Thank you for choosing this Mitsubishi converter unit.
This Instruction Manual provides handling information and precautions for use of the FR-CC2-P series.

In correct handling might cause an unexpected fault. Before using this converter unit, always read this Instruction Manual carefully to use the product correctly.

### Safety Instructions

#### Electric Shock Prevention

**WARNING**

- Make sure the converter is not held by the electrical cables or the converter body. Failure to do so may lead to injuries.
- Do not touch the converter with the front panel or any other parts when a neutral-point earthed (grounded) power supply for converter equipment is applied high voltage terminals or the charging part of the circuits will result in electric shock.
- Before wiring or inspection, LED indicator of the operation panel must be switched OFF. Any person who is involved in wiring or maintenance shall be fully competent to do the work. Otherwise a burst, damage, etc. may occur.
- The converter unit must be installed on a nonflammable wall and electrical or air conditioning shall be fully compatible in the work. The converter unit must be installed on a strong surface securely.
- Setting dial and key operations must be performed with dry hands to prevent an electric shock. Otherwise you may get an electric shock.
- Do not weld the cables to make excessive stress, heavy loads or painting. Otherwise you may get an electric shock.
- Do not change the existing fan while power is ON. It is dangerous to change the existing fan while power is ON.
- Do not touch the printed circuit board or handle the cables with wet hands. Otherwise you may get an electric shock.

**CAUTION**

- Do not change the cooling fan while power is ON. It is dangerous to change the existing fan while power is ON.
- The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.
- Be sure to perform daily and periodic inspections as specified in the instruction manual. If a product is used without any inspection, a burst, damage, etc. may occur.
- While power is ON for some time after power OFF, do not touch the converter unit as it will be extremely hot. Touching these devices may cause burns.
- The converter unit must be installed on a strong surface securely.
- The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.
- When the converter unit has become faulty, the converter power must be switched OFF. A continuous flow of large current may cause a fire.

#### Fire Prevention

**CAUTION**

- The converter unit must be installed in a nonflammable site and without boxes that suddenly touches the converter unit (fire risk in the rear case, etc.). Mounting it on a rear nonflammable material may cause a fire.
- The converter unit must be installed in a nonflammable site and without boxes that suddenly touches the converter unit (fire risk in the rear case, etc.). Mounting it on a rear nonflammable material may cause a fire.

#### Injury Prevention

**CAUTION**

- The converter unit cannot be repaired by the user. Careless repairs may cause injuries.
- The product must be transported to a certified repair facility. Otherwise a burst, damage, etc. may occur.
- Be sure to perform daily and periodic inspections as specified in the Instruction Manual. Otherwise a burst, damage, etc. may occur.
- While power is ON for some time after power OFF, do not touch the converter unit as it will be extremely hot. Touching these devices may cause burns.
- The converter unit must be installed on a strong surface securely.
- The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.

### Additional instructions

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

**WARNING**

- Even if power is OFF, do not remove the front cover except for maintenance. Otherwise a burst, damage, etc. may occur.
- Do not install the product on a hot surface. Otherwise a burst, damage, etc. may occur.
- Do not stand or rest heavy objects on the product. Otherwise a burst, damage, etc. may occur.
- Any person who is opening a package using a sharp object, such as a knife and scissors, must wear gloves to prevent injuries caused by the sharp edges of the sharp object.

The polarity (+ and -) must be correct. Otherwise a burst, damage, etc. may occur.

The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.

The converter unit must be installed on a strong surface securely.

The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.

The converter power must be switched OFF. A continuous flow of large current may cause a fire.

The converter unit must be installed in a nonflammable site and without boxes that suddenly touches the converter unit (fire risk in the rear case, etc.). Mounting it on a rear nonflammable material may cause a fire.

The converter unit has become faulty, the converter power must be switched OFF. A continuous flow of large current may cause a fire.

The converter unit cannot be repaired by the user. Careless repairs may cause injuries.

The product must be transported to a certified repair facility. Otherwise a burst, damage, etc. may occur.

Be sure to perform daily and periodic inspections as specified in the Instruction Manual. Otherwise a burst, damage, etc. may occur.

While power is ON for some time after power OFF, do not touch the converter unit as it will be extremely hot. Touching these devices may cause burns.

The converter unit must be installed on a strong surface securely.

The cables must be connected to the correct terminals. Otherwise a burst, damage, etc. may occur.

The converter power must be switched OFF. A continuous flow of large current may cause a fire.

The converter unit has become faulty, the converter power must be switched OFF. A continuous flow of large current may cause a fire.

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The converter unit has become faulty, the converter power must be switched OFF. A continuous flow of large current may cause a fire.

The converter unit cannot be repaired by the user. Careless repairs may cause injuries.

The product must be transported to a certified repair facility. Otherwise a burst, damage, etc. may occur.
CAUTION

Transportation and mounting
- The storage temperature (applicable for a short time, e.g. during transit) must be between -20 and +65°C. Otherwise the converter unit may be damaged.
- The converter unit must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.) Otherwise the converter unit may be damaged.
- The converter unit must be used at an altitude of 2500 m or less, with 2.9 m/s² or less vibration at 10 to 55 Hz (directions of X, Y, Z axes). Otherwise the converter unit may be damaged. (For the details, refer to page 17.)
- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.) infiltrate into a Mitsubishi product, the product will be damaged. Halogen-based materials are often included in fumigant, which is used to sterilize or disinfect wooden packages. When packaging, prevent residual fumigant components from being infiltrated into Mitsubishi products, or use an alternative sterilization or disinfection method (heat disinfection, etc.) for packaging. Sterilization of disinfection of wooden package should also be performed before packing a product.

Test run
- Before starting operation, each parameter must be confirmed and adjusted. A failure to do so may cause some machines to make unexpected motions.

CAUTION

Usage
- Do not use a magnetic contactor on the input side for frequent starting/stopping of the inverter. Otherwise the life of the inverter and the converter unit decreases.
- The effect of electromagnetic interference must be reduced by using a noise filter or by other means. Otherwise nearby electronic equipment may be affected.
- Apparatus measures must be taken to suppress harmonics. Otherwise power supply harmonics from the inverter or the converter unit may affect the power supply system, power factor correction capacitor and generator.
- When parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations because all parameters return to their initial values.
- Before running a converter unit which had been stored for a long period, inspection and test operation must be performed to ensure that your body must be discharged before you touch the product.

Emergency stop
- A safety backup such as an emergency brake must be provided to prevent hazardous conditions to the machine and equipment in case of converter unit failure.
- When the breaker on the converter unit's input side trips, check for the wiring fault (short circuit), damage to internal parts of the converter unit, etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.
- When a protective function is activated, take an appropriate corrective action, then reset the converter unit (inverter), and resume the operation.

Maintenance, inspection and parts replacement
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the product.

WARNING

Usage
- Ensure pressing the STOP/RESET key of the operation panel does not return the circuit to the previous state during operation. This will start the operation in an abnormal state. In addition, if the operation panel is turned off and on while the inverter is operating, the output will be off by several seconds when the power is turned back on. Be sure to wait for the power to stabilize after the power is turned back on. Exception: when using the motor control function, it allows the inverter to be started after the power is turned back on.
- Ensure that the current output from the inverter to the motor is not greater than the motor's rating. Otherwise the motor may be damaged.
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the product.

