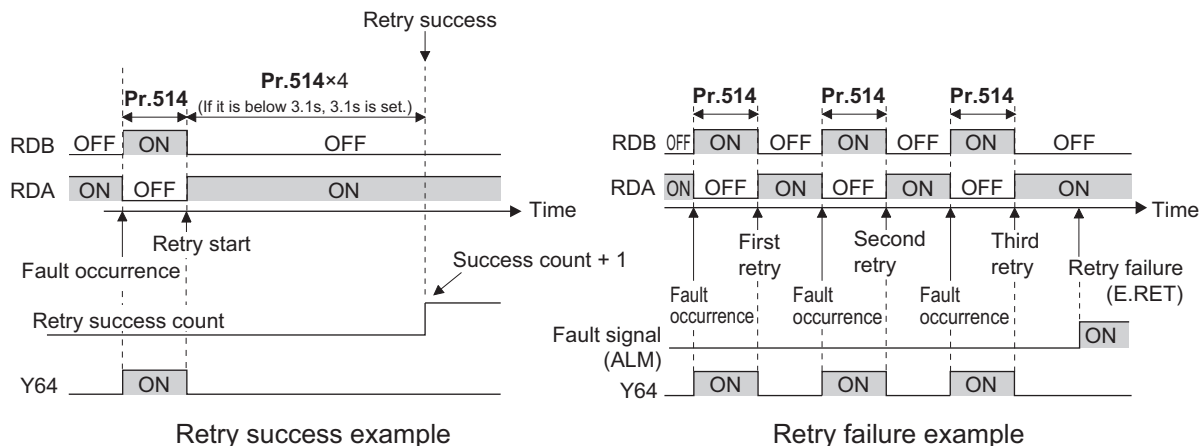
◆ Retry operation during emergency drive operation (Pr.515, Pr.514)

- Set the retry operation during emergency drive operation. Use **Pr.515 Emergency drive dedicated retry count** to set the retry count, and use **Pr.514 Emergency drive dedicated retry waiting time** to set the retry waiting time.
- The ALM signal output conditions depend on the **Pr.67 Number of retries at fault occurrence** setting.
- For the protective functions (faults) for which a retry is performed during emergency drive operation, refer to [page 104](#).

◆ Retry count check (Pr.69)

- Reading the **Pr.69** value provides the cumulative number of successful restart times made by retries. The cumulative count in **Pr.69** increases by 1 when a retry is successful. Retry is regarded as successful when normal operation continues without a fault for the **Pr.514** setting multiplied by four or longer (3.1 seconds at the shortest). (When retry is successful, the cumulative number of retry failures is cleared.)

- Writing "0" in Pr.69 clears the cumulative count.



◆ Operation of protective functions during emergency drive

- Protective functions during emergency drive operation are as follows.

Protective function	Operation during emergency drive
E.OVT	Retry
E.TH3	Retry
E.FIN	Retry
E.IPF	The function is disabled.
E.UVT	The function is disabled.
E.ILF	The function is disabled.
E.OHT	Retry
E.PE	Output shutoff
E.PUE	The function is disabled.

Protective function	Operation during emergency drive
E.RET	Output shutoff
E.PE2	Output shutoff
E.CPU	Retry
E.CTE	The function is disabled.
E.P24	The function is disabled.
E.IOH	Output shutoff
E.SER	The function is disabled.
E.PBT	Retry
E.1	Retry

Protective function	Operation during emergency drive
E.5	Retry
E.6	Retry
E.7	Retry
E.13	Output shutoff

- The fault output during emergency drive operation is as follows.

Signal	Pr.190 to Pr.195 setting		Description
	Positive logic	Negative logic	
Y65	65	165	Turns ON during emergency drive operation.
ALM	99	199	Turns ON at the occurrence of a fault that causes the above-mentioned "retry" or "output shutoff" during emergency drive operation. Use Pr.67 Number of retries at fault occurrence to select whether to output the Fault (ALM) signal during the retry operation. In the initial setting, "0" is set (the ALM signal is not output during retry).
ALM3	66	166	Output when a fault occurs during emergency drive operation. During emergency drive operation, if a fault that does not activate any protective function occurs, the signal turns ON for 3 seconds and then turns OFF.

◆ Input signal operation

- The following table shows status of input signals during emergency drive operation.

Input signal status	Input signal
Valid	OH, RES
Held	X84

◆ Emergency drive status monitor

- Set "68" in Pr.774 to Pr.776 or Pr.992 to monitor the status of the emergency drive on the operation panel.

- Description of the status monitor

Operation panel indication	Description	
	Emergency drive setting	Emergency drive operating status
0	Emergency drive function setting is not available.	—
1	Emergency drive	During normal operation
2		Operating properly
3		A certain alarm is occurring. ^{*1}
4		A fault is occurring. The operation is being continued by the retry.
5		A fault is occurring. The continuous operation is not allowed due to output shutoff.
	Emergency drive in operation	

*1 "A certain alarm" means a protective function disabled during emergency drive shown in the tables on [page 104](#).

NOTE

- When the "retry" (**Pr.523** = "200") is selected, it is recommended to use the automatic restart after instantaneous power failure function (refer to [page 118](#)) at the same time.
- Parameter setting is not available during emergency drive operation.
- To return to the normal operation during emergency drive operation, reset the converter unit or the inverter, or turn OFF and ON the power supply.
(The operation will not be returned to normal only by turning OFF the X84 signal.)

CAUTION

- When the emergency drive function is enabled, the operation is continued or the retry operation (automatic reset and restart) is repeated even if a fault occurs, which may damage or burn the inverter, the converter unit, or the motor. Before restarting the normal operation after the operation using this function, make sure that the inverter, the converter unit, and the motor have no fault. Any damage of the inverter, the converter unit, or the motor caused by using the emergency drive function is not covered by the warranty even within the guarantee period.

5.4 (M) Item and output signal for monitoring

Purpose	Parameter to set			Refer to page
To change the item monitored on the operation panel	Operation panel monitor item selection, clearing the cumulative value during monitoring	P.M020 to P.M023, P.M044, P.M100 to P.M104	Pr.170, Pr.268, Pr.290, Pr.563, Pr.774 to Pr.776, Pr.891, Pr.992	106
To assign functions to the output terminals	Output terminal function assignment	P.M400 to P.M405	Pr.190 to Pr.195	109
To detect the control circuit temperature	Control circuit temperature monitoring	P.M060	Pr.663	113

5.4.1 Monitor item selection on operation panel or via communication

The item to be monitored on the screen of the operation panel can be selected. Install the operation panel of the inverter on the converter unit.

Pr.	Name	Initial value	Setting range	Description
774 M101	Operation panel monitor selection 1	9999 (converter output voltage)	2, 8, 13, 20, 25, 43, 44, 55, 62, 68, 98, 9999	The converter output voltage, input current and electronic thermal relay function load factor monitor that are displayed in monitor mode on the operation panel can be switched to a specified monitor.
775 M102	Operation panel monitor selection 2	9999 (input current)		
776 M103	Operation panel monitor selection 3	9999 (electronic thermal O/L relay load factor)		
992 M104	Operation panel setting dial push monitor selection	8 (converter output voltage)	2, 8, 13, 20, 25, 43, 44, 55, 62, 68, 98	Select the monitor item displayed on the operation panel at the time when the setting dial is pressed.
170 M020	Watt-hour meter clear	9999	0	Set "0" to clear the watt-hour meter.
			10	Set "10" to monitor the cumulative power in the range of 0 to 9999 kWh via communication.
			9999	Set "9999" to monitor the cumulative power in the range of 0 to 65535 kWh via communication.
563 M021	Energization time carrying-over times	0	(0 to 65535) (Read-only)	The number of times that the cumulative energization time reaches 65535 hours is displayed. Read-only.
268 M022	Monitor decimal digits selection	9999	0	Value is displayed in 1 increments (an integer).
			1	Value is displayed in 0.1 increments.
			9999	Function disabled.
891 M023	Cumulative power monitor digit shifted times	9999	0 to 4	Set the number of places the decimal point on the watt-hour meter is shifted to left. The meter stops at the maximum number.
			9999	The function of moving the decimal point is not available. The readout is reset to 0 when it exceeds the upper limit.
290 M044	Monitor negative output selection	0	0, 2, 4, 6	Set the availability of output with a minus sign for the operation panel display or monitoring via communication.

◆ Monitor item list (Pr.774 to Pr.776, Pr.992)

- Use **Pr.774 to Pr.776**, or **Pr.992** to select the item to monitor on the operation panel (FR-DU08).
- Refer to the following table and select the item to be monitored. The value in the Pr. setting column is set in each of the parameters for monitoring (**Pr.774 to Pr.776**, and **Pr.992**) to determine the monitored item. The value in the RS-485 column is used for the RS-485 communication special monitor selection. The value in the MODBUS RTU column is used for the MODBUS RTU real time monitor. (The items marked with "—" cannot be selected. The circle in the [-] column indicates that the indication of negative signed numbers is available.)

Monitor item	Increment and unit	Pr. setting	RS-485	MODBUS RTU	Negative indication (-)	Description
Input current ^{*2*3*6}	0.1 A	2	H02	40202		The converter unit input current effective value is displayed. ^{*7}
Converter output voltage ^{*2}	0.1 V	8	H08	40208		The DC bus voltage value is displayed.
Input power	0.1 kW	13	H0D	40213		The power at the converter unit input side is displayed.
Cumulative energization time ^{*1}	1 h	20	H14	40220		The cumulative energization time since the converter unit shipment is displayed. The number of times an integrated value has reached the maximum value of 65535 hours can be checked in Pr.563 .
Cumulative energy ^{*2}	0.1 kWh	25	H19	40225		The cumulative energy based on the monitored input power is displayed. Use Pr.170 to reset it. (Refer to page 108 .)
Station number (RS-485 terminals)	1	43	H2B	40243		The station number (0 to 31) of the converter unit enabling communication via the RS-485 terminals is displayed.
Station number (PU)	1	44	H2C	40244		The station number (0 to 31) of the converter unit enabling communication via the PU connector is displayed.
Input terminal status	—	55	H0F ^{*4}	40215 ^{*4}		The ON/OFF state of the input terminals on the converter unit is displayed. (Refer to page 108 for details of indication on the operation panel.)
Output terminal status	—		H10 ^{*5}	40216 ^{*5}		The ON/OFF state of the output terminals on the converter unit is displayed. (Refer to page 108 for details of indication on the operation panel.)
Electronic thermal O/L relay load factor	0.1%	62	H3E	40262		The accumulated heat value of the converter thermal O/L relay is displayed. The Converter overload trip (electronic thermal relay function) (E.THC) occurs at 100%.
Emergency drive status	1	68	H44	40268		Emergency drive status is displayed. (Refer to page 104 .)
32-bit cumulative energy (lower 16 bits)	1 kWh	—	H4D	40277		The upper or lower 16 bits of the 32-bit cumulative energy is displayed on each indication. It is monitored via RS-485 communication.
32-bit cumulative energy (upper 16 bits)	1 kWh	—	H4E	40278		
32-bit cumulative energy (lower 16 bits)	0.1 kWh	—	H4F	40279		
32-bit cumulative energy (upper 16 bits)	0.1 kWh	—	H50	40280		
Control circuit temperature	1°C	98	H62	40298	○	The temperature of the control circuit board is displayed. When negative number not displayed: 0°C to 100°C When negative number displayed: -20°C to 100°C

*1 The cumulative energization time is accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.

*2 Since each readout of the output voltage and output current displayed on the operation panel is a four-digit number, a value of more than 9999 is displayed as "----".

*3 0 A appears during regenerative driving.

*4 The details of bits for the input terminal status are as follows. (1: ON state, 0: OFF state of a terminal on the inverter. "—" denotes an indefinite (null) value.)

b15											b0					
-	-	-	-	-	-	RES	-	OH	-	-	-	-	-	-	-	RDI

*5 The details of bits for the output terminal status are as follows. (1: ON state, 0: OFF state of a terminal on the inverter. "—" denotes an indefinite (null) value.)

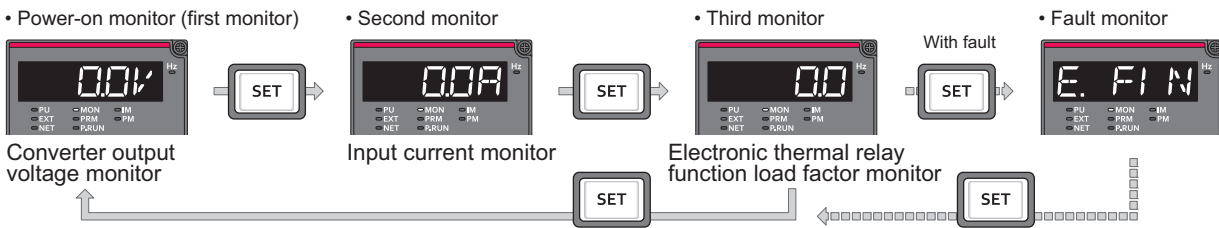
b15											b0					
-	-	-	-	-	-	-	-	-	-	-	ABC1	FAN	RSO	IPF	RDA	RDB

*6 The monitor value is retained when a converter unit fault occurs. Resetting clears the retained values.

*7 While the input current of the converter unit with 12-phase transformer is monitored, a total amount of input current in the wye-delta connections is shown as an effective value of input current. (It is not an effective value of input current in each wye/delta connection.)

◆ Monitor display for operation panel (Pr.774 to Pr.776)

- The monitor displayed at power ON is the first monitor (the converter output voltage monitor in the initial setting). Display the monitor you want to display on the first monitor and hold down **SET** for 1 second. To monitor the converter output voltage, display the screen of converter output voltage and hold down **SET** for 1 second.



- The monitor to be displayed is set using **Pr.774** for the first screen, **Pr.775** for the second screen, and **Pr.776** for the third screen.

◆ Operation panel setting dial push display (Pr.992)

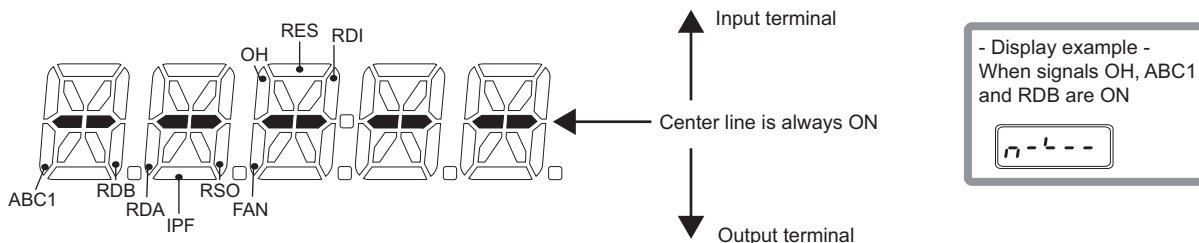
- Use **Pr.992** to select the monitor that appears when the setting dial on the operation panel is pushed. The converter output voltage value is displayed in the initial status (**Pr.992** = "8").

◆ Monitoring I/O terminals on the operation panel (Pr.774 to Pr.776)

- When **Pr.774 to Pr.776** = "55", the I/O terminal state can be monitored on the operation panel.
- The corresponding LED segment is ON when a terminal is ON, and the LED segment is OFF when a terminal is OFF. The center LED segments are always ON.

Pr.774 to Pr.776 setting	Monitor description
55	Displays the I/O terminal ON/OFF state of the converter unit.

- On the I/O terminal monitor (**Pr.774 to Pr.776** = "55"), the upper LEDs denote the input terminal status, and the lower LEDs denote the output terminal status.



◆ Monitoring and resetting cumulative power (Pr.170, Pr.891)

- When the cumulative power is monitored (**Pr.774 to Pr.776** = "25"), the input power monitor value is added up and is updated in 100 ms increments. (The values are saved in EEPROM every hour.)
- Increments and ranges of monitoring on the operation panel (FR-DU08) or via communication (RS-485 communication) are as follows.

On operation panel ^{*1}		Via communication		
Range	Increment	Range		Increment
		Pr.170 = "10"	Pr.170 = "9999"	
0 to 9999.9 kWh	0.1 kWh	0 to 9999 kWh	0 to 65535 kWh	1 kWh
10000 to 99999 kWh	1 kWh		(initial value)	

*1 Energy is measured in the range of 0 to 99999 kWh, and displayed in five digits. After the watt-hour meter (cumulative power counter) reaches "9999.9" (999.99 kWh), the meter displays values in 1 increments such as "10000" (1000.0 kWh).

- The decimal point position on the watt-hour meter can be shifted to left. The number of digits to be shifted is equal to the setting of **Pr.891 Cumulative power monitor digit shifted times**. For example, when **Pr.891** = "2", the cumulative power value 1278.5 kWh is displayed as 12.78 (in 10 kWh increments) on the operation panel, or displayed as 12 on a display used for monitoring via communication.
- When **Pr.891** = "0 to 4", the meter stops at the maximum number. When **Pr.891** = "9999" and the cumulative energy reaches more than the upper limit of readout, cumulative value is reset to 0 and the metering restarts.

- Writing "0" in **Pr.170** clears the cumulative power monitor.

NOTE

- When **Pr.170** is read just after "0" has been written in **Pr.170**, the setting "9999" or "10" is displayed.

◆ Monitoring cumulative energization time (Pr.563)

- Cumulative energization time monitoring (**Pr.774 to Pr.776** = "20") accumulates energization time from shipment of the converter unit every hour.
- When the cumulative energization time counter reaches 65535, it starts from 0 again. The number of times the cumulative energization time counter reaches 65535 can be checked with **Pr.563**.
- Setting "0" in **Pr.171** clears the actual operation time meter. (The cumulative energization time meter cannot be cleared.)

NOTE

- The cumulative energization time does not increase if the power is turned OFF after less than an hour.

◆ Hiding the decimal places for the monitors (Pr.268)

- The numerical figures after a decimal point displayed on the operation panel may fluctuate during analog input, etc. The decimal places can be hidden by selecting the decimal digits with **Pr.268**.

Pr.268 setting	Description
9999 (initial value)	Function disabled.
0	For the first or second decimal places (0.1 increments or 0.01 increments) of the monitor, numbers in the first decimal place and smaller are rounded to display an integral value (1 increments). The monitor value equal to or smaller than 0.99 is displayed as 0.
1	When monitoring with the second decimal place (0.01 increments), the 0.01 decimal place is dropped and the monitor displays the first decimal place (0.1 increments). When monitoring with the first decimal place, the display will not change.

NOTE

- The number of display digits on the cumulative energization time (**Pr.774 to Pr.776** = "20") and the cumulative power (**Pr.774 to Pr.776** = "25") does not change.

◆ Enabling display of negative numbers during monitoring (Pr.290)

- Negative values can be used for indication on the operation panel. To check which items can be monitored with indication of negative numbers, refer to the monitor item list (on [page 106](#)).

Pr.290 setting	Negative numbers indication on operation panel	Monitoring via communication
0 (initial value)	—	—
2	Enabled	—
4	—	Enabled
6	Enabled	Enabled

—: Negative numbers indication disabled (positive only)

5.4.2 Output terminal function selection

Use the following parameters to change the functions of the open collector output terminals and relay output terminals.

Pr.	Name	Initial value	Signal name	Setting range	
190 M400	RDB terminal function selection	For open collector output terminal	111	RDB (Inverter operation enable (NC contact))	2, 8, 11, 17, 25, 26, 64 to 66, 68, 90, 94, 95, 98, 99, 102, 108, 111, 125, 126, 164 to 166, 168, 190, 194, 195, 198, 199, 206, 207, 209, 210, 214, 306, 307, 309, 310, 9999
191 M401	RDA terminal function selection		11	RDA (Inverter operation enable (NO contact))	
192 M402	IPF terminal function selection		2	IPF (Instantaneous power failure/undervoltage)	
193 M403	RSO terminal function selection		209	RSO (Inverter reset)	
194 M404	FAN terminal function selection		25	FAN (Fan fault output)	
195 M405	ABC1 terminal function selection	Relay output terminals	99	ALM (Fault)	

◆ Output signal list

- A function listed below can be set to each output terminal.
- Refer to the following table and set the parameters. (0 to 99: Positive logic, 100 to 199: Negative logic)

Setting		Signal name	Function	Operation	Related parameter	Refer to page
Positive logic	Negative logic					
2	102	IPF	Instantaneous power failure/undervoltage	Output when the protective function for instantaneous power failure or undervoltage is activated.	Pr.57	118
8	108	THP	Electronic thermal O/L relay pre-alarm	Output when the cumulative electronic thermal O/L relay value reaches 85% of the trip level. (The Electronic thermal O/L relay protection (E.THC) is activated when the value reaches 100%.)	—	111
11	—	RDA	Inverter operation enable (NO contact)	Output when the converter unit operation is ready.	—	112
—	111	RDB	Inverter operation enable (NC contact)	Output when a converter unit fault occurs or the converter is reset (inverse to the logic of RDA).		
17	—	Y17	Main circuit power supply MC control	Output while the self power management function is enabled. Turns OFF when a fault activating the self power management operation occurs.	Pr.248, Pr.30	116
25	125	FAN	Fan fault output	Output when a fan fault occurs.	—	111
26	126	FIN	Heat sink overheat pre-alarm	Output when the heat sink temperature reaches about 85% of the heat sink overheat protection operation temperature.	—	164
64	164	Y64	During retry	Output during retry operation.	Pr.65 to Pr.69	98
65	165	Y65	Emergency drive in operation	Output during emergency drive operation.	Pr.67, Pr.514, Pr.515, Pr.523	102
66	166	ALM3	Fault output during emergency drive	Output when a fault occurs during emergency drive operation.		
68	168	EV	24 V external power supply operation	Output while the converter operated with a 24 V power supplied from an external source.	—	53
90	190	Y90	Life alarm	Output when any of the control circuit capacitor, the inrush current limit circuit, or the cooling fan approaches the end of its life.	Pr.255 to Pr.257	94
94	194	ALM2	Fault output 2	Output when the converter unit's protective function is activated to stop the power output (when a fault occurs). The signal output continues during the converter reset and stops after the inverter reset finishes. *1	—	112
95	195	Y95	Maintenance timer	Output when the value of Pr.503 reaches the Pr.504 setting or higher.	Pr.503, Pr.504	95
98	198	LF	Alarm	Output when an alarm (fan fault or communication error warning) occurs.	Pr.121	111, 131, 147

Setting		Signal name	Function	Operation	Related parameter	Refer to page
Positive logic	Negative logic					
99	199	ALM	Fault	Output when the converter unit's protective function is activated to stop the power output (when a fault occurs). The signal output stops when the converter reset starts.	—	112
206	306	Y206	Cooling fan operation command	Output when the cooling fan operation is commanded.	—	112
207	307	Y207	Control circuit temperature	Output when the temperature of the control circuit board reaches the detection level or higher.	Pr.663	113
209	309	RSO	Inverter reset	Output during a converter reset.	—	112
210	310	PWF	Power failure stop	Output during instantaneous power failure, undervoltage, or input phase loss.	Pr.261	118
214	—	Y214	Converter unit fault (E.OHT, E.CPU)	The signal turns ON when the converter unit is in the normal state. The signal turns OFF when the converter unit's protective function (E.OHT, E.CPU) is activated (when a fault occurs).	—	—
9999	—	—	Function disabled.	—	—	—

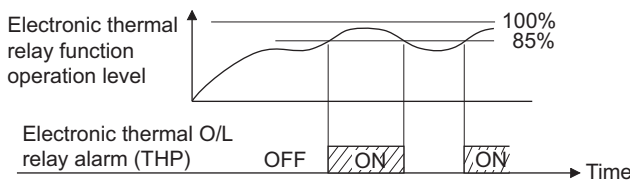
*1 When the power is reset, the Fault output 2 (ALM2) signal turns OFF at the same time as the power turns OFF.

NOTE

- One function can be assigned to more than one terminal.
- The function works during the terminal conducts when the parameter setting is any of "0 to 99, 200 to 299", and the function works during the terminal does not conduct when the setting is "100 to 199, 300 to 399".
- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.
- Do not assign the signal to terminals A1, B1, and C1 which frequently changes its state between ON and OFF. Otherwise, the life of the relay contact may be shortened.

◆ Electronic thermal O/L relay pre-alarm (TH) and warning signal (THP signal)

- If the accumulated electronic thermal value reaches 85% of the setting, electronic thermal O/L relay function pre-alarm (TH) is displayed and the Electronic thermal O/L relay pre-alarm (THP) signal is output. If the value reaches 100% of the setting, the electronic thermal O/L relay protection (E.THC) is activated to shut off the inverter output. The inverter output is not shut off with the TH display.
- To use the THP signal, set "8" (positive logic) or "108" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function to an output terminal.



NOTE

- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Fan fault output signal (FAN)

- A cooling fan operates at power ON of the converter unit. If the fan stops at this time, fan operation is regarded as faulty, Fan alarm (FN) is displayed on the operation panel, and the FAN fault output (FAN) and Alarm (LF) signals are output.
- To use the FAN signal, assign the function to an output terminal by setting "25" (positive logic) or "125" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**. To use the LF signal, assign the function to an output terminal by setting "98" (positive logic) or "198" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**.

◆ Cooling fan operation command signal (Y206 signal)

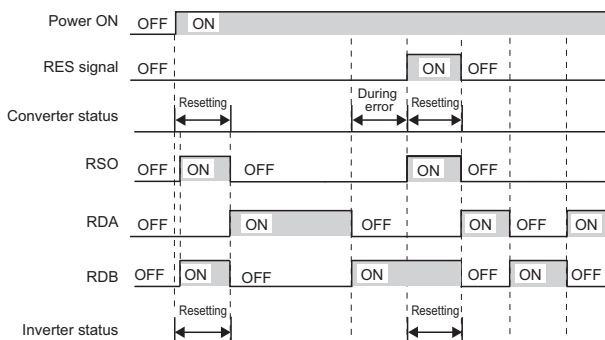
- The Cooling fan operation command (Y206) signal can be output when the converter unit cooling fan meets the conditions for running. The function can be used when the fan installed on the enclosure is synchronized with the converter unit cooling fan.
- The Y206 signal indicates the operating command condition of the converter unit cooling fan depending on the power supply ON/OFF. The signal does not indicate the actual operation of the cooling fan. (The signal is output even if the cooling fan is stopped due to a fault.)
- To use the Y206 signal, set "206" (positive logic) or "306" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function to an output terminal.