CAUTION

Usage
- Do not use a magnetic contactor on the input side for frequent starting/stopping of the inverter. Otherwise the life of the inverter and the converter unit decreases.
- The effect of electromagnetic interference must be reduced by using a noise filter or by other means. Otherwise nearby electronic equipment may be affected.
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Maintenance, inspection and parts replacement
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the product.

General instruction
- Many of the diagrams and drawings in the Instruction Manual show the product without a cover or partially open for explanation. Never operate the product in this manner. The cover must be always remanufactured and the instruction in the Instruction Manual must be followed when operating the product.
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INTRODUCTION

This chapter contains the descriptions that must be read before using this product.
Always read the instructions before using the equipment.

1.1 Product checking

1.2 Component names

1.3 About the related manuals

<Abbreviations>
Operation panel .... Operation panel of the inverter (FR-DU08)
Converter unit ...... Converter unit FR-CC2-P series (for parallel operation)
Inverter ............. Mitsubishi FR-A802-P series inverter (separated converter type for parallel operation)
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.
• 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 suppose that the control logic of the input terminal is the sink
logic, unless otherwise specified. (For the control logic, refer to page 37.)

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 the details, refer to page
39.)
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 agrees with the order and the product is intact.

◆Converter unit model

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-C2</td>
<td>Standard converter unit capacity 200V class</td>
<td>Open</td>
<td>Open operation</td>
</tr>
</tbody>
</table>

F R C C 2 [H] 400K [60P]

◆How to read the SERIAL number

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

The last digit of the production year is indicated as the Year, and the Month is indicated by 0 (October), 1 (November), or 2 (December).

◆Accessory

- Ferrite core (ZCAT3035-1330) × 2: Use two cores on RS-485 cables for communication between two converter units to reduce noise. (Refer to page 45.)
### 1.2 Component names

Component names are shown below.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Description</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>PU connector</td>
<td>Connects the operation panel. This connector also enables the RS-485 communication.</td>
<td>47</td>
</tr>
<tr>
<td>(b)</td>
<td>RS-485 terminals</td>
<td>Enables RS-485 communication between the master and the slave for the parallel operation.</td>
<td>42</td>
</tr>
<tr>
<td>(c)</td>
<td>Terminating resistor selection switch (SW1)</td>
<td>Select whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(d)</td>
<td>Terminating resistor selection switch (SW2)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(e)</td>
<td>Terminating resistor selection switch (SW3)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(f)</td>
<td>Terminating resistor selection switch (SW4)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(g)</td>
<td>Terminating resistor selection switch (SW5)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(h)</td>
<td>Terminating resistor selection switch (SW6)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(i)</td>
<td>Terminating resistor selection switch (SW7)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(j)</td>
<td>Terminating resistor selection switch (SW8)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(k)</td>
<td>Terminating resistor selection switch (SW9)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(l)</td>
<td>Terminating resistor selection switch (SW10)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(m)</td>
<td>Terminating resistor selection switch (SW11)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(n)</td>
<td>Terminating resistor selection switch (SW12)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(o)</td>
<td>Terminating resistor selection switch (SW13)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(p)</td>
<td>Terminating resistor selection switch (SW14)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(q)</td>
<td>Terminating resistor selection switch (SW15)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(r)</td>
<td>Terminating resistor selection switch (SW16)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(s)</td>
<td>Terminating resistor selection switch (SW17)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(t)</td>
<td>Terminating resistor selection switch (SW18)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(u)</td>
<td>Terminating resistor selection switch (SW19)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(v)</td>
<td>Terminating resistor selection switch (SW20)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(w)</td>
<td>Terminating resistor selection switch (SW21)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(x)</td>
<td>Terminating resistor selection switch (SW22)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(y)</td>
<td>Terminating resistor selection switch (SW23)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(z)</td>
<td>Terminating resistor selection switch (SW24)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(A)</td>
<td>Terminating resistor selection switch (SW25)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(B)</td>
<td>Terminating resistor selection switch (SW26)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(C)</td>
<td>Terminating resistor selection switch (SW27)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(D)</td>
<td>Terminating resistor selection switch (SW28)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(E)</td>
<td>Terminating resistor selection switch (SW29)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(F)</td>
<td>Terminating resistor selection switch (SW30)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(G)</td>
<td>Terminating resistor selection switch (SW31)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(H)</td>
<td>Terminating resistor selection switch (SW32)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(I)</td>
<td>Terminating resistor selection switch (SW33)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(J)</td>
<td>Terminating resistor selection switch (SW34)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(K)</td>
<td>Terminating resistor selection switch (SW35)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(L)</td>
<td>Terminating resistor selection switch (SW36)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(M)</td>
<td>Terminating resistor selection switch (SW37)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(N)</td>
<td>Terminating resistor selection switch (SW38)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(O)</td>
<td>Terminating resistor selection switch (SW39)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(P)</td>
<td>Terminating resistor selection switch (SW40)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(Q)</td>
<td>Terminating resistor selection switch (SW41)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(R)</td>
<td>Terminating resistor selection switch (SW42)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(S)</td>
<td>Terminating resistor selection switch (SW43)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(T)</td>
<td>Terminating resistor selection switch (SW44)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(U)</td>
<td>Terminating resistor selection switch (SW45)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(V)</td>
<td>Terminating resistor selection switch (SW46)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(W)</td>
<td>Terminating resistor selection switch (SW47)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(X)</td>
<td>Terminating resistor selection switch (SW48)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(Y)</td>
<td>Terminating resistor selection switch (SW49)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
<tr>
<td>(Z)</td>
<td>Terminating resistor selection switch (SW50)</td>
<td>Selects whether or not to use the terminating resistor for RS-485 communication.</td>
<td>48</td>
</tr>
</tbody>
</table>

**INTRODUCTION** 9
### 1.3 About the related manuals

The manuals related to FR-CC2-P are shown below:

<table>
<thead>
<tr>
<th>Manual name</th>
<th>Manual number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-A802-P Instruction Manual (Hardware)</td>
<td>IB-0600651ENG</td>
</tr>
<tr>
<td>FR-A800 Parallel Operation Function Manual</td>
<td>IB-0600654ENG</td>
</tr>
<tr>
<td>FR-A800 Instruction Manual (Detailed)</td>
<td>IB-0600503ENG</td>
</tr>
</tbody>
</table>
This chapter explains the “installation” and the “wiring” of this product.
Always read the instructions before using the equipment.