NOTE

- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

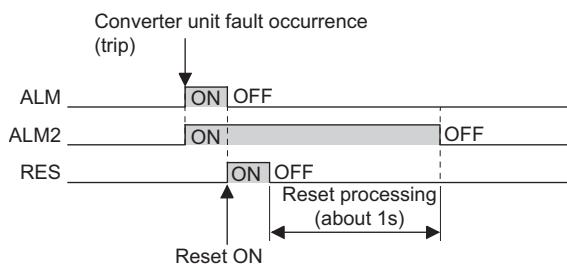
◆ Inverter operation enable signals (RDA and RDB) and inverter reset signal (RSO)

- The inverter operation enable (NO contact) (RDA) signal turns ON when the converter unit operation is ready, and turns OFF when a converter unit fault occurs or the converter is reset.
- A logic inverse to that of RDA is applied to the inverter operation enable (NC contact) (RDB) signal. (However, the RDB signal is OFF while the converter unit power supply is OFF.)
- The RDA and RDB signals are initially assigned to terminals RDA and RDB respectively. By setting "11" for the RDA signal or "111" for the RDB signal in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**, the signals can be assigned to other terminals.
- When the Converter reset (RES) signal is input to the converter unit, the Inverter reset (RSO) signal is output to the inverter.
- The RSO signal is assigned to terminal RSO in the initial status. The RSO signal can be assigned to other terminals by setting "209" (positive logic) or "309" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**.



◆ Fault signal (ALM/ALM2)

- A Fault (ALM/ALM2) signal is output when the converter unit protective function is activated.
- The ALM2 signal stays ON during the resetting the converter after the Fault occurs.
- To use the ALM2 signal, set "94" (positive logic) or "194" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function to an output terminal.
- The ALM signal is initially assigned to the relay terminals A1, B1, and C1.



NOTE

- For details on the converter unit faults, refer to [page 162](#).

5.4.3 Detection of control circuit temperature

The temperature of the control circuit board of the converter unit can be monitored, and a signal can be output according to the predetermined temperature setting.

Pr.	Name	Initial value	Setting range	Description
663 M060	Control circuit temperature signal output level	0°C	0°C to 100°C	Set the temperature where the Y207 signal turns ON.

◆ Control circuit temperature monitoring

- The operation panel can be used to monitor the temperature of the control circuit board within the range of 0°C to 100°C.
- The range becomes -20°C to 100°C by setting the display with a minus sign in **Pr.290 Monitor negative output selection**.

◆ Control circuit temperature detection (Pr.663, Y207 signal)

- The Y207 signal can be output when the control circuit temperature reaches the **Pr.663** setting or higher.
- To use the Y207 signal, set "207" (positive logic) or "307" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function to the output terminal.

NOTE

- The Y207 signal is turned OFF when the control circuit temperature becomes 5°C or more lower than the **Pr.663** setting.
- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

« Parameters referred to »

Pr.190 to Pr.195 (Output terminal function selection) [page 109](#)

Pr.290 Monitor negative output selection [page 106](#)

5.5 (T) Multi-function input terminal parameters

Purpose	Parameter to set			Refer to page
To assign functions to input terminals	Input terminal function selection	P.T700, P.T709, P.T711	Pr.178, Pr.187, Pr.189	114
To change operation when the OH signal is input	OH input selection	P.T723	Pr.876	114

5.5.1 Input terminal function selection

Use the following parameters to select or change the input terminal functions.

Pr.	Name	Initial value	Signal name	Setting range
178 T700	RDI terminal function selection	9999	Function disabled.	7, 21, 62, 84, 9999
187 T709	OH terminal function selection	7	OH (External thermal relay input)	
189 T711	RES terminal function selection	62	RES (Converter reset)	

◆ Input terminal function assignment

- Using **Pr.178, Pr.187, and Pr.189**, set the functions of the input terminals.
- Refer to the following table and set the parameters.

Setting	Signal name	Function	Related parameter	Refer to page
7	OH	External thermal relay input ^{*1}	Pr.876	114
21	X21	Cooling fan ON/OFF control	Pr.244	100
62	RES	Converter reset	—	89
84	X84	Emergency drive execution command	Pr.67, Pr.514, Pr.515, Pr.523	102
9999	—	Function disabled.	—	—

*1 The OH signal is activated when the relay contact is open.

NOTE

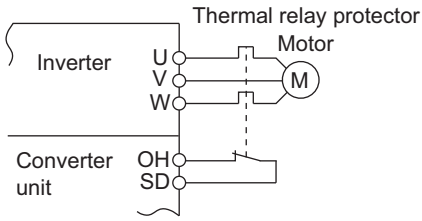
- The same function can be assigned to two or more terminals. In this case, the logic of terminal input is OR.
- When the terminal assignment is changed with **Pr.178, Pr.187, or Pr.189 (Input terminal function selection)**, wiring may be mistaken due to different terminal name and signal contents, or may affect other functions. Set parameters after confirming the function of each terminal.

5.5.2 Operation selection for the external thermal relay input (Pr.876)

The operation when the external thermal relay input (OH) signal is input can be changed by the **Pr.876** setting.

Pr.	Name	Initial value	Setting range	Description
876 T723	OH input selection	0	0	Function disabled.
			1	NC contact: Turning OFF of the OH signal stops the converter unit operation after a fault occurs.
			2	NO contact: Turning ON of the OH signal stops the converter unit operation after a fault occurs.

◆ External thermal relay (OH signal, E.OHT)



External thermal relay input connection diagram

- The External thermal relay input (OH) signal is used when using the external thermal relay or the thermal protector built into the motor to protect the motor from overheating.
- When the thermal relay is activated, the inverter output is shut off by the external thermal relay operation (E.OHT).
- The OH signal is assigned to terminal OH in the initial status. To assign the signal, set "7" in any parameter from **Pr.178**, **Pr.187**, or **Pr.189 (Input terminal function selection)**.

NOTE

- Changing the terminal assignment using **Pr.178**, **Pr.187**, or **Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Operation selection for the OH signal (Pr.876)

- The following table shows the OH signal input status and the converter unit operation determined by the **Pr.876** setting.

OH signal input status (external terminal)	Converter unit operation		
	Pr.876 = "0"	Pr.876 = "1" (NC contact)	Pr.876 = "2" (NO contact)
ON	Function disabled.	Operation continues.	Inverter output shutoff (E.OHT).
OFF	Function disabled.	Inverter output shutoff (E.OHT).	Operation continues.

5.6 (A) Application parameters

Purpose	Parameter to set			Refer to page
To reduce the standby power	Self power management	P.A006, P.E300	Pr.30, Pr.248	116
To restart after instantaneous power failure	Automatic restart after instantaneous power failure	P.A702	Pr.57	118
To decelerate the motor to a stop at power failure	Power failure time deceleration-to-stop function	P.A730	Pr.261	118

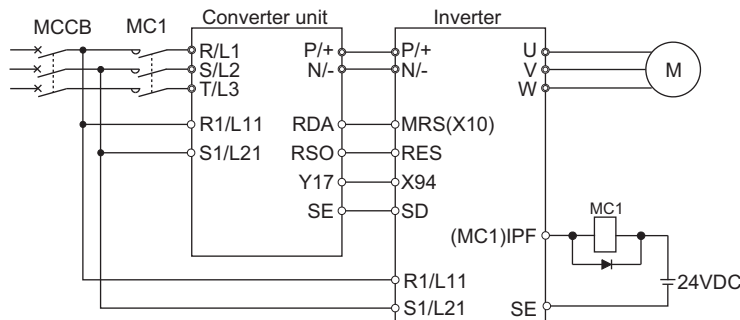
5.6.1 Self power management

By turning ON the magnetic contactor (MC) on the input side before the motor is started and turning OFF the MC after the motor is stopped, power is not supplied to the main circuit, reducing the standby power.

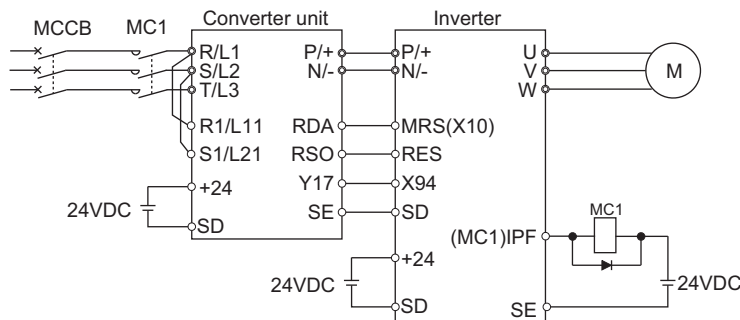
Pr.	Name	Initial value	Setting range	Description
248 A006	Self power management selection	0	0	Self power management function disabled
			1	Self power power management function enabled (main circuit OFF at protective function activation)
			2	Self power management function enabled (main circuit OFF at protective function activation due to a circuit failure)
30 E300	Reset selection during power supply to main circuit	0	0	When power is supplied only to the control circuit, and then switched to be supplied to both the control and main circuits, converter reset is performed.
			100	When power is supplied only to the control circuit, and then switched to be supplied to both the control and main circuits, converter reset is not performed.

◆ Connection diagram

- Sink logic, Pr.192 = "17" (input via terminals R1 and S1)



- Sink logic, Pr.192 = "17" (24V external power supply input)



◆ Operation of the self power management function

- This function controls the magnetic contactor (MC) on the input side using the output relay to reduce the standby power. Use separate power supplies for the main circuit and the control circuit by using terminals R1/L11 or S1/L21 (refer to [page 52](#)) and 24 V external power supply input (refer to [page 53](#)), and control the main circuit power supply MC by the Electronic bypass MC1 signal of the inverter.
- Set **Pr.248 Self power management selection** = "1 or 2" and **Pr.190 to Pr.195 (Output terminal function selection)** = "17" (positive logic) to assign the Control signal for main circuit power supply MC (Y17 signal) to an output terminal. (Set **Pr.248** in accordance with the **Pr.248** setting of the inverter.)
- The Y17 signal turns ON while the self power management function is enabled.
- When the protective function of the converter unit is activated, the Y17 signal is immediately turned OFF according to the **Pr.248** setting.

When **Pr.248** = "1", the Y17 signal is turned OFF when the protective function is activated due to any cause.

When **Pr.248** ="2", the Y17 signal is turned OFF only when the protective function is activated due to an error resulted from a failure in the converter unit circuit or a wiring error (refer to the following table). (For the fault details, refer to [page 162](#).)

Fault type
Inrush current limit circuit fault (E.IOH)
CPU fault (E.CPU)
CPU fault (E.6)
CPU fault (E.7)
Parameter storage device fault (control circuit board) (E.PE)
Parameter storage device fault (main circuit board) (E.PE2)
24 VDC power fault (E.P24)
Operation panel power supply short circuit/RS-485 terminals power supply short circuit (E.CTE)
Internal circuit fault (E.13/E.PBT)

NOTE

- When the retry function is used for resetting during self power management operation, the Y17 signal retains the value before the reset.
- Repeated operation of the magnetic contactor due to frequent start and stop or activation of the protective function may shorten the life of the inverter or the converter unit.
- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Selection between resetting or not resetting during power supply to main circuit (Pr.30 = "100")

- Converter reset is not performed if **Pr.30 Reset selection during power supply to main circuit** = "100", and supplying power to the main circuit (input through terminals R/L1, S/L2, and T/L3) is started when power is supplied only to the control circuit (input through terminals R1/L11 and S1/L12, or 24 V external power supply input).

NOTE

- When supplying power to the main circuit is started when power is supplied only to the control circuit, there is a slight delay before starting.
- When supplying power to the main circuit is started while the protective function of the converter unit is activated, converter reset is performed even when "not resetting after power-ON" is selected.

◀ Parameters referred to ▶▶

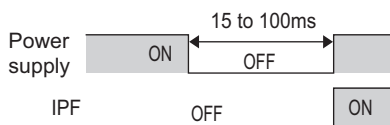
Pr.190 to Pr.195 (Output terminal function selection)  [page 109](#)

5.6.2 Operation selection at instantaneous power failure

When an instantaneous power failure occurs, the converter unit can restart at the power restoration.

Pr.	Name	Initial value	Setting range	Description
57 A702	Restart selection	9999	0	The converter restarts operation at the power restoration from instantaneous power failure.
			9999	The converter does not restart operation automatically at the power restoration from instantaneous power failure.

- When the automatic restart after instantaneous power failure is selected on the inverter side, set **Pr.57 Restart selection** = "0" on the converter unit side.
- When the automatic restart after instantaneous power failure function is selected, the motor driving is resumed at power restoration after an instantaneous power failure or undervoltage. (E.IPF and E.UVT are not activated.)
- When **Pr.57** = "9999" (initial value), the inverter output is shut off at the activation of the instantaneous power failure protection (E.IPF or E.UVT) of the converter unit, even when the automatic restart after instantaneous power failure is selected on the inverter side. (Refer to [page 162](#) for E.IPF or E.UVT.)
- When E.IPF or E.UVT is activated, the Instantaneous power failure/undervoltage (IPF) signal is output.
- The IPF signal is assigned to terminal IPF in the initial status. By setting "2" (positive logic) or "102" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**, the IPF signal can be assigned to another terminal.



CAUTION

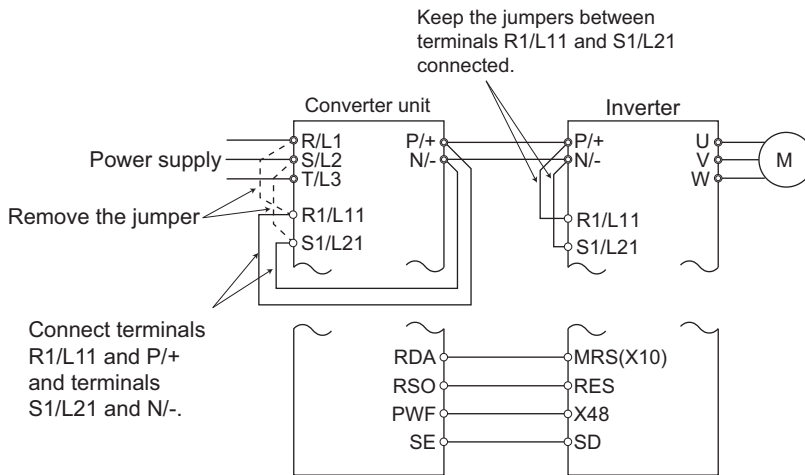
- **When the automatic restart after instantaneous power failure function is selected, the motor suddenly starts (after reset time passes) when an instantaneous power failure occurs. Stay away from the motor and machinery. Apply CAUTION stickers (supplied with the inverter) to easily visible places when automatic restart after instantaneous power failure has been selected.**

5.6.3 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.

Pr.	Name	Initial value	Setting range	Description
261 A730	Power failure stop selection	0	0	Power failure time deceleration-to-stop function disabled
			1, 2, 21, 22	Power failure time deceleration-to-stop function enabled

◆ Connection and parameter setting



- Remove the jumpers between terminals R/L1 and R1/L11 and terminals S/L2 and S1/L21 of the converter unit, and connect terminals R1/L11 and P/+ and terminals S1/L21 and N/-. Do not remove the jumpers of terminal R1/L11 and terminal S1/L21 of the inverter. (In the initial status of the inverter, terminals P/+ and R1/L11 and terminals N/- and S1/L21 are connected.)
- Connect the terminal to which PWF signal of the converter unit is assigned and the terminal to which X48 signal of the inverter is assigned. Also, set **Pr.261** of the converter unit in accordance with the inverter setting.

Pr.261 setting		Description	Power failure time deceleration-to-stop function when the automatic restart after instantaneous power failure is enabled (Pr.57 ≠ "9999").
Inverter	Converter unit		
0	0	Power failure time deceleration-to-stop function disabled	—
1, 11	1	Power failure time deceleration-to-stop function enabled	Disabled
2, 12	2		Enabled
21	21		Disabled
22	22		Enabled

◆ Power failure stop signal (PWF signal)

- The Power failure stop (PWF) signal turns ON during instantaneous power failure, undervoltage, or input phase loss.
- To use the PWF signal, set "210" (positive logic) or "310" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function.

When the input specification of the Power failure stop external (X48) signal of the inverter is the NC contact, set the negative logic for the PWF signal of the converter unit. When the input specification of the inverter's X48 signal is the NO contact, set the positive logic for the PWF signal of the converter unit. (For the X48 signal, the initial setting is the NC contact input specification. For changing the input logic, refer to the Instruction Manual of the inverter.)

NOTE

- When the power failure time deceleration stop function is selected, undervoltage protection (E.UVT), instantaneous power failure protection (E.IPF) and input phase loss protection (E.ILF) are invalid.
- Changing the terminal assignment using **Pr.190 to Pr.195 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.190 to Pr.195 (Output terminal function selection) page 109

Pr.872 Input phase loss protection selection page 97

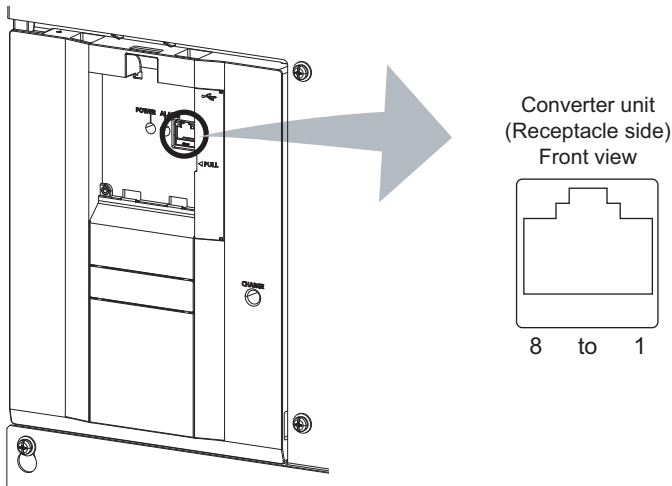
5.7 (N) Communication operation parameters

Purpose	Parameter to set			Refer to page
To start operation via communication	Initial setting of operation via communication	P.N000, P.N001	Pr.549, Pr.342	124
To communicate via PU connector	Initial setting of computer link communication (PU connector)	P.N020 to P.N028	Pr.117 to Pr.124	125
To communicate via RS-485 terminals	Initial setting of computer link communication (RS-485 terminals)	P.N030 to P.N038	Pr.331 to Pr.337, Pr.341	
	MODBUS RTU communication specification	P.N002, P.N030, P.N031, P.N034, P.N080	Pr.539, Pr.331, Pr.332, Pr.334, Pr.343	137

5.7.1 Wiring and configuration of PU connector

Using the PU connector as a computer network port enables communication operation from a personal computer, etc. When the PU connector is connected with a personal, FA or some other computer by a communication cable, a user program can run and monitor the converter unit or read and write to parameters.

◆ PU connector pin-outs



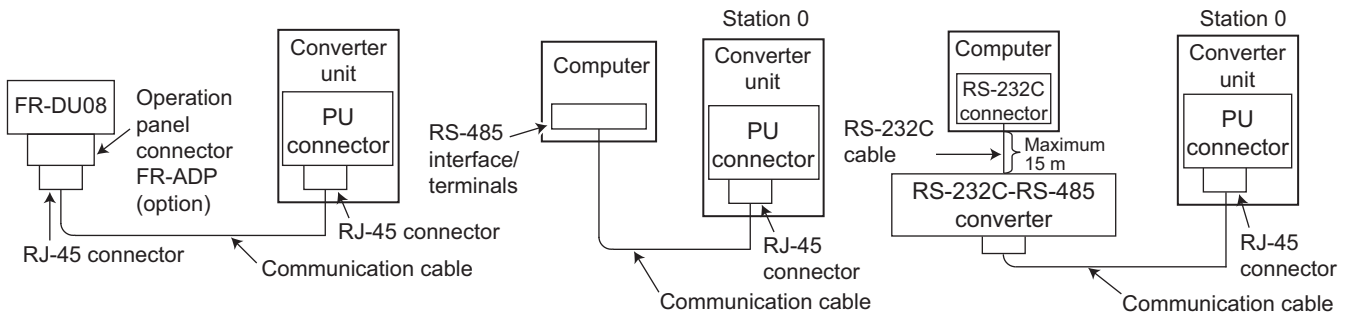
Pin number	Name	Description
1	SG	Earthing (grounding)
2	—	Operation panel power supply
3	RDA	Converter unit receive +
4	SDB	Converter unit send -
5	SDA	Converter unit send +
6	RDB	Converter unit receive -
7	SG	Earthing (grounding)
8	—	Operation panel power supply

NOTE

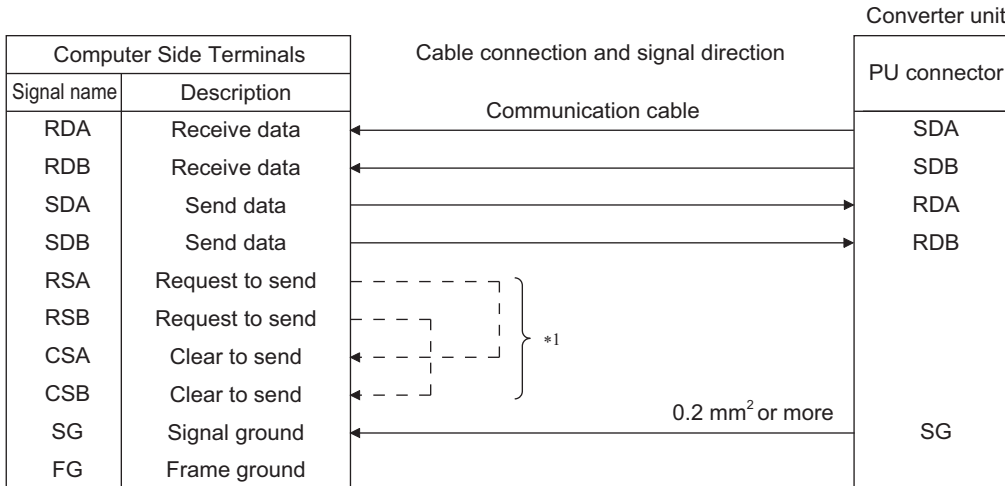
- Pins No. 2 and 8 provide power to the operation panel. Do not use these pins for RS-485 communication.
- Do not connect the PU connector to the computer's LAN board, FAX modem socket, or telephone modular connector. The product could be damaged due to differences in electrical specifications.

◆ Wiring and configuration of PU connector communication system

- System configuration



- Wiring between a computer and a converter for RS-485 communication



*1 Make connection in accordance with the Instruction Manual of the computer to be used with. Fully check the terminal numbers of the computer since they vary with the model.

NOTE

- When performing RS-485 communication with multiple converter units, use the RS-485 terminals. (Refer to [page 122](#).)
- Connection cable between the computer and the converter unit
Refer to the following for the connection cable (RS-232C to RS-485 converter) between the computer with an RS-232C interface and a converter unit. Commercially available products (as of October 2020)

Model	Manufacturer
Interface embedded cable DAFXIH-CAB (D-SUB25P for personal computer) DAFXIH-CABV (D-SUB9P for personal computer) +	Diatrend Corp.
Connector conversion cable DINV-485CAB (for converter unit)*2	
Interface embedded cable for converter unit DINV-CABV*2	

*2 The conversion cable cannot connect multiple converter units. (The computer and a converter unit are connected in a 1:1 pair.) This is an RS232C-to-RS485 converter-embedded conversion cable. No additional cable or connector is required. For the product details, contact the manufacturer.

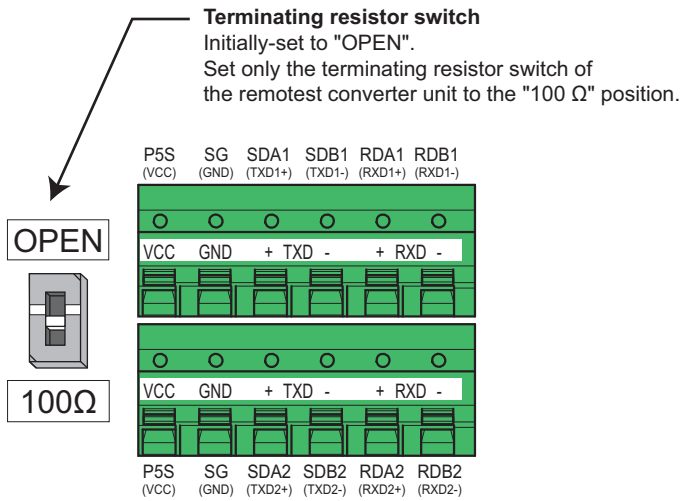
- Use Ethernet cables compliant with the following standards when fabricating the cable.

Ethernet cable	Connector	Standard
Category 5e or higher straight cable (double shielded / STP)*3	RJ-45 connector*3	The cables compliant with the following standards: · IEEE 802.3 (1000BASE-T) · ANSI/TIA/EIA-568-B (Category 5e)

*3 Do not use pins No. 2 and 8 of the communication cable.

5.7.2 Wiring and configuration of RS-485 terminals

◆ RS-485 terminal layout



Name	Description
RDA1 (RXD1+)	Converter unit receive +
RDB1 (RXD1-)	Converter unit receive -
RDA2 (RXD2+)	Converter unit receive + (for branch)
RDB2 (RXD2-)	Converter unit receive - (for branch)
SDA1 (TXD1+)	Converter unit send +
SDB1 (TXD1-)	Converter unit send -
SDA2 (TXD2+)	Converter unit send + (for branch)
SDB2 (TXD2-)	Converter unit send - (for branch)
P5S (VCC)	5 V (permissible load current 100 mA)
SG (GND)	Earthing (grounding) (connected to terminal SD)

◆ Wiring the RS-485 terminals

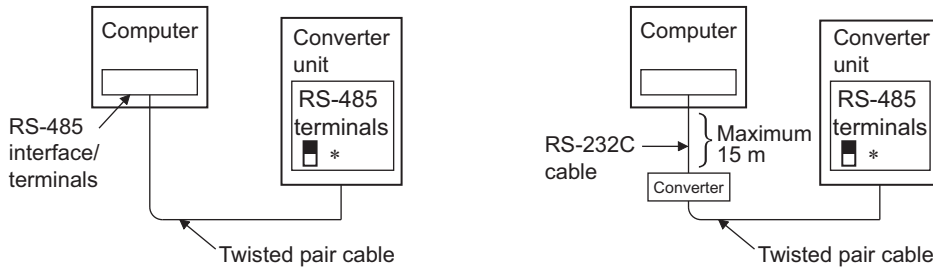
- The size of RS-485 terminal block is the same as that of the control circuit terminal block. Refer to [page 49](#) for the wiring method.

NOTE

- To avoid malfunction, keep the RS-485 terminal wires away from the control circuit board.

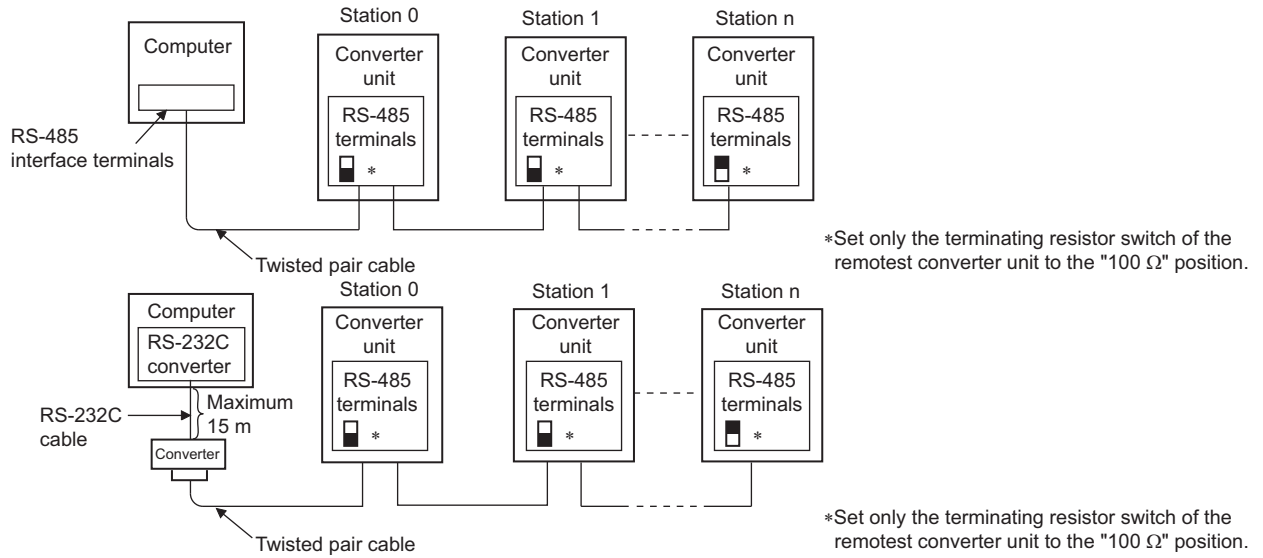
◆ System configuration of RS-485 terminals

- Computer and converter unit connection (1:1)



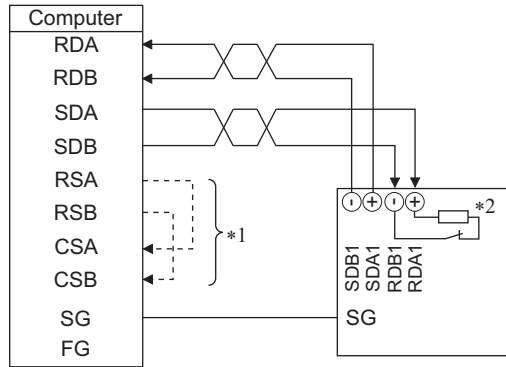
*Set the terminating resistor switch to the "100 Ω" position.

- Combination of a computer and multiple converter units (1:n)

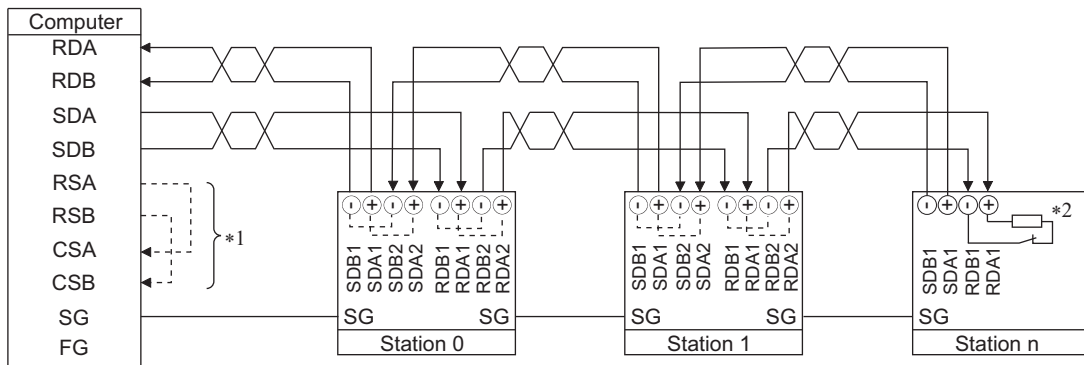


◆ RS-485 terminal wiring method

- Wiring between a computer and a converter unit for RS-485 communications



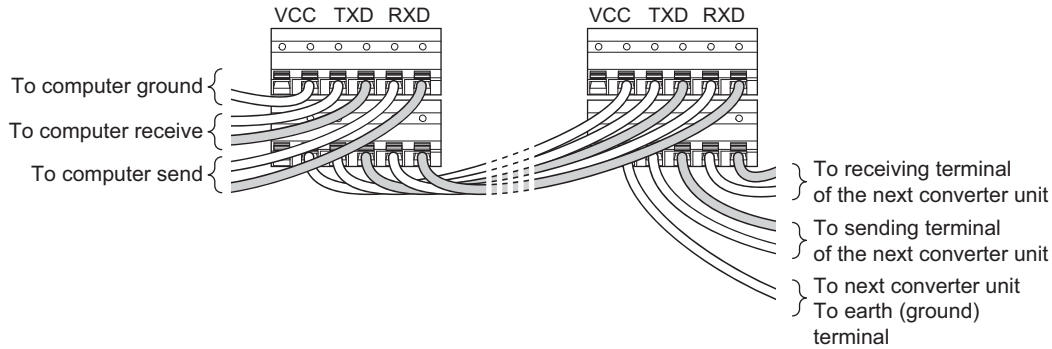
- Wiring between a computer and multiple converter units for RS-485 communication



- *1 Make connection in accordance with the Instruction Manual of the computer to be used with. Fully check the terminal numbers of the computer since they vary with the model.
- *2 On the converter unit most remotely connected with the computer, set the terminating resistor switch in the ON (100 Ω) position.

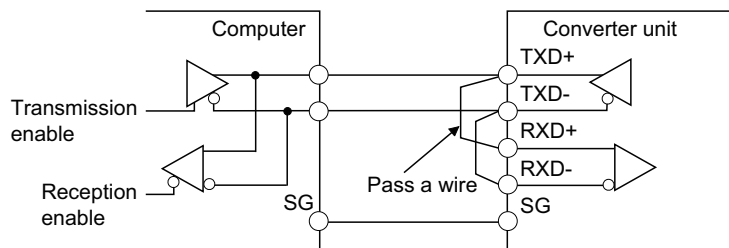
NOTE

- For branching, connect the wires as shown in the following table.



◆ Two-wire type connection

- If the computer is 2-wire type, a connection from the converter can be changed to 2-wire type by passing wires across reception terminals and transmission terminals of the RS-485 terminals.



NOTE

- A program should be created so that transmission is disabled (receiving state) when the computer is not sending and reception is disabled (sending state) during sending to prevent the computer from receiving its own data.

5.7.3 Initial setting of operation via communication

Set the action when the converter unit is performing operation via communication.

- Set the RS-485 communication protocol. (Mitsubishi inverter protocol / MODBUS RTU protocol)
- Set the action at fault occurrence or at writing of parameters.

Pr.	Name	Initial value	Setting range	Description
549 N000	Protocol selection	0	0	Mitsubishi inverter protocol (computer link)
			1	MODBUS RTU protocol
342 N001	Communication EEPROM write selection	0	0	Parameter values written by communication are written to the EEPROM and RAM.
			1	Parameter values written by communication are written to the RAM.

◆ Setting the communication protocol (Pr.549)

- Select the RS-485 communication protocol.
- The MODBUS RTU protocol can be used by communication from the RS-485 terminals.

Pr.549 setting	Communication protocol
0 (initial value)	Mitsubishi inverter protocol (computer link)
1	MODBUS RTU protocol

◆ Communication EEPROM write selection (Pr.342)

- The parameter storage device can be changed from "EEPROM and RAM" to "RAM only" when writing parameters via the converter unit's PU connector or RS-485 terminals. Use this function if parameter settings are changed frequently.
- When changing the parameter values frequently, set "1" in **Pr.342 Communication EEPROM write selection** to write them to the RAM only. The life of the EEPROM will be shorter if parameter write is performed frequently with the setting unchanged from "0 (initial value)" (EEPROM write).

NOTE

- Turning OFF the converter unit's power supply clears the modified parameter settings when **Pr.342** = "1 (write only to RAM)". Therefore, the parameter settings last stored to EEPROM apply at next power-ON.
- The parameter setting written in RAM cannot be checked on the operation panel. (The values displayed on the operation panel are the ones stored in EEPROM.)

5.7.4 Initial settings and specifications of RS-485 communication

Use the following parameters to perform required settings for RS-485 communication between the converter unit and a personal computer.

- Use the PU connector on the converter unit or RS-485 terminals as communication interface.
- Parameter setting, monitoring, etc. can be performed using Mitsubishi inverter protocol or MODBUS RTU communication protocol.
- To make communication between the personal computer and converter unit, setting of the communication specifications must be made to the converter unit in advance. Data communication cannot be made if the initial settings are not configured or if there is any setting error.

◆ Parameters related to PU connector communication

Pr.	Name	Initial value	Setting range	Description	
117 N020	PU communication station number	0	0 to 31	Specify the converter unit station number. Set the converter unit station numbers when two or more converter units are connected to one personal computer.	
118 N021	PU communication speed	192	48, 96, 192, 384, 576, 768, 1152	Select the communication speed. The setting value × 100 equals the communication speed. For example, enter 192 to set the communication speed of 19200 bps.	
N022	PU communication data length	0	0 1	Data length 8 bits Data length 7 bits	
N023	PU communication stop bit length	1	0 1	Stop bit length 1 bit Stop bit length 2 bits	
119	PU communication stop bit length / data length	1	0	Stop bit length 1 bit	Data length 8 bits
			1	Stop bit length 2 bits	
			10	Stop bit length 1 bit	Data length 7 bits
			11	Stop bit length 2 bits	
120 N024	PU communication parity check	2	0 1 2	Parity check disabled. Parity check (odd parity) enabled. Parity check (even parity) enabled.	
121 N025	PU communication retry count	1	0 to 10 9999	Set the permissible number of retries for unsuccessful data reception. If the number of consecutive errors exceeds the permissible value, the inverter output will be stopped. The inverter output will not be shut off even when a communication error occurs.	
122 N026	PU communication check time interval	9999	0	PU connector communication is disabled.	
			0.1 to 999.8 s	Set the interval of the communication check (signal loss detection) time. If a no-communication state persists for longer than the permissible time, the inverter output will be shut off.	
			9999	No communication check (signal loss detection)	
123 N027	PU communication waiting time setting	9999	0 to 150 ms	Set the time delay between data transmission to the converter unit and the response.	
			9999	The time delay is not set in this parameter but in communication data. Delay time: Number set in the data × 10 ms	
124 N028	PU communication CR/LF selection	1	0	Without CR/LF	
			1	With CR	
			2	With CR/LF	

◆ Parameters related to RS-485 terminal communication

Pr.	Name	Initial value	Setting range	Description
331 N030	RS-485 communication station number	0	0 to 31 (0 to 247) ^{*1*2}	Specify the converter unit station number. (Same specifications as Pr.117)
332 N031	RS-485 communication speed	96	3, 6, 12, 24, 48, 96, 192, 384, 576, 768, 1152	Select the communication speed. (Same specifications as Pr.118)
N032	RS-485 communication data length	0	0, 1	Select the data length. (Same specifications as P.N022) ^{*3}
N033	RS-485 communication stop bit length	1	0, 1	Select the stop bit length. (Same specifications as P.N023) ^{*4}
333	RS-485 communication stop bit length / data length	1	0, 1, 10, 11	Select the stop bit length and data bit length. (Same specifications as Pr.119) ^{*3*4}
334 N034	RS-485 communication parity check selection	2	0, 1, 2	Select the parity check specifications. (Same specifications as Pr.120)
335 N035 ^{*5}	RS-485 communication retry count	1	0 to 10, 9999	Set the permissible number of retries for unsuccessful data reception. (Same specifications as Pr.121)
336 N036 ^{*5}	RS-485 communication check time interval	0 s	0	The RS-485 communication is available, but a communication error occurs.
			0.1 to 999.8 s	Set the interval of the communication check (signal loss detection) time. (Same specifications as Pr.122)
			9999	No communication check (signal loss detection)
337 N037 ^{*5}	RS-485 communication waiting time setting	9999	0 to 150 ms, 9999	Set the time delay between data transmission to the converter unit and the response. (Same specifications as Pr.123)
341 N038 ^{*5}	RS-485 communication CR/LF selection	1	0, 1, 2	Select the presence/absence of CR/LF. (Same specifications as Pr.124)

*1 When "1" (MODBUS RTU protocol) is set in Pr.549, the setting range within parentheses is applied.

*2 When a value outside the setting range is set, the converter operates at the initial value.

*3 In the MODBUS RTU protocol, the data length is fixed at 8 bits.

*4 In the MODBUS RTU protocol, Pr.334 setting is applied as the stop bit length. (Refer to page 137.)

*5 In the MODBUS RTU protocol, this is invalid.

NOTE

- The monitor items and parameter settings can be read during communication with the **Pr.336 RS-485 communication check time interval = "0 (initial value)"** setting, but a converter unit communication error (E.SER) occurs. To perform operation or parameter writing via communication, set "9999" or a large setting value in **Pr.336**. (The setting value is determined by the computer program.) (Refer to page 132.)
- Always reset the converter after making the initial settings of the parameters. After changing the communication-related parameters, communication cannot be made until the converter is reset.

5.7.5 Mitsubishi inverter protocol (computer link communication)

Parameter setting and monitoring, etc. are possible through communication using the Mitsubishi inverter protocol (computer link communication) via the PU connector or RS-485 terminals on the converter unit.

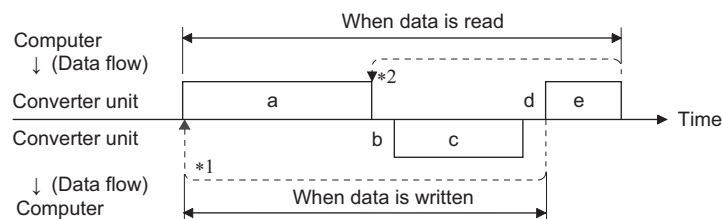
◆ Communication specifications

- The communication specifications are shown in the following table.

Item	Description	Related parameter
Communication protocol	Mitsubishi inverter protocol (computer link communication)	Pr.551
Conforming standard	EIA-485 (RS-485)	—
Number of connectable units	1: N (maximum 32 units), the setting range of station number is 0 to 31.	Pr.117 Pr.331
Communication speed	PU connector	Selected among 4800/9600/19200/38400 bps
	RS-485 terminals	Selected among 300/600/1200/2400/4800/9600/19200/38400/57600/76800/115200 bps
Control procedure	Asynchronous method	—
Communication method	Half-duplex system	—
Communication specifications	Character system	ASCII (selectable between 7 bits and 8 bits)
	Start bit	1 bit
	Stop bit length	Selectable between 1 bit and 2 bits
	Parity check	Selectable between enabled (even or odd) or disabled
	Error check	Sum code check
	Terminator	CR/LF (Selectable between enabled (either or both) or disabled)
Time delay setting	Selectable between enabled or disabled	Pr.123 Pr.337

◆ Communication procedure

- Data communication between the computer and converter unit is made in the following procedure.
 - Request data is sent from the computer to the converter unit. (The converter unit will not send data unless requested.)
 - Communication delay time
 - Reply data: sent from the converter unit to the computer in response to the computer request (data a)
 - Converter unit data processing time
 - Answer data: sent from the computer in response to the reply data sent from the converter unit (data c) (Subsequent communication is made properly even without data e.)



*1 If a data error is detected and a retry must be made, perform retry operation with the user program. The converter unit output is shut off if the number of consecutive retries exceeds the parameter setting.

*2 On receipt of a data error occurrence, the converter unit returns reply data (data c) to the computer again. The converter unit output is shut off if the number of consecutive data errors reaches or exceeds the parameter setting.

◆ Communication operation presence/absence and data format types

- Data communication between the computer and converter unit is made in ASCII code (hexadecimal code).

- Communication operation presence/absence and data format types are as follows.

Symbol	Operation	Special monitor write	Parameter write	Converter reset	Monitor	Parameter read	
a	Communication request is sent to the converter unit in accordance with the user program in the computer.	A1	A	A	B	B	
b	Converter unit data processing time	With	With	Without	With	With	
c	Reply data from the converter unit (Data (a) is checked for an error.)	No error ^{*1} (Request accepted)	C	C	C ^{*2}	E, E1, E2, E3	E
		Error detected (Request rejected)	D	D	D ^{*2}	D	D
d	Computer processing delay time	10 ms or more					
e	Reply from computer in response to reply data c (Data c is checked for error.)	No error ^{*1} (No converter unit processing)	Without	Without	Without	Without (C)	Without (C)
		Error detected (Converter unit outputs c again.)	Without	Without	Without	F	F

*1 In the communication request data from the computer to the converter unit, the time of 10 ms or more is also required after an acknowledgment (ACK) signal showing "No data error detected" is sent. (Refer to page 131.)

*2 Reply from the converter unit to the converter reset request can be selected. (Refer to page 135.)

- Data writing format

a. Communication request data from the computer to the converter unit

Format	Number of characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
A	ENQ ^{*1}	Converter unit station number ^{*2}		Instruction code		^{*3}	Data				Sum check		^{*4}
A1	ENQ ^{*1}	Converter unit station number ^{*2}		Instruction code		^{*3}	Data		Sum check		^{*4}		

c. Reply data from the converter unit to the computer (No data error detected)

Format	Number of characters			
	1	2	3	4
C	ACK ^{*1}	Inverter station number ^{*2}		^{*4}

c. Reply data from the converter unit to the computer (Data error detected)

Format	Number of characters				
	1	2	3	4	5
D	NAK ^{*1}	Converter unit station number ^{*2}		Error code	^{*4}

*1 Indicates a control code.

*2 Specifies the converter unit station numbers in the range of H00 to H1F (stations 0 to 31) in hexadecimal.

*3 Set the delay time. When **Pr.123 PU communication waiting time setting** or **Pr.337 RS-485 communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)

*4 CR/LF code: When a computer transmits data to the converter unit, some computers automatically provide either one or both of the codes CR (carriage return) and LF (line feed) at the end of a data group. In this case, setting must be also made on the converter unit according to the computer. Use **Pr.124** or **Pr.341** for the CR+LF code setting.

- Data reading format

a. Communication request data from the computer to the converter unit

Format	Number of characters								
	1	2	3	4	5	6	7	8	9
B	ENQ ^{*1}	Converter unit station number ^{*2}		Instruction code		^{*3}	Sum check		^{*4}

c. Reply data from the converter unit to the computer (No data error detected)

Format	Number of characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
E	STX ^{*1}	Converter unit station number ^{*2}		Read data				ETX ^{*1}	Sum check		*4		
E1	STX ^{*1}	Converter unit station number ^{*2}		Read data		ETX ^{*1}	Sum check		*4				
E2	STX ^{*1}	Converter unit station number ^{*2}		Read data (model information / capacity)					ETX ^{*1}	Sum check		*4	

Format	Number of characters											
	1	2	3	4 to 23				24	25	26	27	
E3	STX ^{*1}	Converter unit station number ^{*2}		Read data (model information / converter unit model)				ETX ^{*1}	Sum check		*4	

c. Reply data from the converter unit to the computer (Data error detected)

Format	Number of characters				
	1	2	3	4	5
D	NAK ^{*1}	Converter unit station number ^{*2}		Error code	*4

e. Transmission data from the computer to the converter unit when reading data

Format	Number of characters			
	1	2	3	4
C (No data error detected)	ACK ^{*1}	Converter unit station number ^{*2}		*4
F (Data error detected)	NAK ^{*1}	Converter unit station number ^{*2}		*4

*1 Indicates a control code.

*2 Specifies the converter unit station numbers in the range of H00 to H1F (stations 0 to 31) in hexadecimal.

*3 Set the delay time. When **Pr.123 PU communication waiting time setting** or **Pr.337 RS-485 communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)

*4 CR/LF code: When a computer transmits data to the converter unit, some computers automatically provide either one or both of the codes CR (carriage return) and LF (line feed) at the end of a data group. In this case, setting must be also made on the converter unit according to the computer. Use **Pr.124** or **Pr.341** for the CR+LF code setting.

◆ Data definitions

- Control code

Signal name	ASCII code	Description
STX	H02	Start Of Text (Start of data)
ETX	H03	End Of Text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (Data error detected)

- Converter unit station number

Specify the station number of the converter unit which communicates with the computer.

- Instruction code

Specify the processing request, for example, operation or monitoring, given by the computer to the converter unit. Therefore, the operation or monitoring an item is enabled by specifying the corresponding instruction code. (Refer to [page 135.](#))

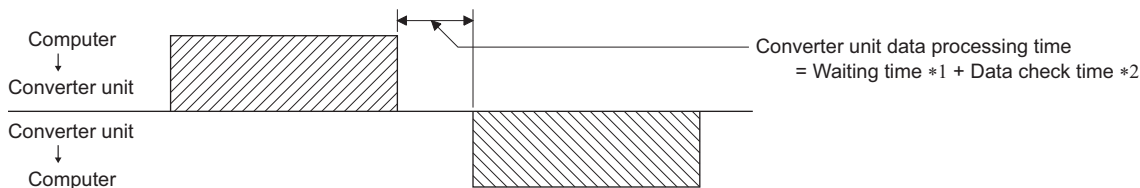
- Data

Read/write data such as parameters transmitted from/to the converter unit. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer to [page 135.](#))

- Time delay

Specify the delay time (time period between the time when the converter unit receives data from the computer and the time when the converter unit starts transmission of reply data). Set the time delay in accordance with the response time of the computer in the range of 0 to 150 ms in 10 ms increments. (For example; 1 = 10 ms, 2 = 20 ms)

When **Pr.123 PU communication waiting time setting** or **Pr.337 RS-485 communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)



- *1 When **Pr.123** = "9999", the waiting time is the data setting value × 10 ms. When **Pr.123** ≠ "9999", the waiting time is the value set in **Pr.123**.
- *2 The time is about 10 to 30 ms. It varies depending on the instruction code.

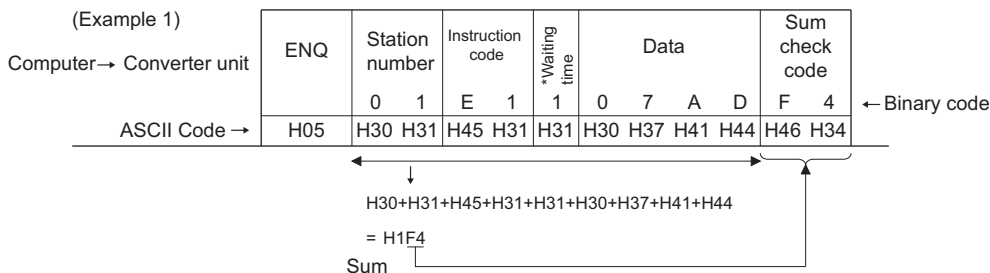
NOTE

- The data check time varies depending on the instruction code. (Refer to [page 131](#).)

• **Sum check code**

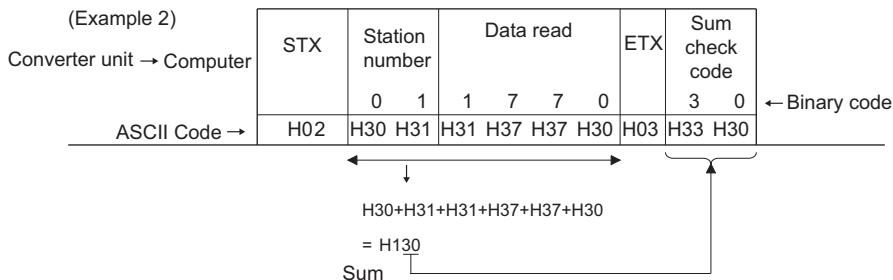
The sum check code is a 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum derived from the checked ASCII data.

(Example 1)



* When the **Pr. 123 Waiting time setting** ≠ "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

(Example 2)



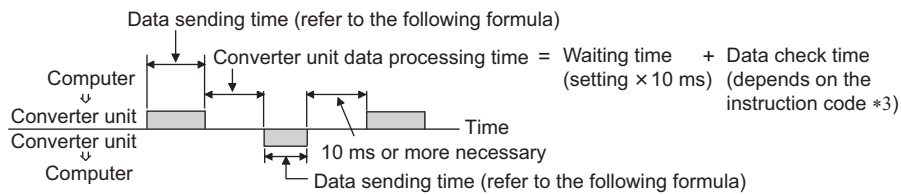
• **Error code**

If any error is found in the data received by the converter unit, its error definition is sent back to the computer together with the NAK code.

Error code	Error item	Error description	Converter unit operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than the permissible number of retries.	The inverter output is shut off (E.PUE/E.SER) if error occurs continuously more than the permissible number of retries.
H1	Parity error	The parity check result does not match the specified parity.	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the converter unit.	
H3	Protocol error	The data received by the converter unit has a grammatical mistake. Or, data receive is not completed within the predetermined time. CR or LF is not as set in the parameter.	
H4	Framing error	The stop bit length differs from the initial setting.	
H5	Overrun error	New data has been sent by the computer before the converter unit completes receiving the preceding data.	
H6	—	—	—

Error code	Error item	Error description	Converter unit operation
H7	Character error	The converter unit received an unusable character (other than 0 to 9, A to F, and control codes).	The converter unit does not accept the data sent to the converter unit. However, the inverter output is not shut off.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted when the converter unit does not perform computer link communication, when the operation commands are not given through communication, or during converter unit operation.	The converter unit does not accept the data sent to the converter unit. However, the inverter output is not shut off.
HB	Instruction code error	The specified instruction code does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, etc.	
HD	—	—	
HE	—	—	—
HF	Normal (no error)	—	—

◆ Response time



[Formula for data transmission time]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters} *1 \times \frac{\text{Communication specifications (Total number of bits)} *2}{\text{Total number of bits}} = \text{data transmission time (s)}$$

*1 Refer to [page 127](#).

*2 Communication specifications

Name	Number of bits	
Stop bit length	1 bit 2 bits	
Data length	7 bits 8 bits	
Parity check	With	1 bit
	Without	0

In addition to the above, 1 start bit is necessary.