2.1 Peripheral devices ...............................................................12
2.2 Removal and reinstallation of the front cover .........................15
2.3 Installation of the converter unit and enclosure design ..........17
2.4 Terminal connection diagrams ............................................24
2.5 Main circuit terminals ....................................................31
2.6 Control circuit ...............................................................35
2.7 Communication connectors and terminals ..........................45
2.8 Parameter setting for the parallel operation .........................48
2.1 Peripheral devices

2.1.1 Converter unit and peripheral devices

- For operating two units in parallel
- One circuit breaker and one magnetic contactor in total in a system

One circuit breaker and one magnetic contactor per converter unit
Peripheral devices

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Inverter (FR-A802-P)</td>
<td>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. The control signal lines must be kept fully away from the main circuit lines to protect them from noise. The applicable motor capacity indicated is the maximum capacity applicable for use of a 4-pole motor.</td>
</tr>
<tr>
<td>C1</td>
<td>Converter unit (FR-CC2-P)</td>
<td>Must be within the permissible power supply specifications of the converter unit.</td>
</tr>
<tr>
<td>C2</td>
<td>Molded case circuit breaker (MCB), earth leakage circuit breaker (ELB), or fuse</td>
<td>Must be selected carefully since an inrush current flows in the converter unit at power ON.</td>
</tr>
<tr>
<td>E2</td>
<td>Magnetic contactor (MC)</td>
<td>Do not use this to start and stop the inverter. Do not do so will shorten the life of the inverter and the converter unit.</td>
</tr>
<tr>
<td>M1</td>
<td>Noise filter</td>
<td>Suppresses the noise radiated from the power supply side of the converter unit.</td>
</tr>
<tr>
<td>M2</td>
<td>Noise filter</td>
<td>Installs to reduce the electromagnetic noise generation from the inverter or the converter unit. The noise filter is effective in the range from about 0.5 MHz to 5 MHz.</td>
</tr>
<tr>
<td>S1</td>
<td>Inductive inductor</td>
<td>Installs to suppress induction noise.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2</td>
<td>Inductive inductor</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
- Do not use an earth leakage circuit breaker as a circuit breaker which is intended to be installed per converter unit. Doing so may cause unintended operation of the inverter.
- For every magnetic contactor installed for a converter unit in parallel connection, switching of power with the same timing is critical to supplying power simultaneously. Otherwise, the converter units may be damaged.

To prevent an electric shock, always earth (ground) the converter unit, the inverter, and the motor.
- Do not install a power factor correction capacitor or surge suppressor or capacitor type filter on the inverter's output side. Doing so will cause the inverter output shutoff or the capacitor and surge suppressor to be damaged. 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 valve interference
  - The output circuit (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 of the converter unit. In this case, activating the EMC filter may minimize interference. (Refer to page 57.)
- For details of options and peripheral devices, refer to the respective Instruction Manual.

### Peripheral devices

**Compatible inverters**

The table below shows the converter units compatible with the inverters according to the connected motor capacity. The capacity of all converter units must be the same in a system, and that of all inverters also must be the same.

<table>
<thead>
<tr>
<th>Motor capacity (kW)</th>
<th>Number of converter units</th>
<th>Converter unit (FR-CC2)-P</th>
<th>Inverter (FR-A842)-P</th>
</tr>
</thead>
<tbody>
<tr>
<td>630</td>
<td>2</td>
<td>H400K</td>
<td>400K</td>
</tr>
<tr>
<td>710</td>
<td>2</td>
<td>H450K</td>
<td>450K</td>
</tr>
<tr>
<td>800</td>
<td>2</td>
<td>H500K</td>
<td>500K</td>
</tr>
<tr>
<td>900</td>
<td>2</td>
<td>H560K</td>
<td>560K</td>
</tr>
<tr>
<td>945</td>
<td>3</td>
<td>H400K</td>
<td>400K</td>
</tr>
<tr>
<td>1065</td>
<td>3</td>
<td>H450K</td>
<td>450K</td>
</tr>
<tr>
<td>1200</td>
<td>3</td>
<td>H500K</td>
<td>500K</td>
</tr>
<tr>
<td>1350</td>
<td>3</td>
<td>H560K</td>
<td>560K</td>
</tr>
</tbody>
</table>

* The applicable motor capacity indicated is the maximum capacity applicable for use of a 4-pole motor.
Peripheral devices

◆ Selecting the breaker/magnetic contactor

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

Refer to the table below to prepare appropriate peripheral devices.

One circuit breaker and one magnetic contactor in total in a system

<table>
<thead>
<tr>
<th>Motor output (kW)</th>
<th>Number of converter units</th>
<th>Applicable converter unit</th>
<th>Molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB)</th>
<th>Input-side magnetic contactor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TR-CC2 [-P]</td>
<td>(NF, NV type)</td>
<td></td>
</tr>
<tr>
<td>630</td>
<td>2</td>
<td>H400K 900 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
<tr>
<td>710</td>
<td>2</td>
<td>H450K 1000 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>2</td>
<td>H500K 1200 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>2</td>
<td>H560K 1500 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
<tr>
<td>945</td>
<td>3</td>
<td>H400K 900 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
<tr>
<td>1065</td>
<td>3</td>
<td>H450K 1000 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>3</td>
<td>H500K 1200 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
<tr>
<td>1350</td>
<td>3</td>
<td>H560K 1500 A</td>
<td>S-N800 1000 A rated product</td>
<td></td>
</tr>
</tbody>
</table>

1) The motor output indicates the output power of a 4-pole motor at 400 VAC 50 Hz driven by all of the converter units in parallel connection.
2) Select an MCCB according to the power supply capacity. For the use in the United States or Canada, provide the appropriate UL and cUL listed fuse that is suitable for branch circuit protection. (Refer to page 159.)
3) The magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 600,000 times. When the magnetic contactor is used for emergency stops during motor driving, the electrical durability is 50 times.
4) If using an MC for emergency stops during motor driving, select an MC regarding the converter unit input side current as JEM1038-AC-3 class rated current. When providing an MC to use the commercial power supply during general-purpose motor operation, select an MC regarding the rated motor current as JEM1038-AC-3 class rated current.
5) The motor output indicates the output power of a 4-pole motor at 400 VAC 50 Hz driven by all of the converter units in parallel connection.
6) Select an MCCB according to the power supply capacity. For the use in the United States or Canada, provide the appropriate UL and cUL listed fuse that is suitable for branch circuit protection. (Refer to page 159.)
7) The magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 600,000 times. When the magnetic contactor is used for emergency stops during motor driving, the electrical durability is 50 times.
8) If using an MC for emergency stops during motor driving, select an MC regarding the converter unit input side current as JEM1038-AC-3 class rated current. When providing an MC to use the commercial power supply during general-purpose motor operation, select an MC regarding the rated motor current as JEM1038-AC-3 class rated current.

When the breaker on the converter unit’s input side trips, check for the wiring fault (short circuit), damage to internal parts of the breaker or the converter unit, etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.
2.2 Removal and reinstallation of the front cover

◆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.)
- Push the upper edge of the accessory cover and pull the accessory cover to remove.

To install the inverter operation panel, align its connector on the back with the PU connector of the inverter, 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 front cover (lower side)

- Remove the mounting screws to remove the front cover (lower side).
- With the front cover (lower side) removed, wiring of the main circuit terminals can be performed.
**Removal and reinstallation of the front cover**

**Removal of the front cover (upper side)**

(a) With the front cover (lower side) removed, loosen the mounting screws on the front cover (upper side). (These screws cannot be removed.)