Minimum number of total bits: 9 bits

Maximum number of total bits: 12 bits

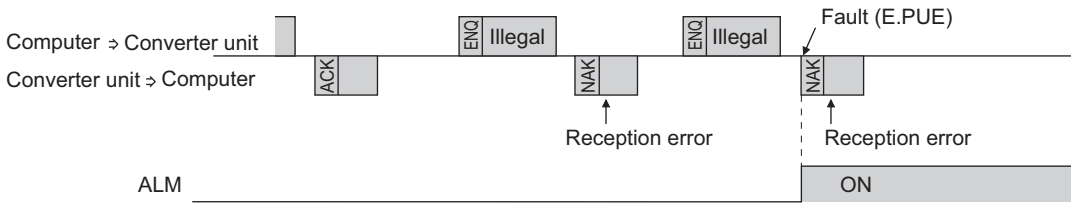
*3 Data check time

Item	Check time
Converter status monitor, reading monitor values	< 20 ms
Reading/writing parameters (RAM)	< Approximately 20 ms
Reading/writing parameters (EEPROM)	< Approximately 50 ms

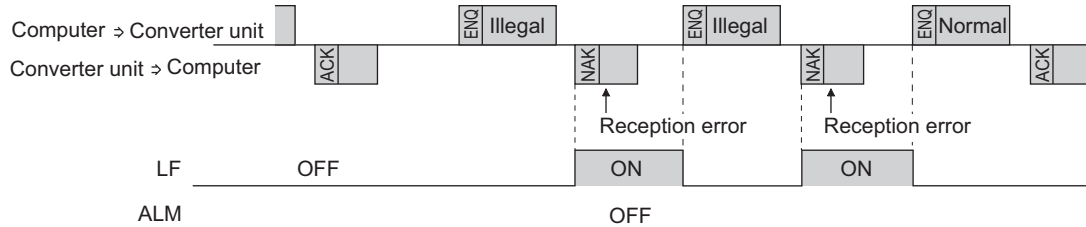
◆ Retry count setting (Pr.121, Pr.335)

- Set the permissible number of retries at data receive error occurrence. (Refer to [page 130](#) for data receive error for retry.)
- When the data receive errors occur consecutively and the number of retries exceeds the permissible number setting, a communication fault (PU connector communication: E.PUE, RS-485 terminal communication: E.SER) occurs and the inverter output is shut off.
- When a data transmission error occurs while "9999" is set, the inverter does not shut off its output but outputs the Alarm (LF) signal. To use the LF signal, set "98" (positive logic) or "198" (negative logic) in any parameter from **Pr.190 to Pr.195 (Output terminal function selection)** to assign the function to an output terminal.

Example: PU connector communication, Pr. 121 = "1" (initial value)



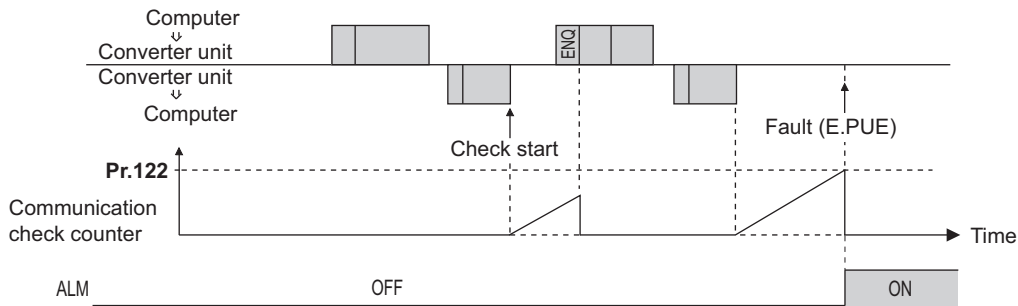
Example: PU connector communication, Pr. 121 = "9999"



◆ Signal loss detection (Pr.122, Pr.336)

- If signal loss is detected between the converter unit and computer, communication error "E.PUE" (PU connector communication) or "E.SER" (RS-485 terminal communication) will occur and the inverter output is shut off.
- When "9999" is set, the communication check (signal loss detection) will not be performed.
- When the setting is "0", communication through the PU connector is not possible. The monitor items and parameter settings can be read during communication via RS-485 terminals, but a communication error (E.SER) occurs.
- Setting any value from 0.1 s to 999.8 s will enable signal loss detection. To detect signal loss, data must be sent from the computer within the communication check time interval (for further information on control codes, refer to [page 129](#)). The converter unit makes a communication check (clearing of communication check counter) regardless of the station number setting of the data sent from the master.

Example: PU connector communication, Pr. 122 = "0.1 to 999.8 s"



◆ Programming instructions

- When data from the computer has any error, the converter unit does not accept that data. Hence, in the user program, always insert a retry program for data error.
- All data communication (for example, monitoring) is started when the computer gives a communication request. The converter unit does not return any data without the computer's request. Hence, design the program so that the computer gives a data read request for monitoring, etc. as required.
- Program example) Writing "0" in **Pr.57**

```

#include <stdio.h>
#include <windows.h>

void main(void){
    HANDLE          hCom;          // Communication handle
    DCB             hDcb;          // Structure for setting communication settings
    COMMTIMEOUTS   hTim;          // Structure for setting timeouts

    char           szTx[0x10];     // Send buffer
    char           szRx[0x10];     // Receive buffer
    char           szCommand[0x10]; // Command
    int            nTx,nRx;        // For storing buffer size
    int            nSum;           // For calculating sum code
    BOOL           bRet;
    int            nRet;
    int            i;

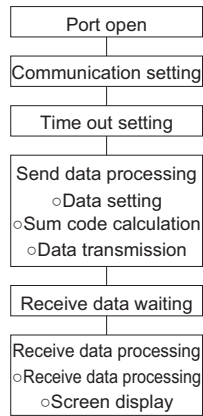
    // **** Open COM1 port ****
    hCom = CreateFile("COM1", (GENERIC_READ | GENERIC_WRITE), 0, NULL, OPEN_EXISTING, FILE_ATTRIBUTE_NORMAL, NULL);
    if(hCom != NULL) {
        // **** Set COM1 port communication ****
        GetCommState(hCom,&hDcb); // Get current communication information
        hDcb.DCBLength = sizeof(DCB); // Structure size setting
        hDcb.BaudRate = 19200; // Communication speed = 19200 bps
        hDcb.ByteSize = 8; // Data length = 8 bits
        hDcb.Parity = 2; // Parity check at even numbers
        hDcb.StopBits = 2; // Stop bit = 2 bits
        bRet = SetCommState(hCom,&hDcb); // Setting of changed communication information
        if(bRet == TRUE) {
            // **** Set COM1 port timeout ****
            GetCommTimeouts(hCom,&hTim); // Get current timeout values
            hTim.WriteTotalTimeoutConstant = 1000; // Write timeout 1 second
            hTim.ReadTotalTimeoutConstant = 1000; // Read timeout 1 second
            hTim.ReadTotalTimeoutConstantSetCommTimeouts(hCom,&hTim); // Setting of changed timeout values
            // **** Setting a command to write "0" in Pr.57 of the station number 1 converter unit ****
            sprintf(szCommand,"01FB10000"); // Send data (Parameter write)
            nTx = strlen(szCommand); // Send data size
            // **** Generate sum code ****
            nSum = 0; // Initialize sum data
            for(i = 0; i < nTx; i++) {
                nSum += szCommand[i]; // Calculate sum code
                nSum &= (0xff); // Mask data
            }

            // **** Generate send data ****
            memset(szTx,0,sizeof(szTx)); // Initialize send buffer
            memset(szRx,0,sizeof(szRx)); // Initialize receive buffer
            sprintf(szTx,"%5s%02X",szCommand,nSum); // ENQ code + send data + sum code
            nTx = 1 + nTx + 2; // ENQ code + number of send data + number of sum codes

            nRet = WriteFile(hCom,szTx,nTx,&nTx,NULL);
            // **** Send ****
            if(nRet != 0) {
                nRet = ReadFile(hCom,szRx,sizeof(szRx),&nRx,NULL);
                // **** Receive ****
                if(nRet != 0) {
                    // **** Display receive data ****
                    for(i = 0; i < nRx; i++) {
                        printf("%02X ",(BYTE)szRx[i]); // Output received data to console
                        // Display ASCII code in Hexadecimal' In case of 0, "30" is displayed.
                    }
                    printf("\n\r");
                }
            }
        }
        CloseHandle(hCom); // Close communication port
    }
}

```

General flowchart



CAUTION

- Always set the communication check time interval before starting operation to prevent hazardous conditions.
- Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage or other factors, the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter output will be shut off (E.PUE, E.SER).
Turn the RES signal of the inverter ON or shut off the power supply to coast the motor to a stop.
- Note that the converter unit does not detect a fault if communication is broken due to signal cable breakage, computer fault or other factors.

◆ Setting items and set data

- After completion of parameter settings, set the instruction codes and data as shown in the following table, then start communication from the computer to allow reading/writing of parameters and monitoring.

Item	Read/write	Instruction code	Data description	Number of data digits (format)*1																																																				
Monitor	Converter output voltage	Read	H6F	H0000 to HFFFF: Converter output voltage (hexadecimal) in 0.1 V increments	4 digits (B and E/D)																																																			
	Input current	Read	H70	H0000 to HFFFF: Output current (hexadecimal) in 0.1 A increments	4 digits (B and E/D)																																																			
	Electronic thermal O/L relay load factor	Read	H71	H0000 to HFFFF: Electronic thermal relay function load factor (hexadecimal) in 0.1% increments	4 digits (B and E/D)																																																			
	Special monitor	Read	H72	H0000 to HFFFF: Monitor data selected in the instruction code HF3	4 digits (B and E/D)																																																			
	Special monitor selection No.	Read	H73	Monitor selection data (Refer to page 106 for details on selection No.)	2 digits (B and E1/D)																																																			
		Write	HF3		2 digits (A1 and C/D)																																																			
	Fault record	Read	H74 to H77	<p>H0000 to HFFFF: Two fault records per code.</p> <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr> <td style="border: none;">b15</td> <td style="border: none;">b8 b7</td> <td style="border: none;">b0</td> </tr> <tr> <td>H74</td> <td>Latest fault</td> <td>Present fault</td> </tr> <tr> <td>H75</td> <td>Third latest fault</td> <td>Second latest fault</td> </tr> <tr> <td>H76</td> <td>Fifth latest fault</td> <td>Fourth latest fault</td> </tr> <tr> <td>H77</td> <td>Seventh latest fault</td> <td>Sixth latest fault</td> </tr> </table> </div> <p>Fault record display example (instruction code H74)</p> <p>With the read data H3040 (Last fault : E.THC) (Present fault : E.FIN)</p> <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr> <td style="border: none;">b15</td> <td style="border: none;">b8 b7</td> <td style="border: none;">b0</td> </tr> <tr> <td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td colspan="8" style="text-align: center;">Last fault (H30)</td> <td colspan="8" style="text-align: center;">Present fault (H40)</td> </tr> </table> </div> <p>(Refer to page 162 for details on fault record read data.)</p>	b15	b8 b7	b0	H74	Latest fault	Present fault	H75	Third latest fault	Second latest fault	H76	Fifth latest fault	Fourth latest fault	H77	Seventh latest fault	Sixth latest fault	b15	b8 b7	b0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	Last fault (H30)								Present fault (H40)								4 digits (B and E/D)
	b15	b8 b7	b0																																																					
	H74	Latest fault	Present fault																																																					
	H75	Third latest fault	Second latest fault																																																					
H76	Fifth latest fault	Fourth latest fault																																																						
H77	Seventh latest fault	Sixth latest fault																																																						
b15	b8 b7	b0																																																						
0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0																																								
Last fault (H30)								Present fault (H40)																																																
Converter status monitor (extended)	Read	H79	The status of output signals can be monitored. (For the details, refer to page 137 .)	4 digits (B and E/D)																																																				
Converter status monitor	Read	H7A		2 digits (B and E1/D)																																																				
Converter reset	Write	HFD	H9696: Converter unit reset As the converter unit is reset at the start of communication by the computer, the converter unit cannot send reply data back to the computer.	4 digits (A and C/D)																																																				
			H9966: Converter unit reset After the computer correctly starts communication and send data to the inverter, the converter unit returns the ACK signal to the computer before being reset.	4 digits (A and D)																																																				
Fault history clear	Write	HF4	H9696: Fault history is cleared.	4 digits (A and C/D)																																																				

Item	Read/write	Instruction code	Data description	Number of data digits (format) ^{*1}	
Parameter clear / All parameter clear	Write	HFC	<p>All parameters return to initial values. Whether to clear communication parameters or not can be selected according to the data.</p> <ul style="list-style-type: none"> Parameter clear H9696: Parameters including communication parameters are cleared. H5A5A: Parameters other than communication parameters are cleared.^{*2} All parameter clear H9966: Parameters including communication parameters are cleared. H55AA: Parameters other than communication parameters are cleared.^{*2} <p>For details on whether or not to clear parameters, refer to page 188. When a clear is performed with H9696 or H9966, communication related parameter settings also return to the initial values. When resuming the operation, set the parameters again. Performing a clear will clear the instruction code HEC, HF3, and HFF settings. Only H9966 and H55AA (All parameter clear) are valid when a password is registered (refer to page 92).</p>	4 digits (A and C/D)	
Parameter	Read	H00 to H63	Refer to the instruction code (page 188) and write and/or read parameter values as required. When setting Pr.100 and later, the link parameter extended setting must be set.	4 digits (B and E/D)	
	Write	H80 to HE3		4 digits (A and C/D)	
Link parameter extended setting	Read	H7F	Parameter settings are changed (extended) according to the settings. For details of the settings, refer to the instruction code (page 188).	2 digits (B and E1/D)	
	Write	HFF		2 digits (A1 and C/D)	
Model information monitor	Inverter model	Read	H7C	The inverter model name can be read in ASCII code. "H20" (blank code) is set for blank area. Example) For "FR-CC2-H": H46, H52, H2D, H43, H43, H32, H2D, H48, H20, H20...H20	20 digits (B and E3/D)
	Capacity	Read	H7D	The capacity in the converter model can be read in ASCII code. Data read is displayed in increments of 0.1 kW. "H20" (blank code) is set for blank area. Example) 315K..."3150" (H20, H20, H33, H31, H35, H30)	6 digits (B and E2/D)

*1 Refer to [page 127](#) for data formats (A, A1, B, C, C1, D, E, E1, E2, E3, F).

*2 Turning OFF the power supply while clearing parameters with H5A5A or H55AA returns the communication parameter settings to the initial settings.

NOTE

- Set 65520 (HFFF0) as a parameter value "8888" and 65535 (HFFFF) as "9999".
- For the instruction codes HFF, HEC, and HF3, their values once written are held, but cleared to zero when a converter reset or all clear is performed.
- When a 32-bit parameter setting or monitor item is read and the value to be read exceeds HFFFF, HFFFF is returned.

◆ Converter status monitor

Item	Instruction code	Bit length	Description *1	Example																																
Converter status monitor	H7A	8 bits	b0: RDB (Inverter operation enable (NC contact)) b1: Fixed to 0 b2: Fixed to 0 b3: RDA (Inverter operation enable (NO contact)) b4: RSO (Inverter reset) b5: IPF (Instantaneous power failure/undervoltage) b6: FAN (Fan fault output) b7: ABC1 (Fault)	[Example 1] H01...Inverter operation enable signal (NC contact) ON b7 b0 <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td> </tr> </table> [Example 2] H80...Fault occurrence b7 b0 <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0																
0	0	0	0	0	0	0	1																													
1	0	0	0	0	0	0	0																													
Converter status monitor (extended)	H79	16 bits	b0: RDB (Inverter operation enable (NC contact)) b1: Fixed to 0 b2: Fixed to 0 b3: RDA (Inverter operation enable (NO contact)) b4: RSO (Inverter reset) b5: IPF (Instantaneous power failure/undervoltage) b6: FAN (Fan fault output) b7: ABC1 (Fault) b8 to b14: — b15: Fault occurrence	[Example 1] H0001...Inverter operation enable signal (NC contact) ON b15 b0 <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td> </tr> </table> [Example 2] H8080...Fault occurrence b15 b0 <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1																					
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0																					

*1 The signal within parentheses () is the initial status. The description changes depending on the setting of Pr.190 to Pr.195 (Output terminal function selection).

5.7.6 MODBUS RTU communication specification

Operation or parameter setting via communication is possible using the MODBUS RTU communication protocol through RS-485 terminals on the converter unit.

Pr.	Name	Initial value	Setting range	Description
331 N030	RS-485 communication station number	0	0	Broadcast communication
			1 to 247	Specify the converter unit station number. Set the converter unit station numbers when two or more converter units are connected to one personal computer.
332 N031	RS-485 communication speed	96	3, 6, 12, 24, 48, 96, 192, 384, 576, 768, 1152	Select the communication speed. The setting value × 100 equals the communication speed. For example, enter 96 to set the communication speed of 9600 bps.
334 N034	RS-485 communication parity check selection	2	0	Parity check disabled. Stop bit length: 2 bits.
			1	Parity check (odd parity) enabled. Stop bit length: 1 bit.
			2	Parity check (even parity) enabled. Stop bit length: 1 bit.
343 N080	Communication error count	0	—	Displays the communication error count during MODBUS RTU communication. Read-only.
539 N002	MODBUS RTU communication check time interval	9999	0	The MODBUS RTU communication is available, but a communication error occurs.
			0.1 to 999.8 s	Set the interval of the communication check (signal loss detection) time. (Same specifications as Pr.122)
			9999	No communication check (signal loss detection)
549 N000	Protocol selection	0	0	Mitsubishi inverter protocol (computer link)
			1	MODBUS RTU protocol

NOTE

- To use the MODBUS RTU protocol, set "1" in **Pr.549 Protocol selection**.
- If MODBUS RTU communication is performed from the master to the address 0 (station number 0), the data is broadcasted, and the converter unit does not send any reply to the master. To obtain replies from the converter unit, set **Pr.331 RS-485 communication station number** ≠ "0 (initial value)".
- Some functions are disabled in broadcast communication. (Refer to [page 140.](#))

◆ Communication specifications

- The communication specifications are shown in the following table.

Item	Description	Related parameter	
Communication protocol	MODBUS RTU protocol	Pr.549	
Conforming standard	EIA-485 (RS-485)	—	
Number of connectable units	1: N (maximum 32 units), the setting range of station number is 0 to 247.	Pr.331	
Communication speed	Selected among 300/600/1200/2400/4800/9600/19200/38400/57600/76800/115200 bps	Pr.332	
Control procedure	Asynchronous method	—	
Communication method	Half-duplex system	—	
Communication specifications	Character system	Binary (fixed at 8 bits)	—
	Start bit	1 bit	—
	Stop bit length	Select from the following three types: No parity check, stop bit length 2 bits Odd parity check, stop bit length 1 bit Even parity check, stop bit length 1 bit	Pr.334
	Parity check		
	Error check	CRC code check	—
Terminator	Not available	—	
Time delay setting	Not available	—	

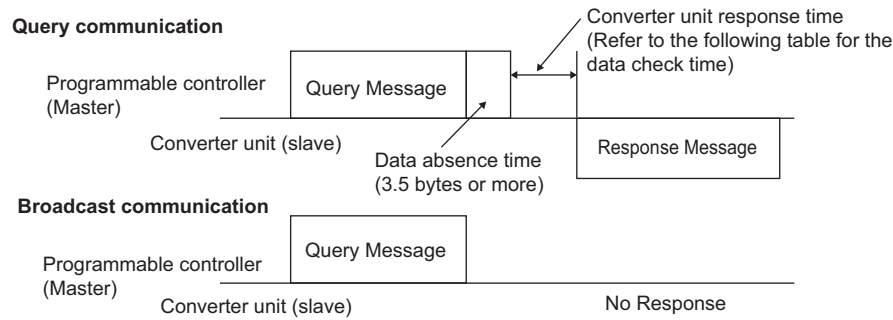
◆ Outline

- The MODBUS communication protocol was developed by Modicon for programmable controllers.
- The MODBUS protocol uses exclusive message frames to perform serial communication between a master and slaves. These exclusive message frames are provided with a feature called "functions" that allows data to be read or written. These functions can be used to read or write parameters from the converter unit, or check the converter unit's operating status, for example. This product classifies the data of each converter unit into holding register area (register address 40001 to 49999). The master can communicate with converter units (slaves) by accessing pre-assigned holding register addresses.

NOTE

- There are two serial transmission modes, the ASCII (American Standard Code for Information Interchange) mode and the RTU (Remote Terminal Unit) mode. However, this product supports only the RTU mode, which transfers 1 byte data (8 bits) as it is. Also, only communication protocol is defined by the MODBUS protocol. Physical layers are not stipulated.

◆ Message format



- Data check time

Item	Check time
Monitoring	< 20 ms
Reading parameters	< Approximately 50 ms
Parameter clear / All parameter clear	< 5 s
Reset command	No reply

- Query
 - A message is sent to the slave (the converter unit) having the address specified by the master.
- Normal response
 - After the query from the master is received, the slave executes the request function, and returns the corresponding normal response to the master.
- Error Response
 - When an invalid function code, address or data is received by the slave, the error response is returned to the master. This response is appended with an error code that indicates the reason why the request from the master could not be executed.
 - This response cannot be returned for errors, detected by the hardware, frame error and CRC check error.
- Broadcast
 - The master can broadcast messages to all slaves by specifying address 0. All slaves that receive a message from the master execute the requested function. With this type of communication, slaves do not return a response to the master.

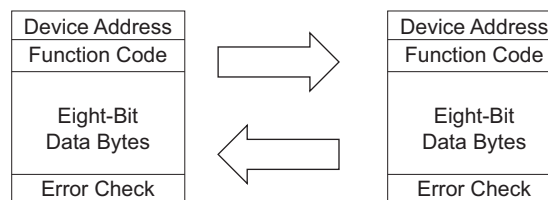
NOTE

- During broadcast communication, functions are executed regardless of the set converter unit station number (**Pr.331**).

◆ Message frame (protocol)

- Communication method
 - Basically, the master sends a query message (inquiry), and slaves return a response message (response). At normal communication, the device address and function code are copied as they are, and at erroneous communication (illegal function code or data code), bit 7 (= H80) of the function code is turned ON, and the error code is set at data bytes.

Query message from Master



Response message from slave

Message frames comprise the four message fields shown in the figures above.

A slave recognizes message data as one message when a 3.5 character long no-data time (T1: start/end) is added before and after the data.

- Details of protocol

The following table explains the four message fields.

Start	Address	Function	Data	CRC check		End
T1	8 bits	8 bits	n × 8 bits	L 8 bits	H 8 bits	T1

Message field	Description
Address field	"0 to 247" can be set in the single-byte (8-bit) length field. Set "0" when sending broadcast messages (instructions to all addresses), and "1 to 247" to send messages to individual slaves. The response from the slave also contains the address set by the master. The value set in Pr.331 RS-485 communication station number is the slave address.
Function field	"1 to 255" can be set as the function code in the single-byte (8-bit) length field. The master sets the function to be sent to the slave as the request, and the slave performs the requested operation. Refer to the function code list for details of the supported function codes. An error response is generated when a function code other than those in the function code list is set. The normal response from the slave contains the function code set by the master. The error response contains H80 and the function code.
Data field	The format changes according the function code. (Refer to page 140 .) The data, for example, includes the byte count, number of bytes, and accessing content of holding registers.
CRC check field	Errors in the received message frame are detected. Errors are detected in the CRC check, and the 2 bytes length data is appended to the message. When the CRC is appended to the message, the lower bytes of the CRC are appended first, followed by the upper bytes. The CRC value is calculated by the sender that appends the CRC to the message. The receiver recalculates the CRC while the message is being received, and compares the calculation result against the actual value that was received in the error check field. If the two values do not match, the result is treated as an error.

◆ Function code list

Function name	Read/write	Code	Outline	Broadcast communication	Message format reference page
Read holding register	Read	H03	The data of the holding registers is read. The various data of the converter unit can be read from MODBUS registers. System environmental variable (Refer to page 145 .) Real time monitor (Refer to page 106 .) Fault history (Refer to page 146 .) Model information monitor (Refer to page 146 .) Converter unit parameters (Refer to page 146 .)	Not available	page 140
Preset single register	Write	H06	Data is written to a holding register. Data can be written to MODBUS registers to output instructions to the converter unit or set parameters. System environmental variable (Refer to page 145 .) Converter unit parameters (Refer to page 146 .)	Available	page 141
Diagnostics	Read	H08	Functions are diagnosed. (Communication check only) A communication check can be made since the query message is sent and the query message is returned as it is as the return message (subfunction code H00 function). Subfunction code H00 (Return query data)	Not available	page 142
Preset multiple registers	Write	H10	Data is written to multiple consecutive holding registers. Data can be written to consecutive multiple MODBUS registers to set converter unit parameters. System environmental variable (Refer to page 145 .) Converter unit parameters (Refer to page 146 .)	Available	page 142
Read holding register access log	Read	H46	The number of registers that were successfully accessed by the previous communication is read. Queries by function codes H03 and H10 are supported. The number and start address of holding registers successfully accessed by the previous communication are returned. "0" is returned for both the number and start address for queries other than function code H03 and H10.	Not available	page 143

◆ Read holding register (reading data of holding registers) (H03 or 03)

- Query message

a. Slave address	b. Function	c. Starting address		d. No. of points		CRC check	
(8 bits)	H03 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Normal response (Response message)

a. Slave address	b. Function	e. Byte count	f. Data			CRC check	
(8 bits)	H03 (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n × 16 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message		Description
a	Slave address	Set the address to send messages to. Broadcast communication is not possible. (Invalid when "0" is set.)
b	Function	Set H03.
c	Starting address	Set the holding register address from which to start reading the data. Starting address = start register address (decimal) - 40001 For example, when starting register address 0001 is set, the data of holding register address 40002 is read.
d	No. of points	Set the number of holding registers for reading data. Data can be read from up to 125 registers.

- Content of normal response

Message		Description
e	Byte count	The setting range is H02 to HFA (2 to 250). Twice the number of reads specified by (d) is set.
f	Data	The amount of data specified by (d) is set. Read data is output Hi bytes first followed by Lo bytes, and is arranged as follows: data of start address, data of start address+1, data of start address+2, and so forth.

■ Example) Read the register values of 41067 (Pr.67) to 41069 (Pr.69) from slave address 17 (H11).

Query message

Slave address	Function	Starting address		No. of points		CRC check	
H11 (8 bits)	H03 (8 bits)	H04 (8 bits)	H2B (8 bits)	H00 (8 bits)	H03 (8 bits)	— (8 bits)	— (8 bits)

Normal response (Response message)

Slave address	Function	Byte count	Data						CRC check	
H11 (8 bits)	H03 (8 bits)	H06 (8 bits)	H00 (8 bits)	H00 (8 bits)	H00 (8 bits)	H0A (8 bits)	H00 (8 bits)	H00 (8 bits)	— (8 bits)	— (8 bits)

Read value

Register 41067 (Pr.67): H0000 (0)

Register 41068 (Pr.68): H000A (1.0 s)

Register 41069 (Pr.69): H0000 (0)

◆ Preset single register (writing data to holding registers) (H06 or 06)

- The content of the system environment variables and converter unit parameters (refer to [page 145](#)) assigned to the holding register area can be written.
- Query message

a. Slave address	b. Function	c. Register address		d. Preset data		CRC check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Normal response (Response message)

a. Slave address	b. Function	c. Register address		d. Preset data		CRC check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message		Description
a	Slave address	Set the address to send messages to. Setting "0" enables broadcast communication.
b	Function	Set H06.
c	Register address	Set the holding register address to write data to. Register address = holding register address (decimal) - 40001 For example, when register address 0001 is set, data is written to holding register address 40002.
d	Preset Data	Set the data to write to the holding register. Write data is fixed at 2 bytes.

- Content of normal response

The contents in the normal response (a to d, including the CRC check) are the same as those in the query messages.

In the case of broadcast communication, no response is returned.

■ Example) Write 114 (H0072) to 41075 (Pr.75) of slave address 5 (H05).

Query message

Slave address	Function	Register address		Preset data		CRC check	
H05 (8 bits)	H06 (8 bits)	H04 (8 bits)	H32 (8 bits)	H00 (8 bits)	H72 (8 bits)	— (8 bits)	— (8 bits)

Normal response (Response message)

The same data as those in the query message

NOTE

- With broadcast communication, no response is generated even if a query is executed, so when the next query is made, it must be made after waiting for the inverter data processing time after the previous query is executed.

◆ Diagnostics (diagnosis of functions) (H08 or 08)

- A communication check can be made since the query message is sent and the query message is returned as it is as the return message (subfunction code H00 function). Subfunction code H00 (Return query data)
- Query message

a. Slave address	b. Function	c. Subfunction		d. Data		CRC check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Normal response (Response message)

a. Slave address	b. Function	c. Subfunction		d. Data		CRC check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message		Description
a	Slave address	Set the address to send messages to. Broadcast communication is not possible. (Invalid when "0" is set.)
b	Function	Set H08.
c	Subfunction	Set H0000.
d	Data	Any 2-byte long data can be set. The setting range is H0000 to HFFFF.

- Content of normal response

The contents in the normal response (a to d, including the CRC check) are the same as those in the query messages.

NOTE

- With broadcast communication, no response is generated even if a query is executed, so when the next query is made, it must be made after waiting for the inverter data processing time after the previous query is executed.

◆ Preset multiple registers (writing data to multiple holding registers) (H10 or 16)

- Data can be written to multiple holding registers.
- Query message

a. Slave address	b. Function	c. Starting address		d. No. of registers		e. Byte count	f. Data			CRC check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n × 2 × 8 bits)	L (8 bits)	H (8 bits)

- Normal response (Response message)

a. Slave address	b. Function	c. Starting address		d. No. of registers		CRC check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message	Description
a Slave address	Set the address to send messages to. Setting "0" enables broadcast communication.
b Function	Set H10.
c Starting address	Set the holding register address from which to start writing the data. Starting address = start register address (decimal) - 40001 For example, when starting address 0001 is set, data is written to holding register 40002.
d No. of registers	Set the number of holding registers for writing data. Data can be written to up to 125 registers.
e Byte count	The setting range is H02 to HFA (2 to 250). Set twice the value specified by d.
f Data	Set the amount of data specified by d. Write data is output Hi bytes first followed by Lo bytes, and is arranged as follows: data of start address, data of start address+1, data of start address+2, and so forth.

- Content of normal response

The contents in the normal response (a to d, including the CRC check) are the same as those in the query messages.

■ Example) Write 2 (H02) to 41190 (Pr.190) and 8 (H08) to 41191 (Pr.191) of slave address 25 (H19).

Query message

Slave address	Function	Starting address		No. of registers		Byte count	Data				CRC check	
H19 (8 bits)	H10 (8 bits)	H04 (8 bits)	HA5 (8 bits)	H00 (8 bits)	H02 (8 bits)	H04 (8 bits)	H00 (8 bits)	H02 (8 bits)	H00 (8 bits)	H08 (8 bits)	— (8 bits)	— (8 bits)

Normal response (Response message)

Slave address	Function	Starting address		No. of registers		CRC check	
H19 (8 bits)	H10 (8 bits)	H04 (8 bits)	HA5 (8 bits)	H00 (8 bits)	H02 (8 bits)	— (8 bits)	— (8 bits)

◆ Read holding register access log (H46 or 70)

- Queries by function codes H03 and H10 are supported. The number and start address of holding registers successfully accessed by the previous communication are returned. "0" is returned for both the number and start address for queries other than the function codes above.
- Query message

a. Slave address	b. Function	CRC check	
(8 bits)	H46 (8 bits)	L (8 bits)	H (8 bits)

- Normal response (Response message)

a. Slave address	b. Function	c. Starting address		d. No. of points		CRC check	
(8 bits)	H46 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message	Description
a Slave address	Set the address to send messages to. Broadcast communication is not possible. (Invalid when "0" is set.)
b Function	Set H46.

- Content of normal response

Message		Description
c	Starting address	The start address of the holding register that was successfully accessed is returned. Starting address = start register address (decimal) - 40001 For example, when starting address 0001 is returned, the holding register address that was successfully accessed is 40002.
d	No. of points	The number of holding registers that were successfully accessed is returned.

■ **Example) Read the successful register start address and number of successful accesses from slave address 25 (H19).**

Query message

Slave address	Function	CRC check	
H19 (8 bits)	H46 (8 bits)	— (8 bits)	— (8 bits)

Normal response (Response message)

Slave address	Function	Starting address		No. of points		CRC check	
H19 (8 bits)	H46 (8 bits)	H04 (8 bits)	H32 (8 bits)	H00 (8 bits)	H02 (8 bits)	— (8 bits)	— (8 bits)

The number of holding registers that were successfully accessed was returned as two with the start address 41075 (**Pr.75**).

◆ **Error response**

- An error response is returned if the query message received from the master contains an illegal function, address or data. No response is returned for parity, CRC, overrun, framing, and busy errors.

NOTE

- No response is also returned in the case of broadcast communication.

- Error response (Response message)

a. Slave address	b. Function	c. Exception code	CRC check	
(8 bits)	H80 + Function (8 bits)	(8 bits)	L (8 bits)	H (8 bits)

	Message	Description
a	Slave address	Set the address received from the master.
b	Function	The function code requested by the master and H80 is set.
c	Exception code	The codes in the following table are set.

- Error code list

Code	Error item	Error description
01	ILLEGAL FUNCTION	The query message from the master has a function code that cannot be handled by the slave.
02	ILLEGAL DATA ADDRESS*1	The query message from the master has a register address that cannot be handled by the slave. (No parameter, parameter cannot be read, parameter cannot be written)
03	ILLEGAL DATA VALUE	The query message from the master has data that cannot be handled by the slave. (Out of parameter write range, a mode is specified, or some other error)

*1 An error response is not returned in the following cases.

- (a) Function code H03 (reading data of holding registers)

When the number of registers is specified as one or more and there are one or more holding registers from which data can be read

- (b) Function code H10 (writing data to multiple holding registers)

When the number of registers is specified as one or more and there are one or more holding registers to which data can be written.

In other words, when function code H03 or H10 is used and multiple holding registers are accessed, an error response is not returned even if a nonexistent holding register or holding register that cannot be read or written from/to is accessed.

NOTE

- An error response is returned if none of the accessed holding registers exist. When an accessed holding register does not exist, the read value is 0 and the written data is invalid.

- Error detection of message data

The following errors are detected in message data from the master. The inverter output is not shut off even if an error is detected.

Error check items

Error item	Error description	Converter unit operation
Parity error	The data received by the converter unit has different parity from the specified one (Pr.334 setting).	When this error occurs, Pr.343 is incremented by one. When this error occurs, the LF signal is output.
Framing error	The data received by the converter unit has a different stop bit length from the specified one (Pr.334 setting).	
Overrun error	The next data has been sent by the master before the converter unit completes receiving the preceding data.	
Message frame error	The data length of the message frame is checked, and an error is generated if the received data length is less than 4 bytes.	
CRC check error	An error is generated if the data in the message frame does not match the calculation result.	

NOTE

- The LF signal can be assigned to an output terminal by setting **Pr.190 to Pr.195 (Output terminal function selection)**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.

◆ MODBUS register

- The following shows the MODBUS registers for system environment variables (read/write), real time monitor items (read), parameters (read/write), fault history data (read/write), and model information monitor items (read).
- System environment variables

Register	Definition	Read/write	Remarks
40002	Converter reset	Write	Any value
40003	Parameter clear	Write	Set H965A.
40004	All parameter clear	Write	Set H99AA.
40006	Parameter clear ^{*1}	Write	Set H5A96.
40007	All parameter clear ^{*1}	Write	Set HAA99.
40009	Converter unit status	Read/write	Refer to the following.

*1 Settings in the communication parameters are not cleared.

- Converter unit status

Bit	Description
0	RDB (Inverter operation enable (NC contact)) ^{*2}
1	0
2	0
3	RDA (Inverter operation enable (NO contact)) ^{*2}
4	RSO (Inverter reset) ^{*2}
5	IPF (Instantaneous power failure/undervoltage) ^{*2}
6	FAN (Fan fault output) ^{*2}
7	ABC1 (Fault) ^{*2}
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	Fault occurrence

*2 The signal within parentheses () is the initial status. The description changes depending on the setting of **Pr.190 to Pr.195 (Output terminal function selection)** (page 109).

- Real time monitor

Refer to [page 106](#) for the register numbers and monitor items of the real time monitor.

- Parameter

Pr.	Register	Name	Read/write	Remarks
0 to 999	41000 to 41999	For details on parameter names, refer to the parameter list (page 82).	Read/write	The parameter number + +41000 is the register number.
1000 to 1999	45000 to 45359	For details on parameter names, refer to the parameter list (page 82).	Read/write	The parameter number + +44000 is the register number.

- Fault history

Register	Definition	Read/write	Remarks
40501	Fault record 1	Read/write	Being 2 bytes in length, the data is stored as H00○○. Refer to the lowest 1 byte for the error code. (For details on error codes, refer to page 160 .) The fault history is batch-cleared by writing to register 40501. Set any value as data.
40502	Fault record 2	Read	
40503	Fault record 3	Read	
40504	Fault record 4	Read	
40505	Fault record 5	Read	
40506	Fault record 6	Read	
40507	Fault record 7	Read	
40508	Fault record 8	Read	

- Model information monitor

Register	Definition	Read/write	Remarks
44001	Model (1st and 2nd characters)	Read	The inverter model name can be read in ASCII code. "H20" (blank code) is set for blank area. Example) For "FR-CC2-H": H46, H52, H2D, H43, H43, H32, H2D, H48, H20, H20...H20
44002	Model (3rd and 4th characters)	Read	
44003	Model (5th and 6th characters)	Read	
44004	Model (7th and 8th characters)	Read	
44005	Model (9th and 10th characters)	Read	
44006	Model (11th and 12th characters)	Read	
44007	Model (13th and 14th characters)	Read	
44008	Model (15th and 16th characters)	Read	
44009	Model (17th and 18th characters)	Read	
44010	Model (19th and 20th characters)	Read	
44011	Capacity (1st and 2nd characters)	Read	The capacity in the converter unit can be read in ASCII code. Data read is displayed in increments of 0.1 kW. "H20" (blank code) is set for blank area. Example) 315K..." 3150" (H20, H20, H33, H31, H35, H30)
44012	Capacity (3rd and 4th characters)	Read	
44013	Capacity (5th and 6th characters)	Read	

NOTE

- When a 32-bit parameter setting or monitor item is read and the value to be read exceeds HFFFF, HFFFF is returned.

◆ Pr.343 Communication error count

- The communication error occurrence count can be checked.

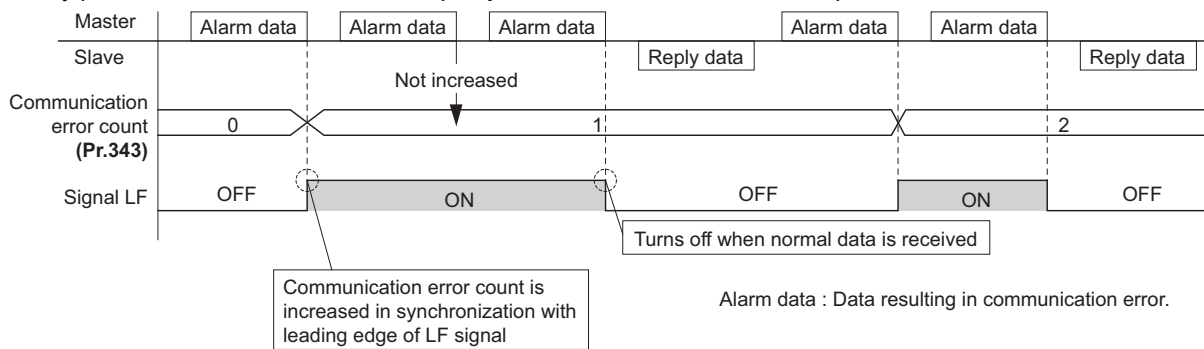
Parameter	Setting range	Minimum setting range	Initial value
343	(Read-only)	1	0

NOTE

- The communication error count is temporarily stored in the RAM memory. The value is not stored in EEPROM, and so is cleared to 0 when power is reset or the converter unit is reset.

◆ Alarm (LF) signal output (communication error warning)

- During a communication error, the Alarm (LF) signal is output by open collector output. Assign the terminal to be used using any parameter from **Pr.190 to Pr.195 (Output terminal function selection)**.



NOTE

- The LF signal can be assigned to an output terminal by setting **Pr.190 to Pr.195**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.

5

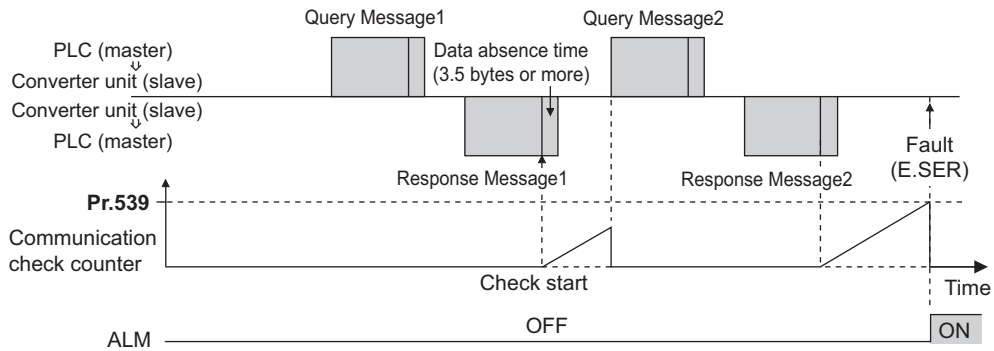
◆ Signal loss detection (Pr.539 MODBUS RTU communication check time interval)

- If signal loss is detected between the converter unit and the master, the Communication fault (inverter) "E.SER" will occur and the inverter output is shut off.
- When "9999" is set, the communication check (signal loss detection) will not be performed.
- When the setting is "0", the monitor items and parameter settings can be read, but a communication error (E.SER) occurs.
- Setting any value from 0.1 s to 999.8 s will enable signal loss detection. To detect signal loss, data must be sent from the master within the communication check time interval. (The inverter makes a communication check (clearing of communication check counter) regardless of the station number setting of the data sent from the master).

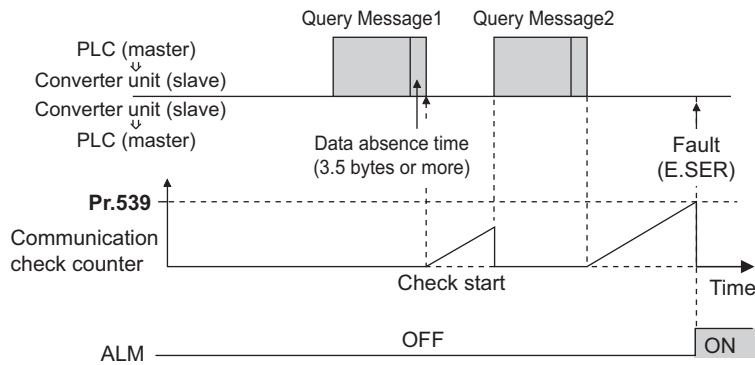
- The communication check time by query communication includes a no-data time (3.5 bytes). This no-data time differs according to the communication speed, so take this no-data time into consideration when setting the communication check time.

Example: RS-485 terminal communication, Pr. 539 = "0.1 to 999.8s"

Query communication



Broadcast communication






5.8 Parameter clear / All parameter clear

Point

- Set "1" to **Pr.CLR Parameter clear** or **ALL.CL All parameter clear** to initialize all parameters. (Parameters cannot be cleared when **Pr.77 Parameter write selection** = "1".)
- Terminal function selection parameters are not cleared even after Parameter clear has been performed.
- Refer to the parameter list on [page 188](#) for parameters cleared with this operation.

Operating procedure

1. Turning ON the power of the converter unit
The operation panel is in the monitor mode.
2. Selecting the parameter setting mode
Press **MODE** to choose the parameter setting mode. (The parameter number read previously appears.)
3. Selecting a parameter number
Turn  to "**Pr.CLR**" for Parameter clear or turn it to "**ALL.CL**" for All parameter clear, and press **SET**. "**0** (initial value)" appears.
4. Parameter clear
Turn  to change the set value to "**1**". Press **SET** to enter the setting. "**1**" and "**Pr.CLR**" ("**ALL.CL**") are displayed alternately after parameters are cleared.
 - Turn  to read another parameter.
 - Press **SET** to show the setting again.
 - Press **SET** twice to show the next parameter.

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

5.9 Parameter copy and parameter verification

Pr.CPY setting value	Description
0.---	Initial display
1.RD	Copy the source parameters to the operation panel.
2.WR	The parameters copied to the operation panel can be also copied to the destination converter units.
3.VFY	Verify parameters in the converter unit and those in the operation panel. (Refer to page 151.)

NOTE






- When the copy destination is other than the FR-CC2 series or when parameter copy is attempted after the parameter copy reading was stopped, the model error "r-E4" appears.
- Refer to the parameter list on [page 188](#) for the availability of parameter copy.
- When the power is turned OFF or an operation panel is disconnected, etc. during parameter copy writing, write again or check the setting values by parameter verification.
- While password protection is enabled, parameter copy and parameter verification cannot be performed. (Refer to [page 92.](#))
- If parameters are copied from an older converter unit to a newer converter unit that has additional parameters, out-of-range setting values may be written in some parameters. In this case, the operation remains the same as the one in the initial setting.

5.9.1 Parameter copy

- Converter unit parameter settings can be copied to other converter units.

◆ Reading the parameter settings in the converter and storing them in the operation panel

Operating procedure







1. Connect the operation panel to the source converter unit.
2. Selecting the parameter setting mode
Press  to choose the parameter setting mode. (The parameter number read previously appears.)
3. Selecting the parameter number
Turn  to "Pr.CPY" (Parameter copy), and press .
"0.---" appears.
4. Reading to and storing in the operation panel
Turn  to change the set value to "RD". Press  to start reading the converter unit parameter settings by the operation panel. (It takes about 30 seconds to read and store all the settings. During reading, "RD" blinks.)
5. End of reading and storing
"RD" and "Pr.CPY" are displayed alternately after the reading and storing are completed.

NOTE

- "r-E1" appears when a parameter read error occurred. Perform the operation from step 3 again.

◆ Copying parameter settings stored in the operation panel to the converter unit

Operating procedure

1. Connect the operation panel to the destination converter unit.
2. Selecting the parameter setting mode
Press  to choose the parameter setting mode. (The parameter number read previously appears.)
3. Selecting the parameter number
Turn  to "Pr.CPY" (Parameter copy), and press .
"0. -- --" appears.
4. Selecting parameter write
Turn  to change the set value to "2WR", then press .
"2. ALL" appears.
5. Writing to the converter unit
Press  to start writing the parameter settings stored in the operation panel to the converter unit. (It takes about 60 seconds to write all the settings. During copying, "2. ALL" blinks.)
6. End of copying
"2WR" and "Pr.CPY" are displayed alternately after copying ends.
7. When parameters are written to the destination converter unit, reset the converter unit before operation by, for example, turning the power supply OFF.

5




NOTE

- "rEE" appears when a parameter write error occurred. Perform the operation from step 3 again.

5.9.2 Parameter verification


- Whether the parameter settings of converter units are the same or not can be checked.


Operating procedure

1. Copy the parameter settings of the verification source converter unit to the operation panel according to the procedure on [page 150](#).
2. Move the operation panel to the converter unit to be verified.
3. Turning ON the power
The operation panel is in the monitor mode.
4. Selecting the parameter setting mode
Press  to choose the parameter setting mode. (The parameter number read previously appears.)
5. Selecting the parameter number
Turn  to "Pr.CPY" (Parameter copy), and press .
"0. -- --" appears.

6. Parameter verification


Turn  to change the setting value to "31F4" (Parameter copy verification).

Press . Verification of the parameter settings copied to the operation panel and the parameter settings of the verification destination converter unit is started. (It takes about 60 seconds to verify all the settings. During verification, "31F4" blinks.)

- If there are different parameters, the different parameter number and "r-E3" are displayed alternately.
- To continue verification, press .

7. "PCPY" and "31F4" are displayed alternately after verification ends.







NOTE

- When "r-E3" blinks, the parameter setting may be different between the source converter unit and the destination converter unit. To continue verification, press .

5.10 Checking parameters changed from their initial values (initial value change list)

Parameters changed from their initial values can be displayed.

Operating procedure

1. Turning ON the power of the converter unit
The operation panel is in the monitor mode.
2. Selecting the parameter setting mode
Press  to choose the parameter setting mode. (The parameter number read previously appears.)
3. Selecting the parameter number
Turn  to "Pr.CHG" (Initial value change list), and press .
"P. ---" appears.
4. Checking the initial value change list
Turn . The parameter numbers that have been changed from their initial value appear in order.
 - If  is pressed with parameters that have been changed, the setting can be changed. (Parameter numbers are no longer displayed in the list when they are returned to their initial values.)Other changed parameters appear by turning .
 - "P. ---" is returned to when the last changed parameter is displayed.

NOTE

- The initial value change list can be used also for parameter setting.

MEMO

CHAPTER 6 PROTECTIVE FUNCTIONS

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6 PROTECTIVE FUNCTIONS

This chapter explains the "PROTECTIVE FUNCTIONS" that operate in this product.

Always read the instructions before use.

6.1 Converter unit fault and alarm indications

- When the converter unit detects a fault, the operation panel displays an indication such as error message or warning, or a protective function activates to shut off the inverter output in accordance with the fault.
- When any fault occurs, take an appropriate corrective action, then reset the converter unit or the inverter, and resume the operation. Restarting the operation without a reset may break or damage the converter unit or the inverter.
- When a protective function is activated, note the following points.

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

- Converter unit fault or alarm indications are categorized as follows:

Displayed item	Description
Error message	A message regarding operational fault and setting fault by 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.


NOTE

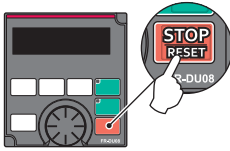
- The last eight faults can be displayed on the operation panel. (Fault history) (For the operation, refer to [page 158](#).)

6.2 Reset method for the protective functions

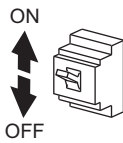
Reset the converter unit by performing any of the following operations. Note that the accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the converter unit.

The converter unit recovers about 1 second after the reset is released.

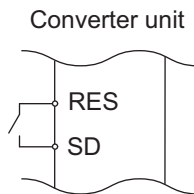
- On the operation panel, press  to reset the converter unit. (This operation is valid only when a protective function for a fault is activated. (Refer to [page 164](#) for faults.))



- Switch the power OFF once, then switch it ON again.



- 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 converter unit is in a reset status.)



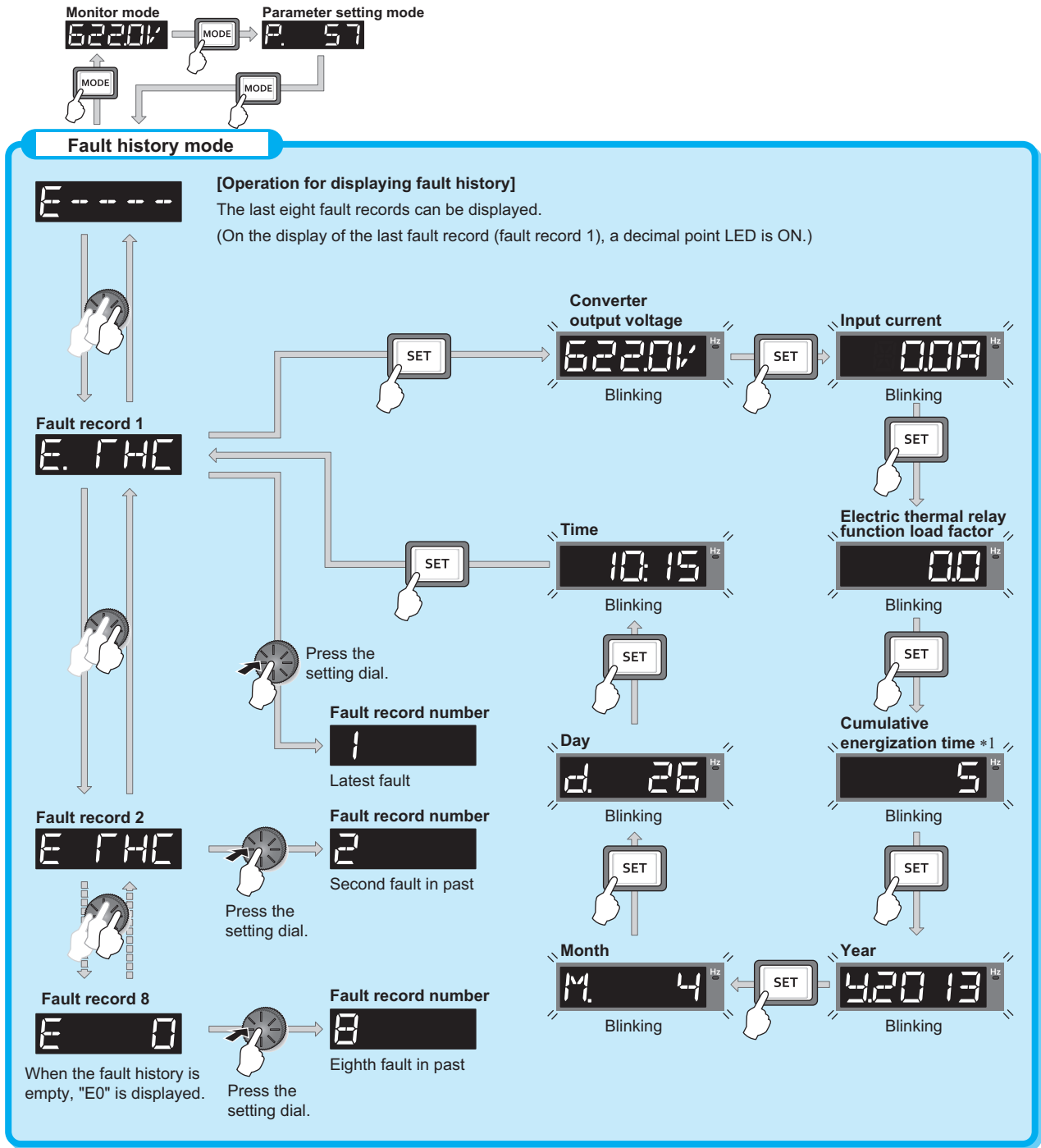
NOTE

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

6.3 Check and clear of the fault history

The operation panel stores the past eight fault records which appears when a protective function is activated (fault history).

◆ Check for the fault history



*1 The cumulative energization time is accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.

NOTE









- The fault history can be checked when the operation panel of the inverter is installed on the converter unit.

◆ Fault history clearing procedure

Point

- Set Err.CL Fault history clear = "1" to clear the fault history.