(b) While holding the areas around the installation hooks on the sides of the front cover (upper side), pull out the front cover (upper side) using its upper side as a support.

(c) With the front cover (upper side) removed, wiring of the control circuit or the RS-485 terminals can be performed.

**Reinstallation of the front cover**

(a) Insert the upper hooks of the front cover (upper side) into the sockets of the converter unit. Insert the upper hooks of the front cover (upper side) into the sockets of the converter unit.

(b) Tighten the mounting screw at the lower part of the front cover (upper side).

(c) Fasten the front cover (lower side) with the mounting screws.

**NOTE**

- Fully make sure that the front cover is installed securely. Always tighten the mounting 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 of the enclosure 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 unit 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

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surrounded air temperature</td>
<td>-10°C to +50°C (non-freezing)</td>
</tr>
<tr>
<td>Surrounding air humidity</td>
<td>95% RH or less (non-condensing)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20°C to +65°C</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)</td>
</tr>
<tr>
<td>Altitude</td>
<td>1,000 m or lower</td>
</tr>
<tr>
<td>Vibration</td>
<td>2.9 m/s² or less at 10 to 55 Hz (directions of X, Y, Z axes)</td>
</tr>
</tbody>
</table>

**Temperature**

The permissible surrounding air temperature of the converter unit is between -10°C and +50°C. 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.

(a) Measures against high temperature
- Use a forced ventilation system or similar cooling system. (Refer to page 19.)
- 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.

(b) 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 inverter near the air outlet of an air conditioner.
  - If temperature changes are caused by opening/closing of e-door, install the inverter away from the door.

**Humidity**

Operate the converter unit within the ambient air humidity of usually 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 insulation distance defined in IEC 11011 "Control Equipment Insulator" is humidity of 45 to 95%.
Installation of the converter unit and enclosure design

(a) 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.

(b) 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.

(c) Measures against condensation
Condensation may occur if frequent operation stops change the in-enclosure temperature suddenly or if the outside air temperature changes suddenly. Condensation causes such faults as reduced insulation and corrosion.
- Take the measures against high humidity in (a).
- 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 inverter in a totally enclosed enclosure.
- Take measures if the in-enclosure temperature rises. (Refer to page 19.)
- 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 unit 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 above-mentioned measures.

 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 inverter in a non-hazardous place.

High altitude
Use the converter unit at an altitude of within 1000 m. For use at an altitude above 1000 m (up to 2000 m), derate the rated current 3% per 500 m. 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 for the directions of X, Y, Z axes. Applying vibration and impacts for a long time may loosen the structures and cause poor contacts of connectors, even if those vibration and impacts are within the specified values. 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 isolations.
- 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.

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

<table>
<thead>
<tr>
<th>Cooling system</th>
<th>Enclosure structure</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural cooling</td>
<td></td>
<td>The cooling systems are classified as follows in terms of the cooling calculation method.</td>
</tr>
<tr>
<td>Natural ventilation (totally enclosed)</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Forced cooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heatsink cooling</td>
<td></td>
<td>This system has restrictions on the heatsink mounting position and area. This system is for relatively small capacities.</td>
</tr>
<tr>
<td>Forced ventilation</td>
<td></td>
<td>This system is for general indoor installation. This is appropriate for enclosure downsizing and cost reduction, and often used.</td>
</tr>
<tr>
<td>Heat pipe</td>
<td></td>
<td>This is a totally enclosed for enclosure downsizing.</td>
</tr>
</tbody>
</table>
2.3.3 Installation of the converter unit

- **Installation of the converter unit**

  - Install the converter unit on a strong surface securely with screws.
  - Leave enough clearance 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 enclosing multiple converter units 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.
  - For replacing the cooling fan, 30 cm or more of space is necessary in front of the converter unit. Refer to page 143 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.
Installation of the converter unit and enclosure design

◆Encasing multiple inverters and converter units

When multiple inverters and converter units are placed in the same enclosure, generally arrange them horizontally as shown in the figures on the right. Do not place multiple converter units or the converter unit and the inverter vertically. The exhaust air temperature of 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.)
### 2.3.4 Protruding the heatsink

When encasing a converter unit in an enclosure, the heat generated in the enclosure can be greatly reduced by protruding the heatsink of the converter unit. When installing the converter unit in a compact enclosure, etc., this installation method is recommended.

- Panel cutting
  - Cut the panel of the enclosure.

![Diagram showing panel cutting with dimensions and hole cutouts.](image-url)
Installation of the converter unit and enclosure design

**Shift and removal of a rear side installation frame**

One installation frame is attached to each of the upper and lower parts of the converter unit. Remove the rear side installation frame on the top and bottom sides of the converter unit as shown on the right.

**Installation of the converter unit**

Push the converter unit heatsink portion outside the enclosure and fix the enclosure and converter unit with upper and lower installation frame.

**NOTE**

- Having a cooling fan, the cooling section which comes out of the enclosure cannot be used in 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.
### Terminal connection diagrams

#### 2.4 Terminal connection diagrams

- **When the sink logic is selected**

  1. When using separate power supply for the control circuit, remove the jumpers from R1/L11 and S1/L21.
  2. The function of these terminals can be changed with the input terminal assignment (Pr.178, Pr.187, Pr.189).
  3. The function of these terminals can be changed with the output terminal assignment (Pr.195).
  4. The function of these terminals can be changed with the output terminal assignment (Pr.190 to Pr.194).
  5. The 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 NC contact input specification for the input logic of MRS signal or X10 signal 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, separate the main circuit cables at the input side from the main circuit cables at the output side.
  - After wiring, wire offcuts must not be left in the inverter or the converter unit.
  - Wire offcuts can cause an alarm, 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.
When the source logic is selected

- When the source logic is selected:
  - When using separate power supply for the control circuit, remove the jumpers from R1/L11 and S1/L21.
  - The function of these terminals can be changed with the input terminal assignment (Pr.178, Pr.187, Pr.189).
  - The sink logic is initially set. The control logic can be changed with the jumper connector position.
  - The function of these terminals can be changed with the output terminal assignment (Pr.195).
  - The function of these terminals can be changed with the output terminal assignment (Pr.190 to Pr.194).
  - The connector is for manufacturer setting. Do not use.
  - Plug-in options cannot be used.
  - To use the RDA signal of the converter unit, select the NC contact input specification for the input logic of MRS signal or X10 signal of the inverter.
  - To use the RDB signal of the converter unit, select the NO contact input specification for the input logic of 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, separate the main circuit cables at the input side from the main circuit cables at the output side.
- After wiring, make sure that the circuit breaker is off.
- Always keep the inverter and the converter unit clean.
- When mounting a rack, etc., take care to avoid the main circuit cables. Ensure that they do not interfere with the inverter or the converter unit.
Terminal connection diagrams

System configuration example (for operating two units in parallel)

1. Install wiring between the RS-485 terminals of the converter units as shown in the diagram in page 27. (For the details of wiring of the RS-485 terminals, refer to page 45.)
2. Install wiring between the converter units and the inverters as shown in page 27. (For details of wiring between the converter units and the inverters, refer to page 30.)
3. Set Pr.1001 Parallel operation selection of the converter units as shown in the table below. (Refer to page 46 for the details of Pr.1001.)