Operating procedure

- 1.** Turning ON the power of the inverter
The operation panel is in the monitor mode.
- 2.** Selecting the parameter setting mode
Press  to choose the parameter setting mode. (The parameter number read previously appears.)
- 3.** Selecting the parameter number
Turn  until **Err.CL** (fault history clear) appears. Press  to read the present set value. "0" (initial value) appears.
- 4.** Fault history clear
Turn  to change the set value to "1". Press  to start clearing.
"1" and "Err.CL" are displayed alternately after parameters are cleared.
 - Turn  to read another parameter.
 - Press  to show the setting again.
 - Press  twice to show the next parameter.

6.4 Fault history and the list of fault displays

If the displayed message does not correspond to any of the following or if you have any other problem, contact your sales representative.

◆ Error message

- A message regarding operational fault and setting fault by the operation panel is displayed. The inverter output is not shut off.

Operation panel indication	Name	Refer to page
HOLD	Operation panel lock	162
LOCd	Password locked	162
Er 1	Parameter write error	162
rE 1 to rE 4	Copy operation fault	162
Err.	Error	163

◆ 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	Refer to page
GH	Electronic thermal relay function pre-alarm	163
Mf 1 to Mf 3	Maintenance signal output	163
Ed	Emergency drive in operation	163

◆ Alarm

- The inverter output is not shut off. An Alarm (LF) signal can also be output with a parameter setting.

Operation panel indication	Name	Refer to page
FN	Fan alarm	164

◆ 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 **Pr.997 Fault initiation**.

Operation panel indication	Name	Data code	Refer to page
E. OVF	Overvoltage trip	32 (H20)	164
E. FHC	Converter overload trip (electronic thermal relay function)	48 (H30)	164
E. FIN	Heat sink overheat	64 (H40)	164
E. I PF	Instantaneous power failure	80 (H50)	165
E. UVF	Undervoltage	81 (H51)	165
E. I LF	Input phase loss	82 (H52)	165
E. OHT	External thermal relay operation	144 (H90)	165
E. PE	Parameter storage device fault (control circuit board)	176 (HB0)	165
E. PUE	PU disconnection	177 (HB1)	166
E. REF	Retry count excess	178 (HB2)	166
E. PE2	Parameter storage device fault (main circuit board)	179 (HB3)	166
E. CPU	CPU fault	192 (HC0)	166
E. 5		245 (HF5)	
E. 6		246 (HF6)	
E. 7		247 (HF7)	
E. CFE	Operation panel power supply short circuit/RS-485 terminals power supply short circuit	193 (HC1)	166
E. P24	24 VDC power fault	194 (HC2)	167
E. IOH	Inrush current limit circuit fault	197 (HC5)	167
E. SER	Communication fault (inverter)	198 (HC6)	167
E. Pbf	Internal circuit fault	202 (HCA)	167
E. 13		253 (HFD)	
E. 1		241 (HF1)	
E. 1	Option fault	241 (HF1)	167

◆ Others

- The fault history and the operation status of the converter unit are displayed. It is not a fault.

Operation panel indication	Name	Refer to page
E - - - -	Fault history	158
E. 0	No fault history	167



Operation panel indication	Name	Refer to page
<i>EV</i>	24 V external power supply operation	168

If faults other than the above appear, contact your sales representative.

6.5 Causes and corrective actions

◆ Error message

A message regarding operational troubles is displayed. The inverter output is not shut off.


Operation panel indication	HOLD	HOLD
Name	Operation panel lock	
Description	Operation lock is set. Operation other than  is invalid. (Refer to page 91 .)	
Check point	-----	
Corrective action	Press  for 2 s to release the lock.	

Operation panel indication	LOCD	LOCD
Name	Password locked	
Description	Password function is active. Display and setting of parameters are restricted.	
Check point	-----	
Corrective action	Enter the password in Pr.297 Password lock/unlock to unlock the password function before operating. (Refer to page 92 .)	

Operation panel indication	Er1	Er 1
Name	Parameter write error	
Description	<ul style="list-style-type: none"> Parameter setting was attempted while Pr.77 Parameter write selection is set to disable parameter write. The operation panel and the converter unit cannot make normal communication. 	
Check point	<ul style="list-style-type: none"> Check the Pr.77 setting. (Refer to page 91.) Check the connection between the operation panel and the converter unit. 	

Operation panel indication	rE1	rE 1
Name	Parameter read error	
Description	A failure has occurred at EEPROM in the operation panel during reading of the parameter settings for Parameter copy.	
Check point	-----	
Corrective action	<ul style="list-style-type: none"> Perform Parameter copy again. (Refer to page 150.) The operation panel may be faulty. Contact your sales representative. 	

Operation panel indication	rE2	rE 2
Name	Parameter write error	
Description	A failure has occurred at EEPROM in the operation panel during writing of the parameter settings for Parameter copy.	
Check point	-----	
Corrective action	<ul style="list-style-type: none"> The operation panel may be faulty. Contact your sales representative. Perform Parameter copy again. (Refer to page 150.) 	

Operation panel indication	rE3	rE 3
Name	Parameter verification error	
Description	<ul style="list-style-type: none"> The data in the converter unit are different from the data in the operation panel. A failure has occurred at EEPROM in the operation panel during parameter verification. 	
Check point	Check the parameter setting of the source converter unit against the setting of the target converter unit.	
Corrective action	<ul style="list-style-type: none"> Continue the verification by pressing . Perform parameter verification again. (Refer to page 151.) The operation panel may be faulty. Contact your sales representative. 	

Operation panel indication	rE4	rE4
Name	Product series error	
Description	<ul style="list-style-type: none"> The series of the source converter unit used to copy or verify parameters is not the same as the target converter unit. The operation panel data was incorrect when attempting to verify parameters or copy parameters from the operation panel to the converter unit. 	
Check point	<ul style="list-style-type: none"> Check that the source converter unit being used to verify or copy parameters is the same series as the target converter unit. Check that the copying of parameters was not interrupted due to a loss of power to the converter unit or the operation panel being disconnected. 	
Corrective action	<ul style="list-style-type: none"> Use a source converter unit that is the same series as the target converter unit. Try to copy the parameters to the operation panel from the converter unit again. 	

Operation panel indication	Err.	Err.
Description	<ul style="list-style-type: none"> The RES signal is turned ON. The operation panel and the converter unit cannot make normal communication (contact faults of the connector). This error may occur when the voltage at the input side of the converter unit drops. When using a separate power source for the control circuit power (R1/L11, S1/L21) from the main circuit power (R/L1, S/L2, T/L3), this error may appear at turning ON of the main circuit. It is not a fault. 	
Corrective action	<ul style="list-style-type: none"> Turn OFF the RES signal. Check the connection between the operation panel and the converter unit. Check the voltage on the input side of the converter unit. 	

◆ Warning

Output is not shut off when a protective function is activated.

Operation panel indication	TH	TH
Name	Electronic thermal relay function pre-alarm	
Description	<p>If the accumulated electronic thermal value reaches 85%, TH is displayed and the THP signal is output. If the cumulative value reaches or exceeds the specified value, the protection circuit is activated to stop the outputs of the converter unit.</p> <p>For the terminal used for the THP signal output, assign the function by setting "8" (positive logic) or "108" (negative logic) in any parameter from Pr.190 to Pr.195 (Output terminal function selection).</p>	
Check point	Check for large load or sudden acceleration.	
Corrective action	Reduce the load and frequency of operation.	

Operation panel indication	MT1 to MT3	MT 1 to MT 3
Name	Maintenance signal output	
Description	<p>Appears when the converter unit's cumulative energization time reaches or exceeds the parameter set value. Set the time until the MT is displayed using Pr.504 Maintenance timer 1 warning output set time (MT1), Pr.687 Maintenance timer 2 warning output set time (MT2), and Pr.689 Maintenance timer 3 warning output set time (MT3). MT does not appear when the settings of Pr.504, Pr.687, and Pr.689 are initial values (9999).</p>	
Check point	The set time of maintenance timer has been exceeded. (Refer to page 95 .)	
Corrective action	<p>Take appropriate countermeasures according to the purpose of the maintenance timer setting.</p> <p>Setting "0" in Pr.503 Maintenance timer 1, Pr.686 Maintenance timer 2, and Pr.688 Maintenance timer 3 clears the indication.</p>	

Operation panel indication	ED	Ed
Name	Emergency drive in operation	
Description	Appears during emergency drive operation.	
Check point	<ul style="list-style-type: none"> Emergency drive operation is performed by turning ON the X84 signal. 	
Corrective action	<ul style="list-style-type: none"> The display is cleared when the emergency drive operation ends. (Refer to page 102.) 	

◆ Alarm

Output is not shut off when a protective function is activated. The Alarm (LF) signal can be output depending on the parameter setting. (Set "98" in **Pr.190 to Pr.195 (Output terminal function selection)**. Refer to [page 109.](#))

Operation panel indication	FN	FN
Name	Fan alarm	
Description	Appears when the cooling fan in the converter unit stops due to a fault or slows down.	
Check point	Check the cooling fan for a failure.	
Corrective action	The fan may be faulty. Contact your sales representative.	

◆ Fault

When a protective function is activated, the inverter output is shut off and a fault signal is output.

Operation panel indication	E.OVT	E. OVT
Name	Overvoltage trip	
Description	If the converter unit's internal main circuit DC voltage reaches or exceeds the specified value, the protection circuit is activated to stop the outputs of the inverter. The circuit may also be activated by a surge voltage produced in the power supply system.	
Check point	<ul style="list-style-type: none"> • Check for sudden load change and excessive regeneration. • Check that any power supply failure did not occur. 	
Corrective action	<ul style="list-style-type: none"> • Keep the load stable. • Check the power supply. 	

Operation panel indication	E.THC	E. THC
Name	Converter overload trip (electronic thermal relay function) ^{*1}	
Description	For the protection of converter unit diode, the electronic thermal O/L relay is activated in inverse-time characteristics against the converter unit input current to shut off the inverter output.	
Check point	<ul style="list-style-type: none"> • Check the motor for the use under overload. • Check that the capacity of the inverter used is not larger than that of the converter unit. 	
Corrective action	<ul style="list-style-type: none"> • Reduce the load. • Check the configuration of the inverter and the converter unit again. 	

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

Operation panel indication	E.FIN	E. FIN
Name	Heat sink overheat	
Description	<p>When the heat sink overheats, the temperature sensor is activated, and the inverter output is stopped. The FIN signal can be output when the temperature becomes approximately 85% of the heat sink overheat protection operation temperature.</p> <p>For the terminal used for the FIN signal output, assign the function by setting "26" (positive logic) or "126" (negative logic) in any parameter from Pr.190 to Pr.195 (Output terminal function selection). (Refer to page 109.)</p>	
Check point	<ul style="list-style-type: none"> • Check for too high or low surrounding air temperature. • Check for heat sink clogging. • Check that the cooling fan is not stopped. (Check that FN is not displayed on the operation panel.) 	
Corrective action	<ul style="list-style-type: none"> • Set the surrounding air temperature to within the specifications. • Clean the heat sink. • Replace the cooling fan. 	

Operation panel indication	E.IPF	E. I PF
Name	Instantaneous power failure ^{*1}	
Description	If a power failure (converter unit input shut-off) occurs and lasts for longer than 15 ms, the instantaneous power failure protective function is activated to shut off the inverter output in order to prevent the control circuit from malfunctioning. If a power failure persists for 100 ms or longer, the fault output is not provided, and the inverter restarts if the start signal is ON upon power restoration. (The inverter operation continues if an instantaneous power failure is within 15 ms.) In some operating status (load magnitude, acceleration/deceleration time setting, etc.), overcurrent protection and such may be activated upon power restoration. When instantaneous power failure protection is activated, the IPF signal is output. (Refer to page 118.)	
Check point	Find the cause of instantaneous power failure occurrence.	
Corrective action	<ul style="list-style-type: none"> • Remedy the instantaneous power failure. • Prepare a backup power supply for instantaneous power failure. • Set the function of automatic restart after instantaneous power failure (Pr.57). (Refer to page 118.) 	

*1 E.IPF is not activated in the delta connection (for terminals R2/L12, S2/L22, and T2/L32) even if the power fails for longer than 15 ms while the converter unit is used with a 12-phase transformer.

Operation panel indication	E.UVT	E. UVF
Name	Undervoltage	
Description	If the power supply voltage of the converter unit decreases, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, the output of the inverter is stopped when the power supply voltage drops to about 300 VAC or lower. When undervoltage protection is activated, the IPF signal is output. (Refer to page 118.)	
Check point	Check if a high-capacity motor is driven.	
Corrective action	<ul style="list-style-type: none"> • Check the devices on the power supply line such as the power supply itself. • If the problem still persists after taking the above measure, contact your sales representative. 	

Operation panel indication	E.ILF	E. ILF
Name	Input phase loss ^{*1}	
Description	When Pr.872 Input phase loss protection selection is enabled ("1") and one of the three-phase power input is lost, the inverter output is shut off. This protective function is not available when Pr.872 is set to the initial value (Pr.872 = "0"). (Refer to page 97.)	
Check point	Check for a break in the cable for the three-phase power supply input.	
Corrective action	<ul style="list-style-type: none"> • Wire the cables properly. • Repair a break portion in the cable. 	

*1 E.ILF is not activated even if input is lost for one of the three phases (terminals R2/L12, S2/L22, and T2/L32) while the converter unit is used with a 12-phase transformer.

Operation panel indication	E.OHT	E. OHT
Name	External thermal relay operation	
Description	While "1" (NC contact) or "2" (NO contact) is set in Pr.876 OH input selection to enable the function, the inverter output is shut off if output of the device such as a thermostat is input as the OH signal, and the OH signal turns ON (NO contact input) or turns OFF (NC contact input). The OH signal function is assigned to terminal OH in the initial status. This protective function is not available when Pr.876 is set to the initial value (Pr.876 = "0"). (Refer to page 114.)	
Check point	<ul style="list-style-type: none"> • Check for overheating of the thermostat for overheat protection of peripheral devices. • Check that the value "7" (OH signal) is set correctly to any of Pr.178, Pr.187 or Pr.189 (Input terminal function selection). 	
Corrective action	<ul style="list-style-type: none"> • Reduce the load and operation duty. • Even if the thermostat automatically returns to normal, the converter unit (inverter) will not restart unless it is reset. 	


Operation panel indication	E.PE	E. PE
Name	Parameter storage device fault (control circuit board)	
Description	The inverter output is shut off if a fault occurs in the parameter stored. (EEPROM failure)	
Check point	Check for too many number of parameter write times.	
Corrective action	Contact your sales representative. Set "1" in Pr.342 Communication EEPROM write selection (write to RAM) for the operation which requires frequent parameter writing via communication, etc. Note that writing to RAM goes back to the initial status at power OFF.	

Operation panel indication	E.PUE	E. PUE
Name	PU disconnection	
Description	<ul style="list-style-type: none"> The inverter output is shut off if communication between the operation panel and the converter unit is interrupted (e.g. by removing the operation panel) when the disconnected PU detection function is valid in Pr.75 Reset selection/disconnected PU detection/reset limit. The inverter output is shut off if communication errors occurred consecutively for more than permissible number of retries when 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 Pr.122 PU communication check time interval during the RS-485 communication via the PU connector. 	
Check point	<ul style="list-style-type: none"> Check that the operation panel is connected properly. Check the Pr.75 setting. 	
Corrective action	Connect the operation panel securely.	

Operation panel indication	E.RET	E. RET
Name	Retry count excess	
Description	The inverter output is shut off if the operation cannot be resumed properly within the number of retries set in Pr.67 Number of retries at fault occurrence . This function is available when Pr.67 is set. This protective function is not available in the initial setting (Pr.67 = "0").	
Check point	Find the cause of the fault occurrence.	
Corrective action	Eliminate the cause of the fault preceding this fault indication.	

Operation panel indication	E.PE2	E. PE2
Name	Parameter storage device fault (main circuit board)	
Description	The inverter output is shut off if a fault occurs in the parameter stored. (EEPROM failure)	
Check point	-----	
Corrective action	Contact your sales representative.	

Operation panel indication	E.CPU	E. CPU
	E. 5	E. 5
	E. 6	E. 6
	E. 7	E. 7
Name	CPU fault	
Description	The inverter trips if the communication fault of the built-in CPU occurs.	
Check point	Check for devices producing excess electrical noises around the converter unit.	
Corrective action	<ul style="list-style-type: none"> Take measures against noise if there are devices producing excess electrical noises around the converter unit. Contact your sales representative. 	

Operation panel indication	E.CTE	E. CTE
Name	Operation panel power supply short circuit/RS-485 terminals power supply short circuit	
Description	<ul style="list-style-type: none"> When the power supply for the operation panel (PU connector) is shorted, the power output is shutoff and the inverter output is shut off. At this time, the use of the operation panel and the RS-485 communication via the PU connector are disabled. To reset, enter the RES signal from the terminal, reset through communication via the RS-485 terminals, or switch power OFF then ON again. When the power supply for the RS-485 terminals are short circuited, this function shuts off the power output. At this time, communication from the RS-485 terminals cannot be made. To reset, use  on the operation panel, enter the RES signal, or switch power OFF then ON again. 	
Check point	<ul style="list-style-type: none"> Check that the PU connector cable is not shorted. Check that the RS-485 terminals are connected correctly. 	
Corrective action	<ul style="list-style-type: none"> Check the operation panel and the cable. Check the connection of the RS-485 terminals. 	

Operation panel indication	E.P24	E. P24
Name	24 VDC power fault	
Description	<ul style="list-style-type: none"> When the 24 VDC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch OFF. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel, or switch power OFF, then ON again. 	
Check point	<ul style="list-style-type: none"> Check for a short circuit in the PC terminal output. Check that the 24 V external power supply voltage is correct. 	
Corrective action	<ul style="list-style-type: none"> Repair the short-circuited portion. Supply the power at 24 V. (If the power with insufficient voltage is supplied to the 24 V input circuit for a long time, the inverter internal circuit may heat up. Although it will not damage the inverter, supply power at the correct voltage.) 	

Operation panel indication	E.IOH	E. IOH
Name	Inrush current limit circuit fault	
Description	The inverter output is shut off when the resistor of the inrush current limit circuit is overheated. The inrush current limit circuit is faulty.	
Check point	<ul style="list-style-type: none"> Check that frequent power ON/OFF is not repeated. Check if the input side fuse (5A) in the power supply circuit of the inrush current limit circuit contactor is blown. Check that the power supply circuit of inrush current limit circuit contactor is not damaged. 	
Corrective action	Configure a circuit where frequent power ON/OFF is not repeated. If the problem still persists after taking the above measure, contact your sales representative.	

Operation panel indication	E.SER	E. SER
Name	Communication fault (inverter)	
Description	The inverter output is shut off when communication error occurs consecutively for the permissible number of retries or more when Pr.335 RS-485 communication retry count ≠ "9999" during RS-485 communication through the RS-485 terminals. The inverter output is also shut off if communication is broken for the period of time set in Pr.336 RS-485 communication check time interval .	
Check point	Check the RS-485 terminal wiring.	
Corrective action	Perform wiring of the RS-485 terminals properly.	


Operation panel indication	E.PBT	E. PBT
	E.13	E. 13
Name	Internal circuit fault	
Description	The inverter output is shut off when an internal circuit fault occurs in the converter unit.	
Corrective action	Contact your sales representative.	

Operation panel indication	E.1	E. 1
Name	Option fault	
Description	The inverter output is shut off if a plug-in option is disconnected while the converter unit power is ON.	
Check point	<ul style="list-style-type: none"> Check if a plug-in option is connected. Check for excessive noise around the converter unit. 	
Corrective action	<ul style="list-style-type: none"> Disconnect the plug-in option. (Plug-in options cannot be used.) Take measures against noises if there are devices producing excessive electrical noises around the converter unit. If the problem still persists after taking the above measure, contact your sales representative.	

◆ Others

The operation status of the converter unit is displayed. It is not a fault.

Operation panel indication	E.0	E. 0
Name	No fault history	
Description	Appears when no fault records are stored. (Appears when the fault history is cleared after the protective function has been activated.)	

Operation panel indication	EV	
Name	24 V external power supply operation	
Description	Blinks when the main circuit power supply is off and the 24 V external power supply is being input.	
Check point	Power is supplied from a 24 V external power supply.	
Corrective action	<ul style="list-style-type: none"> • Turning ON the power supply (main circuit) of the converter unit clears the indication. • If the indication is still displayed after turning ON of the power supply (main circuit) of the converter unit, the power supply voltage may be low. 	

 **NOTE**

- If faults other than the above appear, contact your sales representative.

6.6 Check first when you have a trouble

Point

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

6.6.1 The converter does not operate properly.

Check point	Possible cause	Countermeasure	Refer to page
Main circuit, control circuit	The wiring or installation is inadequate.	Check for secure wiring and installation.	32
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.	52

6

6.6.2 Power lamp is not lit

Check point	Possible cause	Countermeasure	Refer to page
Main circuit, control circuit	The wiring or installation is inadequate.	Check for secure wiring and installation. The power lamp is lit when power is supplied to the control circuit (R1/L11, S1/L21).	37

6.6.3 The charge lamp on the converter unit does not come on.

Check point	Possible cause	Countermeasure	Refer to page
Main circuit, control circuit	The wiring or installation is inadequate.	Check for secure wiring and installation. The charge lamp turns ON when power is supplied to the control circuit (R/L1, S/L2, T/L3).	37

6.6.4 Operation panel display is not operating.

Check point	Possible cause	Countermeasure	Refer to page
Main circuit, control circuit	The power is not input.	Input the power.	32
Front cover	The operation panel is not properly connected to the converter unit.	Check if the front cover is installed securely.	23

6.6.5 The inverter does not run.

Check point	Possible cause	Countermeasure	Refer to page
Control circuit	Terminals RDA and SE of the converter unit are not connected to terminals MRS (X10 signal) and SD of the inverter respectively.	Check for secure wiring and installation.	32
Parameter	Inverter parameter settings are incorrect.	Check for the inverter parameter settings.	Refer to the Instruction Manual (Detailed) of the inverter.

6.6.6 Unable to write parameter setting

Check point	Possible cause	Countermeasure	Refer to page
Parameter setting	Parameter write is disabled by the Pr.77 Parameter write selection setting.	Check the Pr.77 setting.	91
	The key lock mode is enabled by the Pr.161 Key lock operation selection setting.	Check the Pr.161 setting.	91

6.6.7 A breaker trips.

Check point	Possible cause	Countermeasure	Refer to page
Main circuit	The wiring or installation is inadequate.	Check for secure wiring and installation.	32
	An appropriate power supply voltage is not applied.	Check if an appropriate power supply voltage is applied.	—

6.6.8 The converter unit generates abnormal noise

Check point	Possible cause	Countermeasure	Refer to page
Fan	The fan cover was not correctly installed when a cooling fan was replaced.	Install the fan cover correctly.	175

CHAPTER 7 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

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7 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

This chapter explains the precautions for maintenance and inspection of this product.
Always read the instructions before use.

7.1 Inspection item

The converter unit 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.

◆ Precautions for maintenance and inspection

When accessing the converter unit for inspection, wait for at least 10 minutes after the power supply has been switched OFF. Then, make sure that the voltage across the main circuit terminals P/+ and N/- on the converter unit is not more than 30 VDC using a digital multimeter, etc.

7.1.1 Daily inspection

Basically, check for the following faults during operation.

- Motor operation fault
- Improper installation environment
- Cooling system fault
- Abnormal vibration, abnormal noise
- Abnormal overheat, discoloration

7.1.2 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection. Consult us for periodic inspection.

Check and clean the cooling system: Clean the air filter, etc.

Check the tightening and retighten: The screws and bolts may become loose due to vibration, temperature changes, etc. Check and tighten them. Tighten them according to the specified tightening torque. (Refer to [page 38](#).)

Check the conductors and insulating materials for corrosion and damage.

Measure the insulation resistance.

Check and change the cooling fan and relay.

7.1.3 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.	

Area of inspection	Inspection item	Description	Inspection interval		Corrective action at fault occurrence	Check by user	
			Daily	Periodic ^{*3}			
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. 		<input type="radio"/>	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.). 		<input type="radio"/>	Contact the manufacturer. Contact the manufacturer.		
	Transformer/reactor	Check for unusual odor and abnormal increase of whining sound.	<input type="radio"/>		Stop the equipment and contact the manufacturer.		
	Terminal block	Check for a damage.		<input type="radio"/>	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. 		<input type="radio"/>	Contact the manufacturer. Contact the manufacturer.		
	Relay/contactator	Check that the operation is normal and no chattering sound is heard.		<input type="radio"/>	Contact the manufacturer.		
Control circuit, protection circuit	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. 		<input type="radio"/>	Contact the manufacturer. Contact the manufacturer.		
	Components check	Overall	<ul style="list-style-type: none"> • Check for unusual odor and discoloration. • Check for serious rust development. 		<input type="radio"/>	Stop the equipment and contact the manufacturer. Contact the manufacturer.	
		Aluminum electrolytic capacitor	<ul style="list-style-type: none"> • Check for liquid leakage in a capacitor and deformation trace. • Visual check. 		<input type="radio"/>	Contact the manufacturer.	
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. 	<input type="radio"/>	<input type="radio"/>	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. 		<input type="radio"/>	Clean. Clean.		
Display	Indication	<ul style="list-style-type: none"> • Check that indications are correct. • Check for stains. 	<input type="radio"/>	<input type="radio"/>	Contact the manufacturer. Clean.		
	Meter/counter	Check that readouts are correct.	<input type="radio"/>		Stop the equipment and contact the manufacturer.		
Load motor	Operation check	Check for vibration and abnormal increase in operation noise.	<input type="radio"/>		Stop the equipment and contact the manufacturer.		

*1 Oil component of the heat dissipation grease used inside the converter unit 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 converter unit.

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

NOTE

- 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.

7.1.4 Checking the converter semiconductor devices

◆ Preparation

- Disconnect the external power supply cables (R/L1, S/L2, T/L3, P/+, and N/-).
- Prepare a continuity tester. (For the resistance measurement, use the 100 Ω range.)

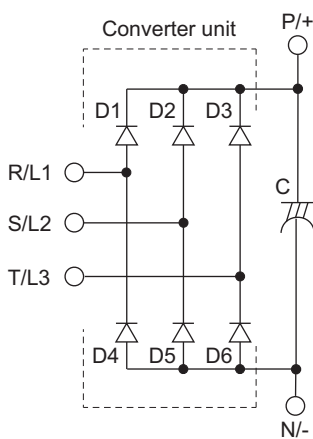
◆ Checking method

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

NOTE

- Before measurement, check 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.

◆ Semiconductor device numbers and terminals to be checked



Converter unit	Tester polarity		Continuity
	\oplus	\ominus	
D1	R/L1	P/+	No
	P/+	R/L1	Yes
D2	S/L2	P/+	No
	P/+	S/L2	Yes
D3	T/L3	P/+	No
	P/+	T/L3	Yes
D4	R/L1	N/-	Yes
	N/-	R/L1	No
D5	S/L2	N/-	Yes
	N/-	S/L2	No
D6	T/L3	N/-	Yes
	N/-	T/L3	No

(Assuming that an analog meter is used.)

7.1.5 Cleaning

Always run the converter unit in a clean status.

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

NOTE

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

7.1.6 Replacement of parts

The converter unit 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 converter unit. 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	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
Main circuit fuse	10 years	Replace (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 Input current: 80% of the converter unit rating

NOTE

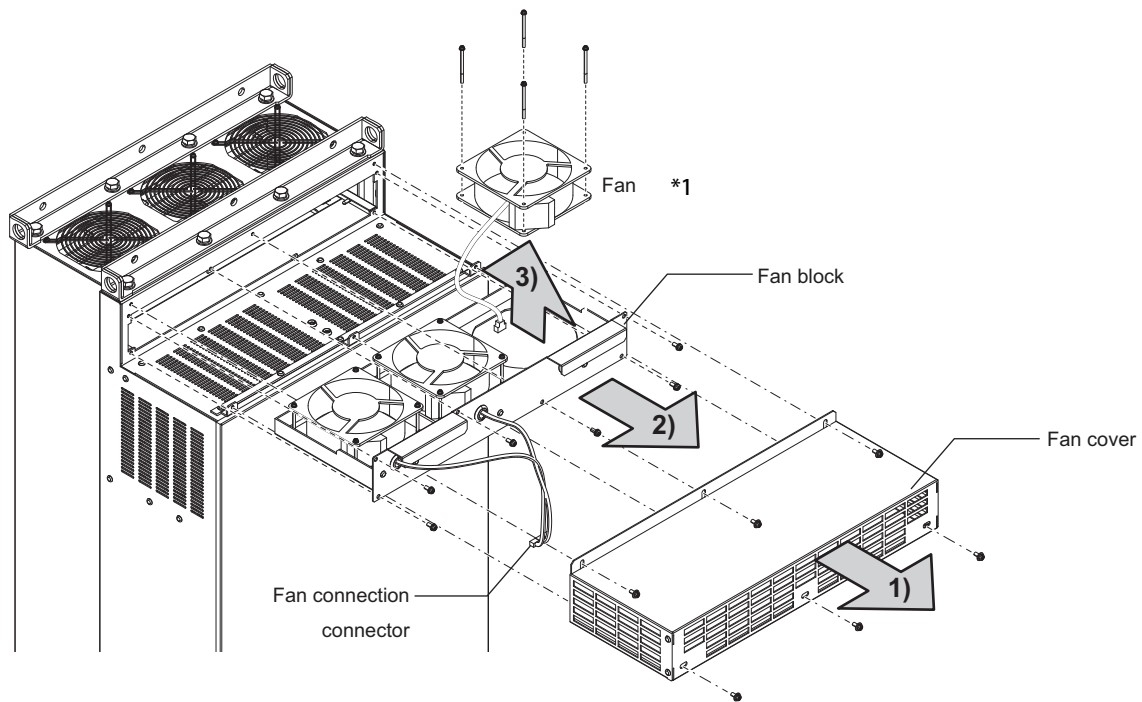
- For parts replacement, contact the nearest Mitsubishi FA center.

◆ 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

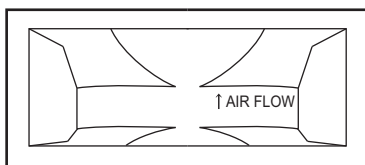
1. Remove the fan cover fixing screws, and remove the fan cover.
2. Disconnect the fan connector and remove the fan block.
3. Remove the fan fixing screws, and remove the fan.



*1 The number of cooling fans differs according to the converter unit capacity.

■ Reinstallation

1. After confirming the orientation of the fan, install the fan so that the "AIR FLOW" arrow faces up.



<Fan side face>

2. Install fans referring to the above figure.
Tightening torque of the fan fixing screws: 0.73 N·m.

NOTE

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

◆ 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 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 remaining life when its capacity has dropped below 80% of its rated capacity.

NOTE

- The converter unit diagnoses the control circuit capacitor by itself, and estimates its remaining life. (Refer to [page 94](#).)

◆ 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 A1, B1, and C1. (Refer to [page 176](#).) (After replacing the control circuit terminal block, connect the jumper connector to the correct position in accordance with the control logic of input signals. (Refer to [page 47](#).)

◆ Main circuit fuse

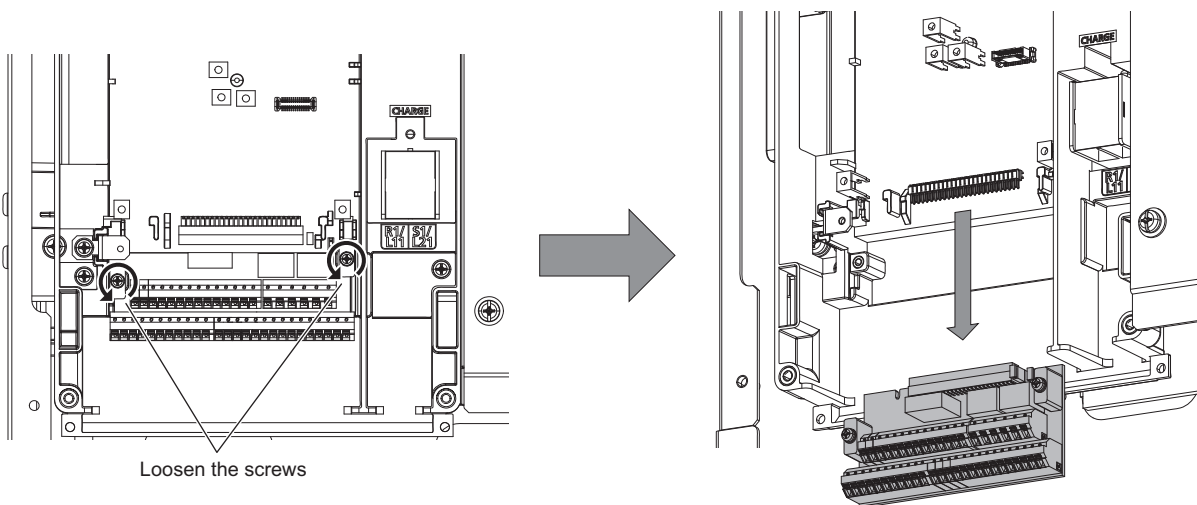
Fuses are used in the converter unit. Replacement intervals of capacitors vary greatly with surrounding temperatures and operating conditions. Replace them roughly every 10 years when used in normal air-conditioned environments.

7.1.7 Removal and reinstallation of the control circuit terminal block

This product has a removable control circuit terminal block, which can be replaced with a new one.

◆ Removal and reinstallation

1. Loosen the two installation screws at the both sides of the control circuit terminal block. (These screws cannot be removed.)
Slide down the control circuit terminal block to remove it.



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

NOTE

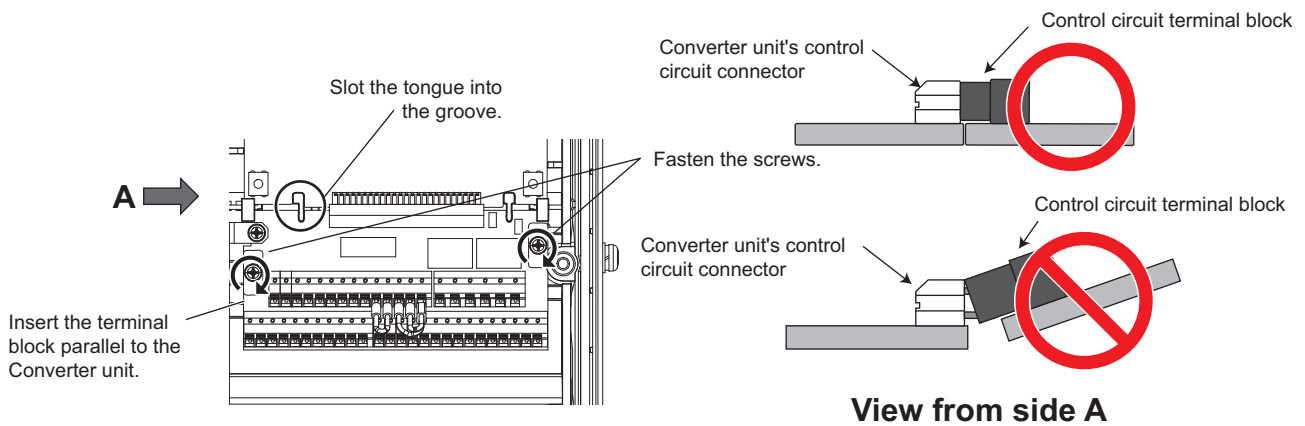
- Before starting the replacement, power OFF the converter unit, wait for at least 10 minutes, and then check that the charge lamp is OFF to ensure safety.

◆ 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 converter unit 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 converter unit.
- To install the control circuit terminal block, slide it upward so that the tongues on the converter unit slot into the grooves on the terminal block.
- Check that the terminal block is parallel to the converter unit and the pins on the converter unit's control circuit connector are not bent. After checking proper connection, fix the terminal block in place with two screws.



NOTE

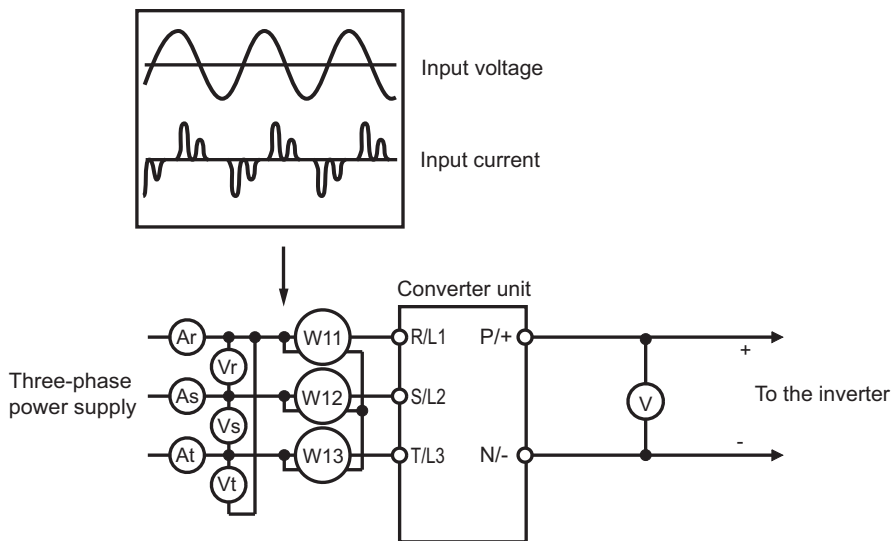
- Do not tilt the terminal block while tightening the screws or removing it from the converter unit. (Otherwise, stress applied to the control circuit terminal block or the control circuit connector may damage the pins.)
- After replacing the control circuit terminal block, connect the jumper connector to the correct position in accordance with the control logic of input signals. (Refer to [page 47.](#))

7.2 Measurement of main circuit voltages, currents, and powers

Since the voltages and currents on the converter unit 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.

NOTE

- When installing meters etc. on the output side of the converter unit:
When the wiring length between the converter unit and the inverter is long, the meters and CTs may generate heat due to line-to-line leakage current. Therefore, choose the equipment which has enough allowance for the current rating.



◆ Measuring points and instruments

Item	Measuring point	Measuring instrument	Remarks (reference measured value)
Power supply voltage V1	Between R/L1 and S/L2, S/L2 and T/L3, and T/L3 and R/L1	Digital power meter (designed for inverter)	Commercial power Within permissible AC voltage fluctuation. (Refer to page 182.)
Input current I1	Line current at R/L1, S/L2, and T/L3		
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		P1 = W11 + W12 + W13 (3-wattmeter method)
Input power factor Pf1	Calculate after measuring input voltage, input current and input power. $Pf_1 = \frac{P_1}{\sqrt{3}V_1 \times I_1} \times 100\%$		
Converter output	Between P/+ and N/-	Digital multimeter or some other tester	Inverter LED indication 1.35 × V1
Input signal	Across terminals RDI, OH, RES(+) and SD (for sink logic)	Digital multimeter or some other tester, or moving-coil type instrument (internal resistance 50 kΩ or more)	Voltage when terminal is open: 20 to 30 VDC. Voltage when signal is ON: 1 V or less.
Fault signal	Between A1 and C1	Digital multimeter or some other tester	Continuity test ^{*1} Normal: discontinuity across A1 and C1 (continuity across B1 and C1)
	Between B1 and C1		Fault: continuity across A1 and C1 (discontinuity across B1 and C1)

*1 When the setting of Pr.195 ABC1 terminal function selection is the positive logic.

7.2.1 Measurement of powers

Use a digital power meter (for inverter) for the input side of the converter unit.

7.2.2 Measurement of voltages

Use a digital power meter (for inverter) for the input side of the converter unit.

7.2.3 Measurement of currents

Use a digital power meter (for inverter) for the input side of the converter unit.

Since the converter unit 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.

The converter unit input current can be monitored on the operation panel. The value displayed on the operation panel is accurate. Hence, it is recommended to monitor values on the operation panel or by outputting the analog signal. Install the operation panel of the inverter on the converter unit.

7.2.4 Example of measuring converter unit input power factor

Calculate the factor from the effective power and the apparent power. A power-factor meter cannot indicate an exact value.

$$\begin{aligned} \text{Total power factor of the inverter} &= \frac{\text{Effective power}}{\text{Apparent power}} \\ &= \frac{\text{Three-phase input power found by the 3-wattmeter method}}{\sqrt{3} \times V \text{ (power supply voltage)} \times I \text{ (input current effective value)}} \end{aligned}$$

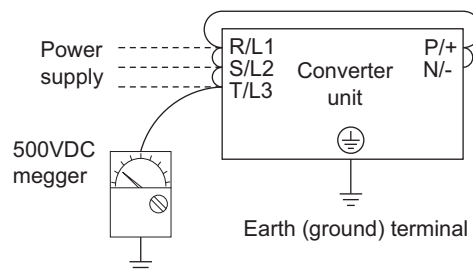
7.2.5 Measurement of converter output voltage (across terminals P and N)

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 710 to 930 VDC is output when no load is applied. 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 1200 to 1300 VDC maximum.

7.2.6 Insulation resistance test using megger

- For the converter unit, 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, and T/L3 (indicated by dashed lines in the diagram).



NOTE

- Before performing the insulation resistance test on the external circuit, disconnect the cables from all terminals of the converter unit so that the test voltage is not applied to the converter unit.
- For the continuity test of the control circuit, use a tester for high resistance range and do not use the megger or buzzer.

7.2.7 Withstand voltage test

Do not conduct a withstand voltage test. Deterioration may occur.

CHAPTER 8 SPECIFICATIONS

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8 SPECIFICATIONS

This chapter explains the specifications of this product.

Always read the instructions before use.

8.1 Converter unit rating

Model FR-CC2-H-[]		315K	355K	400K	450K	500K	560K	630K
Applicable motor capacity (kW)		315	355	400	450	500	560	630
Output	Overload current rating*1	200% 60 s, 250% 3 s				150% 60 s, 200% 3 s	120% 60 s, 150% 3 s	110% 60 s, 120% 3 s
	Rated voltage*2	430 to 780 VDC*4						
Power supply	Rated input AC voltage/frequency	Three-phase 380 to 500 V, 50/60 Hz						
	Permissible AC voltage fluctuation	Three-phase 323 to 550 V, 50/60 Hz						
	Permissible frequency fluctuation	±5%						
	Rated input current (A)	610	683	770	866	962	1094	1212
	Power supply capacity (kVA)*3	465	521	587	660	733	833	924
Protection rating of structure (IEC 60529)		Open type (IP00)						
Cooling system		Forced air						
DC reactor		Built-in						
Approx. mass (kg)		210	213	282	285	288	293	294

*1 The percentage of the overload current rating is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the converter unit and the inverter to return to or below the temperatures under 100% load.

*2 The converter unit output voltage varies according to the input power supply voltage and the load. The maximum point of the voltage waveform at the converter unit output side is approximately the power supply voltage multiplied by $\sqrt{2}$.

*3 The power supply capacity is the value at the rated output current. The input power impedances (including those of the input reactor and cables) affect the value.

*4 The permissible voltage imbalance ratio is 3% or less. (Imbalance ratio = (highest voltage between lines - average voltage between three lines) / average voltage between three lines × 100)

8.2 Common specifications

Input signal (3)		External thermal relay input, converter reset. The signal to be input can be changed using Pr.178, Pr.187, or Pr.189 (Input terminal function selection) .
Operational function		Thermal protection, DC injection brake, automatic restart after instantaneous power failure, retry function, RS-485 communication, life diagnosis, maintenance timer, 24 V power supply input for control circuit
Output signal Open collector output (5) Relay output (1)		Inverter operation enable (NO contact), Instantaneous power failure/undervoltage, Inverter reset, Fan fault output, Fault The signal to be output can be changed using Pr.190 to Pr.195 (Output terminal function selection) .
Operation panel^{*3}	Status monitoring	Converter output voltage, input current, electric thermal relay function load factor The item for monitoring can be changed using Pr.774 to Pr.776 Operation panel monitor selection 1 to 3 .
	Fault monitoring	When a protective function is activated, a fault indication is displayed and the converter output voltage, input current, electronic thermal relay function load factor, cumulative energization time, date (year, month, day) and time at the occurrence of the fault are stored. Each fault is recorded and the last 8 records can be displayed.
Protective function	Fault	Overvoltage trip, Converter overload trip (electronic thermal relay function), Heat sink overheat, Instantaneous power failure, Undervoltage, Input phase loss ^{*2} , External thermal relay operation, PU disconnection ^{*2} , Retry count excess ^{*2} , Parameter storage device fault (control circuit board), Parameter storage device fault (main circuit board), CPU fault, 24 VDC power fault, Inrush current limit circuit fault, Communication fault (inverter), Option fault, Operation panel power supply short circuit/RS-485 terminals power supply short circuit, Internal circuit fault
	Alarm, Warning, Error message	Fan alarm, Electronic thermal relay function pre-alarm, Maintenance signal output ^{*2} , Operation panel lock ^{*2} , Password locked ^{*2} , Parameter write error, Copy operation error, 24 V external power supply operation, Emergency drive in operation ^{*2}
Environment	Surrounding air temperature	FR-CC2-H315K to H560K: -10°C to +50°C (non-freezing) FR-CC2-H630K: -10°C to +40°C (non-freezing)
	Surrounding air humidity	95% RH or less (non-condensing)
	Storage temperature^{*1}	-20°C to +65°C
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude/vibration	2500 m or less (For installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.) 2.9 m/s ² or less at 10 to 55 Hz (in either X, Y, or Z direction)

*1 Applicable to conditions for a short time, for example, in transit.

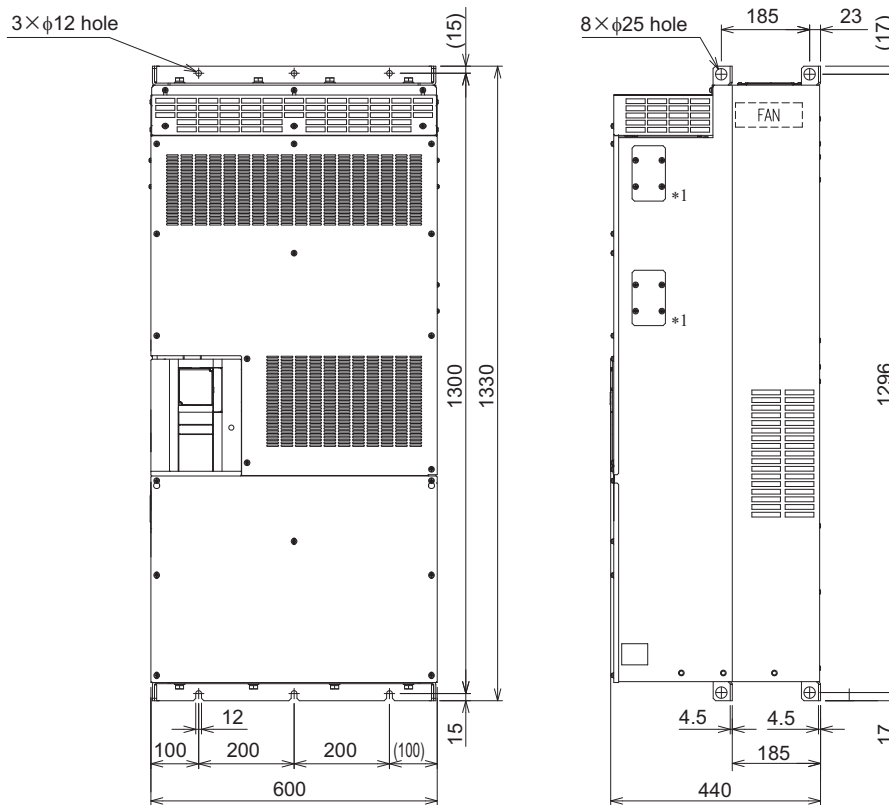
*2 Not activated in the inverter in the initial state.

*3 In the initial status, monitoring using the operation panel is not available. Remove the accessory cover and install the inverter operation panel. (Refer to [page 23](#).)

8.3 Outline dimension drawings

8.3.1 Converter unit outline dimension drawings

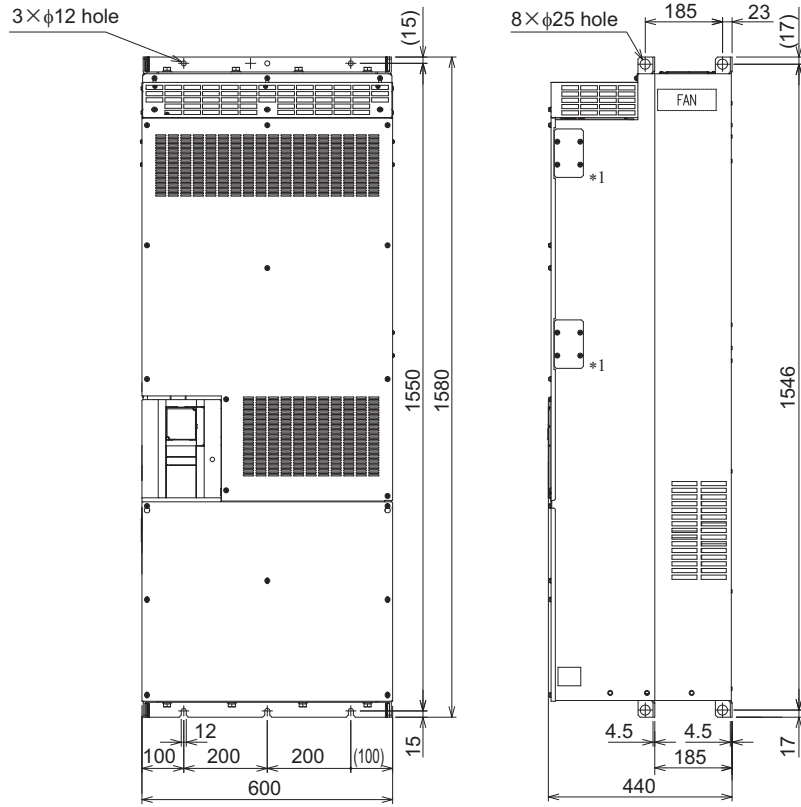
FR-CC2-H315K, H355K



(Unit: mm)

*1 Do not remove the cover on the side of the converter unit.

FR-CC2-H400K, H450K, H500K, H560K, H630K



(Unit: mm)

*1 Do not remove the cover on the side of the converter unit.

MEMO

CHAPTER 9 APPENDIX

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9 APPENDIX

APPENDIX provides the reference information for use of this product.

Refer to APPENDIX as required.

9.1 Instruction code list

- *1 Instruction codes are used to read and write parameters in accordance with the Mitsubishi inverter protocol of RS-485 communication. (For RS-485 communication, refer to [page 125](#).)
- *2 For Parameter copy, Parameter clear, and All parameter clear, ○ indicates the function is available, and × indicates the function is not available.
- *3 Communication parameters that are not cleared by Parameter clear (All parameter clear) via the RS-485 communication. (For RS-485 communication, refer to [page 125](#).)
- *4 Reading and writing via the PU connector are available.