<table>
<thead>
<tr>
<th>Converter unit</th>
<th>Pr.1001 setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave station</td>
<td>1 or 2</td>
</tr>
<tr>
<td>Master station</td>
<td>200</td>
</tr>
</tbody>
</table>

Parameter setting procedure

1. Install wiring of the RS-485 terminals between the converter units.
2. Set "1 or 2" in Pr.1001 of the slave converter unit, and then reset the converter unit.
3. Set "200" in Pr.1001 of the master converter unit, and then reset the converter unit.

After the wiring of the RS-485 terminals and the setting of Pr.1001 on all converter units are completed, communication between the converter units starts automatically.

NOTE

- Set up the slave converter unit first before the master converter unit by the Pr.1001 setting and the converter unit reset.
- Otherwise, an error may occur in communication between the converter units.
- For the inverters operated in parallel, the wires between the inverter and the motor must have the same length for the three phases. Otherwise, normal operation may not be possible.
- When the parameter setting procedure is completed, the Parallel operation ready (Y227) signal turns ON if the signal is preset to output. (Refer to page 48 for the details of the Y227 signal.)

![CAUTION]

- Be sure to set Pr.1001 correctly. Operation with incorrect settings may damage the converter units.
- When connecting wiring between the inverter outputs (U, V, and W) and the motor, the phase sequence must be the same. Connect wiring between the master and slave inverter outputs with the correct phase sequence. Otherwise the inverters may be damaged.

Converter unit
Pr.1001 setting
Slave station 1 or 2
Master station 200

CAUTION

We must to set Pr.1001 correctly. Operation with incorrect settings may damage the converter units.
- When connecting wiring between the inverter outputs (U, V, and W) and the motor, the phase sequence must be the same. Connect wiring between the master and slave inverter outputs with the correct phase sequence. Otherwise the inverters may be damaged.

26 INSTALLATION AND WIRING
Terminal connection diagrams

- Terminal connection diagram for two converter units in parallel

Three-phase AC power supply

R/L1
S/L2
T/L3

U
V
W

R1/L11
S1/L21

P/+  N/-
Terminal connection diagrams

System configuration example (for operating three units in parallel)

- Install wiring between the RS-485 terminals of the converter units as shown in the diagram in page 29. (For the details of wiring of the RS-485 terminals, refer to page 45.)
- Install wiring between the converter units and the inverters as shown in page 29. (For details of wiring between the converter units and the inverters, refer to page 30.)
- Set the converter unit Pr.1001 as shown in the table below. (Refer to page 48 for the details of Pr.1001.)

<table>
<thead>
<tr>
<th>Converter unit</th>
<th>Pr.1001 setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave station 1</td>
<td>1</td>
</tr>
<tr>
<td>Slave station 2</td>
<td>2</td>
</tr>
</tbody>
</table>

Parameter setting procedure

1. Install wiring of the RS-485 terminals between the converter units.
2. Set "1" in Pr.1001 of the slave converter unit 1, and then reset the converter unit.
3. Set "2" in Pr.1001 of the slave converter unit 2, and then reset the converter unit.
4. Set "300" in Pr.1001 of the master converter unit, and then reset the converter unit.

After the wiring of the RS-485 terminals and the setting of Pr.1001 on all converter units are completed, communication between the converter units starts automatically.

NOTE
- It is not important which order steps 2 and 3 are performed in.
- Set up the slave converter unit first before the master converter unit by the Pr.1001 setting and the converter unit reset. Otherwise, an error may occur in communication between the converter units.
- For the inverters operated in parallel, the wires between the inverter and the motor must have the same length for the three phases. Otherwise, normal operation may not be possible.
- When the parameter setting procedure is completed, the Parallel operation ready (Y227) signal turns Off if the signal is preset to output. (Refer to page 48 for the details of the Y227 signal.)

CAUTION
- Be sure to set Pr.1001 correctly. Operation with incorrect settings may damage the converter units.
- When connecting wiring between the inverter outputs (U, V, and W) and the motor, the phase sequence must be the same. Connect wiring between the master and slave inverter outputs with the correct phase sequence. Otherwise the inverters may be damaged.
Terminal connection diagrams

Terminal connection diagram for three converter units in parallel

Three-phase AC power supply

FR-CC2-P (master)
FR-A802-P (master)
FR-CC2-P (slave 1)
FR-A802-P (slave 1)
FR-CC2-P (slave 2)
FR-A802-P (slave 2)

P/+  N/-
MRS(X10)  RES  SD
TXD1+  TXD2+  TXD1-  TXD2-
RXD1+  RXD2+  RXD2-  RXD1-
GND(SG)
R/L1  S/L2  T/L3
U  V  W
R1/L11  S1/L21

INSTALLATION AND WIRING  29
Terminal connection diagrams

Wiring between the converter units and the inverters

- **Main circuit terminals**
  - Wire the converter unit to the inverter at each terminal P and terminal N. Pair the masters or the slaves (1 with 1 or 2 with 2). Otherwise, incorrect connection may damage the converter unit and the inverter.
  - Use cables of 30 m or shorter each to connect the converter unit and the inverter (for terminal P or N).
  - For information about the gauge of cable for terminal P or N, refer to page 33.

- **Control circuit terminals**
  - Wiring both of control circuits in the master converter unit and the master inverter is required. Wire correctly to ensure the command transmission from the converter unit to the inverter. Otherwise, incorrect connection may damage the converter unit and the inverter.
  - Use cables of 30 m or shorter each to wire the control circuits.

- **Do not install an MCCB for terminal P or N. Ensure correct connection in polarity of terminals P and N, which may damage the inverter.**

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Inverter</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>V</td>
</tr>
<tr>
<td>W</td>
<td></td>
</tr>
</tbody>
</table>

- **Control circuit terminals**
  - For the terminal used for the X10 signal input, set “10” in any of Pr.178 to Pr.189 (Input terminal function selection) to assign the function.
  - To use the RDA signal of the converter unit, select the NC 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 NO 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.)
  - For the terminal used for the X11 signal input, set “11” in any of Pr.178 to Pr.189 (Input terminal function selection) to assign the function.
  - Always connect terminal RES of the converter unit and terminal 101 (sink logic) of the inverter, and terminal 280 of the converter unit and terminal 93 (sink logic) of the inverter. Otherwise, the converter unit may be damaged.
2.5 Main circuit terminals

2.5.1 Details on the main circuit terminals

<table>
<thead>
<tr>
<th>Terminal symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>R/L1, S/L2, T/L3</td>
<td>AC power input</td>
<td>Connect these terminals to the commercial power supply.</td>
<td>—</td>
</tr>
<tr>
<td>R1/L11, S1/L21</td>
<td>Power supply for the control circuit</td>
<td>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 S/L2 and across S1/L21 and supply external power to these terminals. The power capacity necessary when separate power is supplied from R1/L11 and S1/L21 is 80 VA.</td>
<td>46</td>
</tr>
<tr>
<td>P/+, N/-</td>
<td>Inverter connection</td>
<td>Install wiring between the converter and the inverter as shown in the terminal connection diagram. (Wire one terminal P to another terminal P, and do likewise for terminal N.)</td>
<td>27, 29</td>
</tr>
<tr>
<td></td>
<td>Earth (ground)</td>
<td>For earth (grounding) the converter unit chassis. This must be earthed (grounded).</td>
<td>34</td>
</tr>
</tbody>
</table>

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

• Make sure the power cables are connected to the R/L1, S/L2, and T/L3. (Phase need not be matched.)
• When wiring the main circuit conductor, tighten a nut from the right side of the conductor.
• When wiring two wires, please wire on both sides of the conductor. (Refer to the drawing below.)
• For wiring, use bolts (nuts) provided with the converter unit.

• 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.
2.5.3  Applicable cables

Select a recommended cable size to ensure that the voltage drop will be 2% or less.

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

<table>
<thead>
<tr>
<th>Converter model FR-CC2-JP</th>
<th>Terminal screw size</th>
<th>Crimp terminal size</th>
<th>Cable group</th>
<th>Cable gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M6</td>
<td>HIV cables, etc. (mm²)</td>
<td>PVC cables, etc. (mm²)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M6</td>
<td>BCL, T1L, TIL3</td>
<td>BCL, T1L, TIL3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M6</td>
<td>TIL3, T2L, TIL3</td>
<td>TIL3, T2L, TIL3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M6</td>
<td>R/L1, S/L2, T/L3</td>
<td>R/L1, S/L2, T/L3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M6</td>
<td>P/+, N/-, Earthing (grounding) cable</td>
<td>P/+, N/-, Earthing (grounding) cable</td>
</tr>
<tr>
<td>H400K M12 (M10) 46 C2-200</td>
<td>2×200</td>
<td>2×200</td>
<td>2×200</td>
<td>2×200</td>
</tr>
<tr>
<td>H450K M12 (M10) 46 C2-250</td>
<td>2×250</td>
<td>2×250</td>
<td>2×250</td>
<td>2×250</td>
</tr>
<tr>
<td>H500K M12 (M10) 46 C2-200</td>
<td>3×200</td>
<td>3×200</td>
<td>3×200</td>
<td>3×200</td>
</tr>
<tr>
<td>H560K M12 (M10) 46 C2-200</td>
<td>3×200</td>
<td>3×200</td>
<td>3×200</td>
<td>3×200</td>
</tr>
</tbody>
</table>

- The recommended cable size is that of the cable (HIV cables, etc. with continuous maximum permissible temperature of 90°C of higher) or THHN cable (continuous maximum permissible temperature of 90°C) for overhead or exposed wiring.
- The recommended cable size is that of the cable (XLPE cable) with continuous maximum permissible temperature of 90°C for overhead or exposed wiring.

The terminal screw size indicates the size of a terminal screw for R/L1, S/L2, T/L3, P/+, N/-, and a screw for earthing (grounding). Screw size for earthing (grounding) is indicated in parentheses.

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

\[ \text{Voltage drop (V)} = \frac{\times \text{wire resistance (mΩ/m)} \times \text{wiring distance (m)} \times \text{current (A)}}{1000} \]

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 screws 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 avoid 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 audio equipment, sensors, computers and other apparatuses that handle low-level signals or operate very fast.

**Earthing (grounding) methods and earthing (grounding) work**

As described previously, earthing (grounding) is roughly classified into an electrical shock prevention type and a noise-influenced-malfunction prevention type. 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.
- If independent earthing (grounding) (I) is not available, use (II) common earthing (grounding) in the figure below where the converter unit is connected with the other equipment at an earthing (grounding) point. Do not use the other equipment’s earthing (grounding) cable to earth (ground) the converter unit as shown in (III).

A leakage current containing many high frequency components flows into the earthing (grounding) cables of the converter unit. Because of this, the converter unit must be earthed (grounded) separately from EMI-sensitive devices.

In a high building, it may be effective to use the EMI prevention type earthing (grounding) connecting to an iron structure frame, and electric shock prevention type earthing (grounding) with the independent earthing (grounding) together.

- **Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes.**
  - NEC section 250, IEC 536 class 1 and other applicable standards.
  - A neutral-point earthed (grounded) power supply in compliance with EN standard must be used.
  - Use the thickest possible earthing (grounding) cable. The earthing (grounding) cable should be the size indicated in the table on page 33.
  - 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 equipment sensitive to noises and run them in parallel in the minimum distance.

**NOTE**

- To be compliant with the EU Directive (Low Voltage Directive), refer to page 156.
## 2.6 Control circuit

### 2.6.1 Details on the control circuit terminals

The input signal function of the terminals in Pr.176, Pr.187, Pr.189 to Pr.195 (I/O terminal function selection) can be selected by setting Pr.178, Pr.187, Pr.189 to Pr.195 (I/O terminal function selection) (Refer to page 92, 96.)

#### Input signal

<table>
<thead>
<tr>
<th>Terminal Symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rate Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>RES</td>
<td>Reset</td>
<td>Use this signal to reset a fault output provided when a protective function is activated. Turn ON, the RES signal be ON to reset, then turn OFF after 5 s.</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 0 to 7 VDC, voltage when contacts are short-circuited: 4 to 6 VDC</td>
</tr>
<tr>
<td>D4</td>
<td>Input thermal relay input</td>
<td>The external thermal relay input (D4) signal is used when using the external thermal relay or a 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 (L.Ch-T).</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 0 to 7 VDC, voltage when contacts are short-circuited: 4 to 6 VDC</td>
</tr>
<tr>
<td>D7</td>
<td>Contact input</td>
<td>The function is designated for input terminal. The function can be designated by setting Pr.176.</td>
<td>———</td>
</tr>
<tr>
<td>SO</td>
<td>Contact input common (sink)</td>
<td>Connect the 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.</td>
<td>Power supply voltage range 19.2 to 28.8 VDC, permissible load current 0.1 A</td>
</tr>
<tr>
<td>S1</td>
<td>Contact input common (sink)</td>
<td>Connect the 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.</td>
<td>Power supply voltage range 19.2 to 28.8 VDC, permissible load current 0.1 A</td>
</tr>
<tr>
<td>SC</td>
<td>Contact input common (sink)</td>
<td>Connect the 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.</td>
<td>Power supply voltage range 19.2 to 28.8 VDC, permissible load current 0.1 A</td>
</tr>
<tr>
<td>S4</td>
<td>24 V external power supply input</td>
<td>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.</td>
<td>Input voltage 23 to 33 VDC, load current 0.1 A or less</td>
</tr>
</tbody>
</table>
## Control circuit