Pr.	Name	Instruction code ^{*1}			Parameter		
		Read	Write	Extended	Copy ^{*2}	Clear ^{*2}	All clear ^{*2}
30	Reset selection during power supply to main circuit	1E	9E	0	○	○	○
57	Restart selection	39	B9	0	○	○	○
65	Retry selection	41	C1	0	○	○	○
67	Number of retries at fault occurrence	43	C3	0	○	○	○
68	Retry waiting time	44	C4	0	○	○	○
69	Retry count display erase	45	C5	0	○	○	○
75	Reset selection/disconnected PU detection/reset limit	4B	CB	0	○	×	×
77 ^{*4}	Parameter write selection	4D	CD	0	○	○	○
117	PU communication station number	11	91	1	○	○ ^{*3}	○ ^{*3}
118	PU communication speed	12	92	1	○	○ ^{*3}	○ ^{*3}
119	PU communication stop bit length / data length	13	93	1	○	○ ^{*3}	○ ^{*3}
120	PU communication parity check	14	94	1	○	○ ^{*3}	○ ^{*3}
121	PU communication retry count	15	95	1	○	○ ^{*3}	○ ^{*3}
122	PU communication check time interval	16	96	1	○	○ ^{*3}	○ ^{*3}
123	PU communication waiting time setting	17	97	1	○	○ ^{*3}	○ ^{*3}
124	PU communication CR/LF selection	18	98	1	○	○ ^{*3}	○ ^{*3}
161	Key lock operation selection	01	81	2	○	×	○
168	Parameter for manufacturer setting. Do not set.						
169							
170	Watt-hour meter clear	0A	8A	2	○	×	○
178	RDI terminal function selection	12	92	2	○	×	○
187	OH terminal function selection	1B	9B	2	○	×	○

Pr.	Name	Instruction code ^{*1}			Parameter		
		Read	Write	Extended	Copy ^{*2}	Clear ^{*2}	All clear ^{*2}
189	RES terminal function selection	1D	9D	2	○	×	○
190	RDB terminal function selection	1E	9E	2	○	×	○
191	RDA terminal function selection	1F	9F	2	○	×	○
192	IPF terminal function selection	20	A0	2	○	×	○
193	RSO terminal function selection	21	A1	2	○	×	○
194	FAN terminal function selection	22	A2	2	○	×	○
195	ABC1 terminal function selection	23	A3	2	○	×	○
244	Cooling fan operation selection	34	B4	2	○	○	○
248	Self power management selection	38	B8	2	○	○	○
255	Life alarm status display	3F	BF	2	×	×	×
256	Inrush current limit circuit life display	40	C0	2	×	×	×
257	Control circuit capacitor life display	41	C1	2	×	×	×
261	Power failure stop selection	45	C5	2	○	○	○
268	Monitor decimal digits selection	4C	CC	2	○	○	○
269	Parameter for manufacturer setting. Do not set.						
290	Monitor negative output selection	62	E2	2	○	○	○
296	Password lock level	68	E8	2	○	×	○
297	Password lock/unlock	69	E9	2	○	○ ^{*4}	○
331	RS-485 communication station number	1F	9F	3	○	○ ^{*3}	○ ^{*3}
332	RS-485 communication speed	20	A0	3	○	○ ^{*3}	○ ^{*3}
333	RS-485 communication stop bit length / data length	21	A1	3	○	○ ^{*3}	○ ^{*3}

Pr.	Name	Instruction code ^{*1}			Parameter		
		Read	Write	Extended	Copy ^{*2}	Clear ^{*2}	All clear ^{*2}
334	RS-485 communication parity check selection	22	A2	3	○	○ ^{*3}	○ ^{*3}
335	RS-485 communication retry count	23	A3	3	○	○ ^{*3}	○ ^{*3}
336	RS-485 communication check time interval	24	A4	3	○	○ ^{*3}	○ ^{*3}
337	RS-485 communication waiting time setting	25	A5	3	○	○ ^{*3}	○ ^{*3}
341	RS-485 communication CR/LF selection	29	A9	3	○	○ ^{*3}	○ ^{*3}
342	Communication EEPROM write selection	2A	AA	3	○	○	○
343	Communication error count	2B	AB	3	×	×	×
503	Maintenance timer 1	03	83	5	×	×	×
504	Maintenance timer 1 warning output set time	04	84	5	○	×	○
514	Emergency drive dedicated retry waiting time	0E	8E	5	○	×	○
515	Emergency drive dedicated retry count	0F	8F	5	○	×	○
523	Emergency drive mode selection	17	97	5	○	×	○
539	MODBUS RTU communication check time interval	27	A7	5	○	○ ^{*3}	○ ^{*3}
549	Protocol selection	31	B1	5	○	○ ^{*3}	○ ^{*3}
563	Energization time carrying-over times	3F	BF	5	×	×	×
598	Undervoltage level	62	E2	5	○	○	○
663	Control circuit temperature signal output level	3F	BF	6	○	○	○
686	Maintenance timer 2	56	D6	6	×	×	×
687	Maintenance timer 2 warning output set time	57	D7	6	○	×	○
688	Maintenance timer 3	58	D8	6	×	×	×
689	Maintenance timer 3 warning output set time	59	D9	6	○	×	○
774	Operation panel monitor selection 1	4A	CA	7	○	○	○
775	Operation panel monitor selection 2	4B	CB	7	○	○	○
776	Operation panel monitor selection 3	4C	CC	7	○	○	○
872	Input phase loss protection selection	48	C8	8	○	○	○
876	OH input selection	4C	CC	8	○	○	○
888	Free parameter 1	58	D8	8	○	×	×
889	Free parameter 2	59	D9	8	○	×	×
891	Cumulative power monitor digit shifted times	5B	DB	8	○	○	○

Pr.	Name	Instruction code ^{*1}			Parameter		
		Read	Write	Extended	Copy ^{*2}	Clear ^{*2}	All clear ^{*2}
990	PU buzzer control	5A	DA	9	○	○	○
992	Operation panel setting dial push monitor selection	5C	DC	9	○	○	○
997	Fault initiation	61	E1	9	×	×	×
1006	Clock (year)	06	86	A	×	×	×
1007	Clock (month, day)	07	87	A	×	×	×
1008	Clock (hour, minute)	08	88	A	×	×	×
1048	Display-off waiting time	30	B0	A	○	○	○

9.2 Instructions for compliance with the EU Directives

The EU Directives are issued to standardize different national regulations of the EU Member States and to facilitate free movement of the equipment, whose safety is ensured, in the EU territory.

Since 1996, compliance with the EMC Directive that is one of the EU Directives has been legally required. Since 1997, compliance with the Low Voltage Directive, another EU Directive, has been also legally required. When a manufacturer confirms its equipment to be compliant with the EMC Directive and the Low Voltage Directive, the manufacturer must declare the conformity and affix the CE marking.

- The authorized representative in the EU

The authorized representative in the EU is shown below.

Name: Mitsubishi Electric Europe B.V.

Address: Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany

- Note

We declare that this converter unit conforms with the EMC Directive in industrial environments and affix the CE marking on the converter unit. When using the converter unit in a residential area, take appropriate measures and ensure the conformity of the converter unit used in the residential area.

◆ EMC Directive

We declare that this converter unit conforms with the EMC Directive and affix the CE marking on the converter unit.

- EMC Directive: 2014/30/EU
- Standard(s): EN 61800-3 Second environment / PDS Category "C3"
- Please ensure you chose the right converter unit for the intended environment. When using the converter unit in a residential area, take appropriate measures and ensure the conformity of the converter unit used in the residential area.
- The installer shall provide a guide for installation and use, including recommended mitigation devices.

Note:

First environment

Environment including buildings/facilities which are directly connected to a low voltage main supply which also supplies residential buildings.

Directly connected means that there is no intermediate transformer between these buildings.

Second environment

Environment including all buildings/facilities which are not directly connected to a low voltage main supply which also supplies residential buildings.

■ Instructions

Ensure the EMC filter is enabled, install the product as stated below, and, then carry out any wiring.

- The converter unit has a built-in EMC filter (Class C3). Enable the EMC filter. (For the details, refer to [page 64.](#))
- Connect the inverter and the converter unit to an earthed (grounded) power supply.
- Install the motor and controller cable found in the EMC Installation Guidelines (BCN-A21041-204) and Technical News (MF-S-188) according to the instructions.
Contact your sales representative for the EMC Installation Guidelines.
- Ensure that the finalized system which includes an inverter and converter unit complies with the EMC Directive.

◆ Low Voltage Directive

We have self-confirmed our converter units as products compliant to the Low Voltage Directive and affix the CE marking on the converter units.

- Low Voltage Directive: 2014/35/EU
- Conforming standard: EN 61800-5-1

■ Outline of instructions

- Do not use an earth leakage circuit breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth (ground) securely.
- Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)

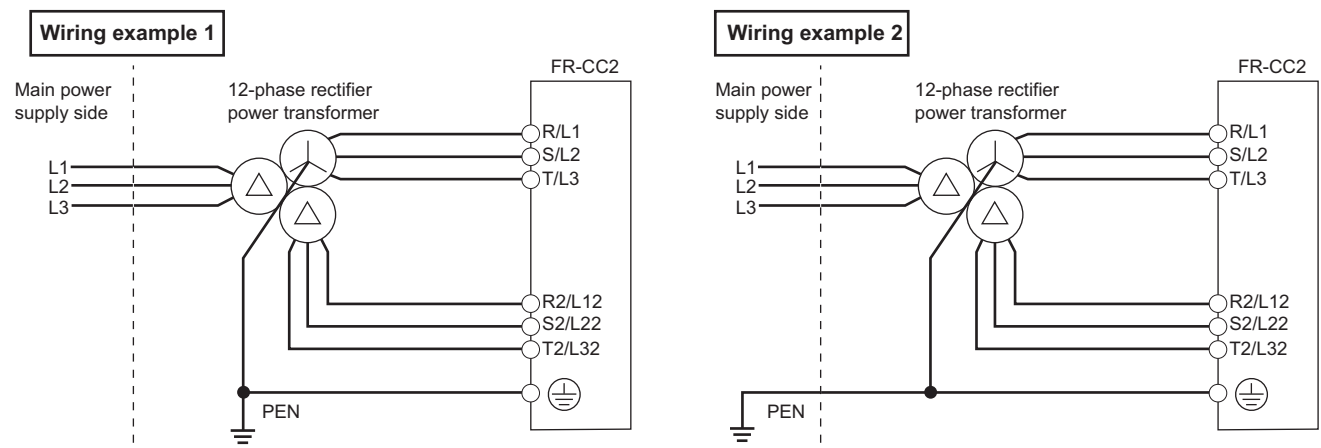
- Use the cable sizes on [page 38](#) under the following conditions.
 - Surrounding air temperature: 40°C maximum
 If conditions are different from above, select appropriate wire according to EN 60204-1 or IEC 60364-5-52.
- Use a tinned (plating should not include zinc) crimping terminal to connect the earth (ground) cable. When tightening the screw, be careful not to damage the threads.

For use as a product compliant with the Low Voltage Directive, use PVC cable whose size is indicated on [page 38](#).
- Use the molded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
- DC current may flow from the converter to a protective earth (ground) conductor. When using a residual current device (RCD) or residual current monitor (RCM), connect a type B RCD or RCM to the power supply side.
- Use the converter unit under the conditions of overvoltage category II (regardless of the earth (ground) condition of the power supply), overvoltage category III (400 V class converters must be used with the earth-neutral system power supply) and pollution degree 2 or lower specified in IEC 60664.
 - To use the converter unit under the conditions of pollution degree 2, install it in an enclosure of IP2X or higher to prevent electric shock and fire.
 - To use the converter unit under the conditions of pollution degree 3, install it in an enclosure of IP54 or higher to prevent electric shock and fire.
- On the input and output of the inverter and the converter unit, use cables of the size and type set forth in EN 60204-1 or IEC 60364-5-52.
- The operating capacity of the relay outputs (terminal symbols A1, B1, C1, A2, B2, C2) should be 30 VDC, 0.3 A. (Relay output has basic isolation from the internal circuit of the inverter and the converter unit.)
- Control circuit terminals on [page 32](#) are safely isolated from the main circuit.
- Environment (For the details, refer to [page 25](#).)

	During operation	In storage	During transportation
Surrounding air temperature	-10°C to +40°C	-20°C to +65°C	-20°C to +65°C
Ambient humidity	95% RH or less	95% RH or less	95% RH or less
Maximum altitude	2500 m ^{*1}	2500 m	10000 m

*1 For installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

- When the output side of the 12-phase transformer is not earthed (grounded), the power supply system of the converter unit is used as an isolated-neutral (IT) system. Install an insulation monitoring device (IMD) for protection against insulation failure.
- To use the system as a TN-C system, earth a neutral point on the output side of the transformer (wye connection) and connect all devices to the protective conductor (PEN).



■ Wiring protection

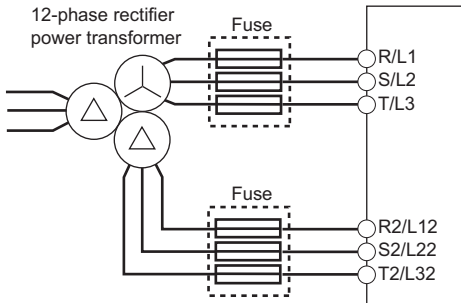
- For 6-phase applications

Provide a Class T, Class J, Class CC, or Class L fuse.

FR-CC2-□	H315K	H355K	H400K	H450K	H500K	H560K	H630K
Rated fuse voltage (V)	500 V or more						
Permissible fuse rating (A)	1100	1200	1350	1500	1800	1800	1800

- For 12-phase applications

Connection example



Provide an appropriate fuse in accordance with the table below.

Converter model	Fuse type	Model	Manufacturer	Rating	
FR-CC2-H315K	UL recognized, high-speed	170M6011, 170M6111	Bussmann	700 A, 700 VAC	
FR-CC2-H355K		170M6012, 170M6112		800 A, 700 VAC	
FR-CC2-H400K		170M6013, 170M6113		900 A, 700 VAC	
FR-CC2-H450K		170M6014, 170M6114		1000 A, 700 VAC	
FR-CC2-H500K		170M6015, 170M6115		1100 A, 700 VAC	
FR-CC2-H560K		170M6016, 170M6116			1250 A, 700 VAC
FR-CC2-H630K					

■ Short circuit ratings

Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 500 V maximum.

◆ EU RoHS Directive

We have declared that our converter units are compliant to the EU RoHS Directive (2011/65/EU) and affix the CE marking on the converter units.

9.3 Instructions for UL and cUL (Standard to comply with: UL 508C, CSA C22.2 No.274-13)

◆ General precaution

CAUTION - Risk of Electric Shock -

The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P/+ and N/- with a meter etc., to avoid a hazard of electrical shock.

WARNING

Operation of the converter unit requires detailed installation and operation instructions provided in the manuals intended for use with the converter unit. Please forward relevant manuals to the end user. The manuals can also be downloaded in PDF form from the Mitsubishi Electric FA Global Website. To order manuals, please contact your sales representative.

WARNING

If the fuse melts down or the breaker trips on the input side of this product, check for wiring faults (such as short circuits). Identify and remove the cause of melting down or the trip before replacing the fuse or resetting the tripped breaker (or before applying the power to the converter unit again).

ATTENTION -

Risque de choc électrique - La durée de décharge du condensateur de bus est de 10 minutes. Avant de commencer le câblage ou l'inspection, mettez l'appareil hors tension et attendez plus de 10 minutes.

AVERTISSEMENT

L'utilisation du variateur de fréquence nécessite des instructions détaillées d'installation et d'utilisation fournies dans les manuels destinés à être utilisés avec le variateur de fréquence. Veuillez transmettre les manuels correspondants à l'utilisateur final. Les manuels peuvent également être téléchargés au format PDF sur Mitsubishi Electric FA Global Website. Pour commander des manuels, veuillez contacter votre représentant commercial.

AVERTISSEMENT

Si le fusible fond ou si le disjoncteur se déclenche du côté entrée de ce produit, vérifier les défauts de câblage (tels que les courts-circuits). Identifier et éliminer la cause de la fonte ou du déclenchement avant de remplacer le fusible ou de réinitialiser le disjoncteur déclenché (ou avant de remettre sous tension l'onduleur).

◆ Installation

The below types of converter unit have been approved as products for use in enclosure.

Design the enclosure so that the surrounding air temperature, humidity and ambience of the converter unit will satisfy the specifications. (Refer to [page 25](#).)

■ Wiring protection

- For 6-phase applications

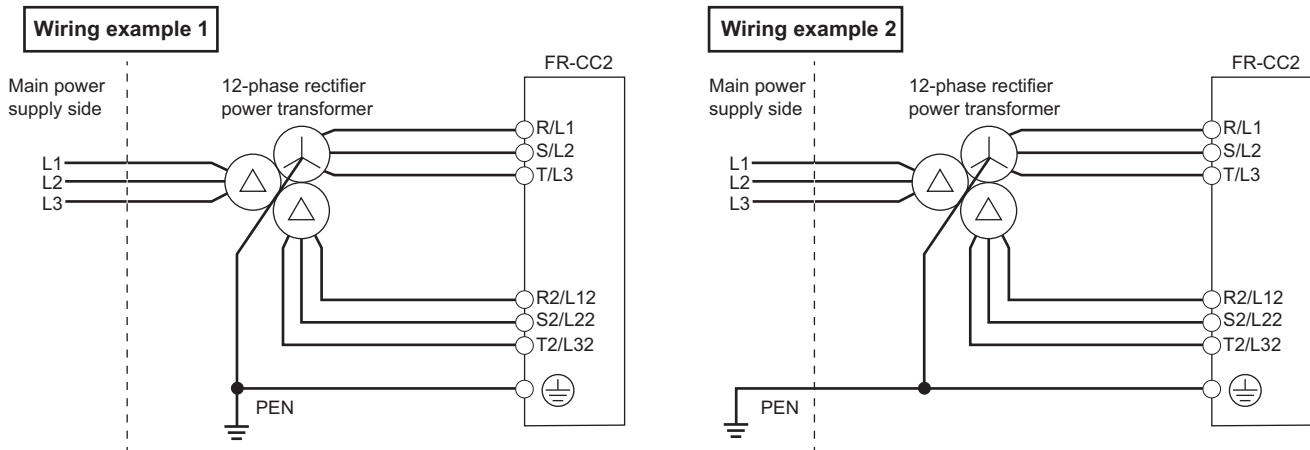
For installation in the United States, Class T, Class J, Class CC, or Class L fuses must be provided, in accordance with the National Electrical Code and any applicable local codes.

For installation in Canada, Class T, Class J, Class CC, or Class L fuses must be provided, in accordance with the Canadian Electrical Code and any applicable local codes.

FR-CC2-□	H315K	H355K	H400K	H450K	H500K	H560K	H630K
Rated fuse voltage (V)	500 V or more						
Permissible fuse rating (A)	1100	1200	1350	1500	1800	1800	1800

- For 12-phase applications

Connection example



For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code and any applicable provincial codes.

For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes.

Provide an appropriate fuse in accordance with the table below.

Converter model	Fuse type	Model	Manufacturer	Rating	
FR-CC2-H315K	UL recognized, high-speed	170M6011, 170M6111	Bussmann	700 A, 700 VAC	
FR-CC2-H355K		170M6012, 170M6112		800 A, 700 VAC	
FR-CC2-H400K		170M6013, 170M6113		900 A, 700 VAC	
FR-CC2-H450K		170M6014, 170M6114		1000 A, 700 VAC	
FR-CC2-H500K		170M6015, 170M6115		1100 A, 700 VAC	
FR-CC2-H560K		170M6016, 170M6116			1250 A, 700 VAC
FR-CC2-H630K					

◆ Wiring to the power supply and the motor

For wiring the input (R/L1, S/L2, T/L3) terminals of the converter unit and output (U, V, W) terminals of the inverter, use the UL listed copper, stranded wires (rated at 75°C) and round crimp terminals. Crimp the terminals with the crimping tool recommended by the terminal manufacturer.

◆ Short circuit ratings

Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 500 V maximum.

9.4 Instructions for UL and cUL (Standard to comply with: UL 61800-5-1, CSA C22.2 No. 274)

◆ Applicable models

- FR-A842-07700(315K) to 12120(500K)
- FR-F842-07700(355K) to 12120(560K)

The above models are compliant with both UL 508C and UL 61800-5-1, CSA C22.2 No. 274.

For the instructions for UL 61800-5-1, CSA C22.2 No. 274, refer to the following.

For the instructions for UL 508C, refer to the FR-A802 (SEPARATED CONVERTER TYPE) INSTRUCTION MANUAL (HARDWARE) and FR-F802 (SEPARATED CONVERTER TYPE) INSTRUCTION MANUAL (HARDWARE).

◆ Product handling information

-WARNING- Operation of this product requires detailed installation and operation instructions provided in this Instruction Manual intended for use with this product. Please forward relevant manuals to the end user. The manuals can also be downloaded in PDF form from the Mitsubishi Electric FA Global Website. To order manuals, please contact your sales representative.

◆ Precautions for compliance with CSA C22.2 No.274

Use the converter unit under the conditions of overvoltage category III and pollution degree 2 or lower specified in IEC 60664.

◆ Branch circuit protection

For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code and any applicable local codes. For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. Short circuit protection of the converter unit cannot be used as branch circuit protection. Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any applicable local code.

■ Precautions for opening the branch-circuit protective device

-WARNING- If the fuse melts down or the breaker trips on the input side of this product, check for wiring faults (such as short circuits). Identify and remove the cause of melting down or the trip before replacing the fuse or resetting the tripped breaker (or before applying the power to the converter unit again).

■ Fuse selection

Fuses are selected based on IEC/EN/UL 61800-5-1 and CSA C22.2 No. 274. For installation in the United States, the following semi-conductor fuses must be provided, in accordance with the National Electrical Code and any applicable local codes. For installation in Canada, the following semi-conductor fuses must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes. Always install the following semiconductor fuses for branch circuit protection.

- 6-phase rectification

Converter model	Cat. No	Manufacturer	Rating (A)
FR-CC2-H315K	PC33UD69V1250TF	Mersen	1250
FR-CC2-H355K	PC33UD69V1250TF	Mersen	1250
FR-CC2-H400K	PC33UD69V1400TF	Mersen	1400
FR-CC2-H450K	PC33UD69V1400TF	Mersen	1400
FR-CC2-H500K	PC33UD69V1400TF	Mersen	1400
FR-CC2-H560K	PC33UD69V1400TF	Mersen	1400
FR-CC2-H630K	PC33UD69V1400TF	Mersen	1400

- 12-phase rectification

Converter model	Cat. No	Manufacturer	Rating (A)
FR-CC2-H315K	PC33UD69V900TF	Mersen	900
FR-CC2-H355K	PC33UD69V900TF	Mersen	900
FR-CC2-H400K	PC33UD69V1100TF	Mersen	1100
FR-CC2-H450K	PC33UD69V1100TF	Mersen	1100
FR-CC2-H500K	PC33UD69V1100TF	Mersen	1100
FR-CC2-H560K	PC33UD69V1100TF	Mersen	1100
FR-CC2-H630K	PC33UD69V1100TF	Mersen	1100

◆ Capacitor discharge time

CAUTION -Risk of Electric Shock- Before wiring or inspection, check that the LED indicator turns OFF. Any person who is involved in wiring or inspection shall wait for 10 minutes or longer after power OFF and check that there are no residual voltage using a digital multimeter or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.

◆ Wiring to the power supply and the motor

- Refer to the National Electrical Code (Article 310) regarding the allowable current of the cable. Select the cable size for 125% of the rated current according to the National Electrical Code (Article 430). For wiring the input (R/L1, S/L2, T/L3) and output (U, V, W) terminals of the converter unit, use the UL listed copper, stranded wires (rated at 75°C) and round crimp terminals. Crimp the terminals with the crimping tool recommended by the terminal manufacturer.

◆ Short circuit ratings

- Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 500 V maximum.

◆ Applicable power supply

For use at an altitude above 2000 m (maximum 2500 m), only a neutral-point earthed (grounded) power supply can be used.

9.5 Instructions for EAC



The product certified in compliance with the Eurasian Conformity has the EAC marking.

Note: EAC marking

In 2010, three countries (Russia, Belarus, and Kazakhstan) established a Customs Union for the purposes of revitalizing the economy by forming a large economic bloc by abolishing or reducing tariffs and unifying regulatory procedures for the handling of articles.

Products to be distributed over these three countries of the Customs Union must comply with the Customs Union Technical Regulations (CU-TR), and the EAC marking must be affixed to the products.

For information on the country of origin, manufacture year and month, and authorized sales representative (importer) in the CU area of this product, refer to the following:

- Country of origin indication
Check the rating plate of the product. (Refer to [page 13](#).)
Example: MADE IN JAPAN
- Manufacture year and month
Check the SERIAL number indicated on the rating plate of the product. (Refer to [page 13](#).)
- Authorized sales representative (importer) in the CU area
The authorized sales representative (importer) in the CU area is shown below.
Name: Mitsubishi Electric Turkey A.S. Head Office
Address: Serifali Mahallesi Kale Sokak. No:41 34775 Umraniye, Istanbul, Turkey
Phone: +90-216-969-25-00
FAX: +90-216-661-44-47

9.6 Restricted Use of Hazardous Substances in Electronic and Electrical Products

The mark of restricted use of hazardous substances in electronic and electrical products is described as follows based on the "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products" of the People's Republic of China.

电器电子产品有害物质限制使用标识要求



本产品中所含有的有害物质的名称、含量、含有部件如下表所示。

• 产品中所含有害物质的名称及含量

部件名称 *2	有害物质 *1					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
电路板组件 (包括印刷电路板及其构成的零部件, 如电阻、电容、集成电路、连接器等)、电子部件	×	○	×	○	○	○
金属壳体、金属部件	×	○	○	○	○	○
树脂壳体、树脂部件	○	○	○	○	○	○
螺丝、电线	○	○	○	○	○	○

上表依据 SJ/T11364 的规定编制。

○: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T26572 规定的限量要求以下。

×: 表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 规定的限量要求。

*1 即使表中记载为 ×, 根据产品型号, 也可能会有有害物质的含量为限制值以下的情况。

*2 根据产品型号, 一部分部件可能不包含在产品中。

9.7 Referenced Standard (Requirement of Chinese standardized law)

This Product is designed and manufactured accordance with the following Chinese standards.

Electrical safety	GB/T 12668.501
EMC	GB/T 12668.3

9.8 Compliance with the UK certification scheme



We declare that this product conforms with the related technical requirements under UK legislation, and affix the UKCA (UK Conformity Assessed) marking on the product. Approval conditions are the same as those for the EU Directives. (Refer to [page 190](#).)

UKCA marking:

The UKCA marking is used for products sold in the markets of Great Britain (England, Wales, and Scotland) from January 1, 2021 after the departure of the UK from the EU on January 31, 2020.

9.9 UL-certified combinations of converter units and inverters

To use converter units with inverters, refer to the "Compatible inverters" section in 2.1.2 Peripheral devices ([page 19](#)). Other Mitsubishi Electric inverters are also available. For details, contact the nearest Mitsubishi Electric FA center.

MEMO

Warranty

When using this product, make sure to understand the warranty described below.

1. Warranty period and coverage

We will repair any failure or defect (hereinafter referred to as "failure") in our FA equipment (hereinafter referred to as the "Product") arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

The term of warranty for Product is twelve months after your purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture whichever comes first ("Warranty Period"). Warranty period for repaired Product cannot exceed beyond the original warranty period before any repair work.

[Limitations]

- (1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule. It can also be carried out by us or our service company upon your request and the actual cost will be charged.
However, it will not be charged if we are responsible for the cause of the failure.
- (2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.
- (3) Even during the term of warranty, the repair cost will be charged on you in the following cases;
 - a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
 - a failure caused by any alteration, etc. to the Product made on your side without our approval
 - a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
 - a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
 - any replacement of consumable parts (condenser, cooling fan, etc.)
 - a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
 - a failure caused by using the emergency drive function
 - a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
 - any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. Term of warranty after the stop of production

- (1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.
- (2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.

3. Service in overseas

Our regional FA Center in overseas countries will accept the repair work of the Product; however, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi Electric shall not be liable for compensation to:

- (1) Damages caused by any cause found not to be the responsibility of Mitsubishi Electric.
- (2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi Electric products.
- (3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi Electric products.
- (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

6. Application and use of the Product

- (1) For the use of our product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.
- (2) Our product is designed and manufactured as a general purpose product for use at general industries.
Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used.

In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used. We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Revision
Feb. 2014	IB(NA)-0600543ENG-A	First edition
Jul. 2014	IB(NA)-0600543ENG-B	Added <ul style="list-style-type: none"> FR-CC2-H560K, H630K
Feb. 2019	IB(NA)-0600543ENG-C	Added <ul style="list-style-type: none"> 12-phase rectification Instructions for EAC Restricted Use of Hazardous Substances in Electronic and Electrical Products Referenced Standard (Requirement of Chinese standardized law) Removal and reinstallation of the control circuit terminal block
Jul. 2021	IB(NA)-0600543ENG-D	Added <ul style="list-style-type: none"> UL-certified combinations of converter units and inverters Compliance with the UK certification scheme
Aug. 2023	IB(NA)-0600543ENG-E	Added <ul style="list-style-type: none"> Cooling fan operation selection (Pr.244) UL standards (changed from UL 508C to UL 61800-5-1)
Mar. 2024	IB(NA)-0600543ENG-F	Added <ul style="list-style-type: none"> Emergency drive <ul style="list-style-type: none"> Pr.514 Emergency drive dedicated retry waiting time Pr.515 Emergency drive dedicated retry count Pr.523 Emergency drive mode selection

Model	FR-CC2 TORISETSU EIBUN
Model code	1AJ014

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