### Output signal

<table>
<thead>
<tr>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rate specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay output 1 (fault output)</td>
<td>When the converter control unit detects that the protection function of the converter unit has been activated and the outputs are stopped. Multi-discontinuity occurs if B and C (continuity occurs if A and C). Normal indicates a converter state.</td>
<td>Contact capacity 230 VAC 0.3 A, 30 VDC 0.3 A</td>
</tr>
<tr>
<td>For manufacturer setting. Do not use.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inverter operation enable (NC contact)</td>
<td>Switched to LOW when a converter unit fault occurs or the converter is reset. The inverter can be started when the RDA status is HIGH.</td>
<td>Permissible load 27 VDC 0.1 A (The voltage drop is 2.8 V at maximum while the signal is ON.)</td>
</tr>
<tr>
<td>Inverter reset</td>
<td>Switched to LOW when a converter unit is reset.</td>
<td>For manufacturer setting. Do not use.</td>
</tr>
<tr>
<td>IPF</td>
<td>Instantaneous power failure</td>
<td>Switched to LOW when an instantaneous power failure is detected.</td>
</tr>
<tr>
<td>FAN</td>
<td>Cooling fan fault</td>
<td>Switched to LOW when a cooling failure occurs.</td>
</tr>
</tbody>
</table>

### Communication

<table>
<thead>
<tr>
<th>Terminal symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS-485 terminals</td>
<td>Converter and transmission terminal</td>
<td>The converter units in parallel connection have the RS-485 communication via the RS-485 terminals on each converter unit. Wiring length: 30 m or less.</td>
</tr>
<tr>
<td>TXD+</td>
<td>Converter unit transmission terminal</td>
<td>For communication through RS-485. (For connection on a 1:1 basis only)</td>
</tr>
</tbody>
</table>

### 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 master converter unit and terminal MRS (X10) of the master inverter, and terminal SE of the master converter unit and terminal SD (PC for source logic) of the master inverter. Not doing so may lead to damage of the converter unit.
2.6.2 Control logic (sink/source) change

Change 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 jumper connector is in the sink logic (SINK) when shipped from the factory.
(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 switches ON when a current flows 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 switches ON when a current flows 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.

When using an external power supply for transistor output:

Sink logic:
- Use terminal PC as a common terminal, and perform wiring as shown below. (Do not connect terminal SD of the converter unit with terminal 0 V of the external power supply. When using terminals PC-SD as a 24 VDC power supply, do not install an external power supply in parallel with the converter unit. Doing so may cause a malfunction in the converter unit due to undesirable currents.)

Source logic:
- Use terminal SD as a common terminal, and perform wiring as shown below. (Do not connect terminal PC of the converter unit with terminal +24V of the external power supply. When using terminals PC-SD as a 24 VDC power supply, do not install an external power supply in parallel with the converter unit. Doing so may cause a malfunction in the converter unit due to undesirable currents.)
### 2.6.3 Wiring of control circuit

#### Control circuit terminal layout

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>+24</td>
</tr>
<tr>
<td>3-4</td>
<td>SD</td>
</tr>
<tr>
<td>5-6</td>
<td>SE</td>
</tr>
<tr>
<td>7-8</td>
<td>RD</td>
</tr>
<tr>
<td>9-10</td>
<td>AR</td>
</tr>
<tr>
<td>11</td>
<td>PE</td>
</tr>
</tbody>
</table>

#### Wiring method

- **Power supply connection**
  - For the control circuit wiring, strip off the sheath of a cable, and use it with a blade terminal. For a single wire, strip off the sheath of the wire and apply directly.
  - Insert the blade terminal or the single wire into a socket of the terminal.

  1. Strip off the sheath for the below length. If the length of the sheath peeled is too long, a short circuit may occur with neighboring wires. If the length is too short, wires might come off.
     - Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it.

  2. Crimp the blade terminal.
     - Insert wires to a blade terminal, and check that the wires come out for about 0 to 0.5 mm from a sleeve. Check the condition of the blade terminal after crimping. Do not use a blade terminal of which the crimping is inappropriate, or the face is damaged.

#### Blade terminals commercially available (as of May 2016)

<table>
<thead>
<tr>
<th>Cable gauge (mm²)</th>
<th>Ferrule terminal model</th>
<th>Crimping tool name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>AI 0, 34-10TQ</td>
<td>CRIMPFOX 6</td>
</tr>
<tr>
<td>0.5</td>
<td>AI 0, 5-10WH</td>
<td>AI 0, 5-10WH-GB</td>
</tr>
<tr>
<td>0.75</td>
<td>AI 0, 75-10GY</td>
<td>AI 0, 75-10 AI 0, 75-10GY-GB</td>
</tr>
<tr>
<td>1.0</td>
<td>AI 1-10RD</td>
<td>AI 1-10RD/1000GB</td>
</tr>
<tr>
<td>1.25, 1.5</td>
<td>A1 1, 5-10 BK</td>
<td>A 1, 5-10 BK/1000GB</td>
</tr>
<tr>
<td>1.25, 1.5 (for two wires)</td>
<td>A1-TWIN 2</td>
<td></td>
</tr>
</tbody>
</table>

- A ferrule terminal with an insulation sleeve compatible with the MTW wire which has a thick wire insulation.
- Applicable to terminals A1, B1, C1, A2, B2, and C2 only.

#### 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.
**Control circuit**

<table>
<thead>
<tr>
<th>Cable gauge (mm²)</th>
<th>Blade terminal product number</th>
<th>Insulation cap product number</th>
<th>Crimping tool product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 to 0.75</td>
<td>BT</td>
<td>VC</td>
<td>NH 69</td>
</tr>
</tbody>
</table>

1. Insert the wires into a socket.

When using stranded wires without a blade terminal, twist enough to avoid short circuit with a nearby terminals or wires.

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

3. Wire removal

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

- Pulling out the wires 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/width: 2.5 mm).
- If a flathead screwdriver with a narrow tip is used, terminal block may be damaged.

Commercially available products (as of February 2016)

<table>
<thead>
<tr>
<th>Name</th>
<th>Model</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver</td>
<td>0-0,4</td>
<td>Phoenix Contact Co., Ltd.</td>
</tr>
</tbody>
</table>

4. **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.
4.1 Control circuit

2.6.4 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 below.

- **Wiring precautions**
  - It is recommended to use a cable of 0.75 mm² for 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.
  - To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main 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.
  - Separate the wiring of the control circuit away from the wiring of the main circuit.

Make cuts in rubber bush of the converter unit side and lead the wires through.
2.6.5 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 mm² to 2 mm²
  - Tightening torque: 1.5 Nm

- Connected to

When a fault occurs, opening of the electromagnetic contactor (MC) on the converter unit power supply side results in power loss in the control circuit, disabling the fault-output signal retention. Terminals R1/L11 and S1/L21 are provided to hold a fault signal. In this case, connect the power supply terminals R1/L11 and S1/L21 of the control circuit to the input side of the MC. Do not connect the power cable to incorrect terminals. Doing so may damage the converter unit.

<Connection diagram>

- When using separate power supplies, always remove the jumpers from terminals R1/L11 and S1/L21. The converter unit may be damaged if the jumpers are not removed.
- The voltage should be the same as that of the main control circuit when the control circuit power is supplied from other than the input side of the MC.
- The power capacity necessary when separate power is supplied from R1/L11 and S1/L21 is 80 VA.
- If the main circuit power is switched OFF (for 0.1 s or more) then ON again, the converter unit is reset and a fault output will not be held.
Control circuit

2.6.6 When supplying 24 V external power to the control circuit

Connect a 24 V external power supply across terminals +24 and SD. Connecting a 24 V external power supply enables I/O terminal ON/OFF operation, operation panel displays, control functions, and communication during communication operation even during power-OFF of converter unit’s main circuit power supply. When the main circuit power supply is turned ON, the power supply changes from the 24 V external power supply to the main circuit power supply.

◆ Specification of the applied 24 V external power supply

<table>
<thead>
<tr>
<th>Term</th>
<th>Rate Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>23 to 25.5 VDC</td>
</tr>
<tr>
<td>Input current</td>
<td>1.4 A or lower</td>
</tr>
</tbody>
</table>

Commercially available products (as of February 2015)

- S8JX-N05024C
  - Specifications: Capacity 50 W, output voltage 24 VDC, output current 2.1 A
  - Installation method: Front installation with cover
- S8VS-06024
  - Specifications: Capacity 60 W, output voltage 24 VDC, output current 2.5 A
  - Installation method: DIN rail installation

◆ Starting and stopping the 24 V external power supply operation

- Supplying 24 V external power 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.

◆ Confirming the 24 V external power supply input

- During the 24 V external power supply operation, the ALARM lamp of the accessory cover blinks. When the operation panel is installed, “EV” blinks.
- During the 24 V external power supply operation, the 24 V external power supply operation signal (EV) is output. To use the EV signal, set "08 (positive logic) or 09 (negative logic)" in one of Pr.190 to Pr.195 (Output terminal function selection) to assign function to an output terminal.
Control circuit

**Operation while the 24 V external power is supplied**

- Faults history and parameters can be read and parameters can be written using the operation panel keys.
- During the 24 V external power supply operation, monitored 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.
- An “E.P24” may appear when the start-up time of the 24 V power supply is too long (less than 1.5 V/s) in the 24 V external power supply operation.
- “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). Otherwise, you may get an electric shock or burn.
2.7 Communication connectors and terminals

2.7.1 RS-485 terminal block

Connecting between the RS-485 terminals of the master/slave converter units enables communication for the parallel operation.

**RS-485 terminal layout**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RXD1+</td>
<td>Converter unit receive+</td>
</tr>
<tr>
<td>RXD1-</td>
<td>Converter unit receive-</td>
</tr>
<tr>
<td>RXD2+</td>
<td>Converter unit receive+ (for branch)</td>
</tr>
<tr>
<td>RXD2-</td>
<td>Converter unit receive- (for branch)</td>
</tr>
<tr>
<td>TXD1+</td>
<td>Converter unit send+</td>
</tr>
<tr>
<td>TXD1-</td>
<td>Converter unit send-</td>
</tr>
<tr>
<td>TXD2+</td>
<td>Converter unit send+ (for branch)</td>
</tr>
<tr>
<td>TXD2-</td>
<td>Converter unit send- (for branch)</td>
</tr>
<tr>
<td>VCC</td>
<td>5 V</td>
</tr>
<tr>
<td>GND</td>
<td>Earth (ground) (connected to terminal SD)</td>
</tr>
</tbody>
</table>

**Connection of RS-485 terminals and wires**

- Use a 4-pair twisted cable for each connection.
- The size of RS-485 terminal block is the same as that of the control circuit terminal block. Refer to page 39 for the wiring method.
- The total length of the cables between the RS-485 terminals must be within 5 m.
- To avoid malfunction, keep the RS-485 terminal wires away from the control circuit board.

**Terminating resistor switch**

- Initially set to "OPEN".
- Set only the terminating resistor switch of the remotest converter unit to the "100 Ω" position.
RS-485 terminal wiring method

- For parallel operation of two converter units

- For parallel operation of three converter units

\[\text{NOTE}\]

- Refer to the diagrams above to connect the converter units with RS-485 cables. Wrap the cables together around each ferrite core (accessory of the inverter) once (two turns). Install each ferrite core as within 10 cm of the converter unit.

- For branching, connect the wires as shown below.

\[\text{NOTE}\]

- Set the terminating resistor switch to the 100 ohm side.

\[\text{NOTE}\]

- Refer to the diagrams above to connect the converter units with RS-485 cables. Wrap the cables together around each ferrite core (accessory of the inverter) once (two turns). Install each ferrite core as within 10 cm of the converter unit.

- For branching, connect the wires as shown below.

\[\text{NOTE}\]

- To the transmission terminals of the master converter unit

\[\text{NOTE}\]

- To the reception terminals of the master converter unit

\[\text{NOTE}\]

- To the earth (ground) terminal of the converter unit

\[\text{NOTE}\]

- To the output terminals of the master converter unit
2.7.2 PU connector

- Installing the operation panel on the enclosure surface

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

  ![Diagram of PU connector installation]

- NOTE

  - Refer to the following table when fabricating the cable on the user side. Keep the total cable length within 20 m.
  - Commercially available products (as of February 2015)

<table>
<thead>
<tr>
<th>Name</th>
<th>Model</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication cable</td>
<td>SGLPEV-T (Cat5e/300 m) 24AWG</td>
<td>Mitsubishi Cable Industries, Ltd.</td>
</tr>
<tr>
<td>RJ-45 connector</td>
<td>5-554720-3</td>
<td>Tyco Electronics</td>
</tr>
<tr>
<td>Parameter unit connection cable (FR-CB2[ ] option)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation panel connection connector (FR-ADP) (option)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation panel</td>
<td>FR-DU08</td>
<td></td>
</tr>
</tbody>
</table>

- Communication operation

  - Using the PU connector enables communication operation from a personal computer, etc. When the PU connector is connected with a personal, FA or other computer by 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 102.
Parameter setting for the parallel operation

2.8 Parameter setting for the parallel operation

**Parameter setting for the parallel operation**

- **Parameter setting for the parallel operation (Pr.1001)**

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>E390</td>
<td>100</td>
<td>100 (initial value)</td>
<td>Master/slave station</td>
</tr>
</tbody>
</table>

- To operate two converter units in parallel, set “200”, and “1” or “2” in Pr.1001 Parallel operation selection of the master and slave converter units respectively. (Setting either slave 1 or 2 will perform the operation.)
- To operate three converter units in parallel, set “300”, “1”, and “2” in Pr.1001 of the master, slave 1, and slave 2 converter units respectively.
- For operating one converter unit (when the parallel operation is not used) in case of an emergency, set “100 (initial value)” in Pr.1001.

**NOTE**
- The setting of Pr.1001 will be applied after next power ON or converter unit reset.
- SLV.1 (Parallel operation slave 1) appears when an operation panel is installed to the slave 1 converter unit (Pr.1001 = "1") and SLV.2 (Parallel operation slave 2) appears when the operation panel is installed to the slave 2 converter unit (Pr.1001 = "2") on the monitor data screen at power-ON (first monitor). (Refer to page 134.)

**CAUTION**
- Be sure to set Pr.1001 correctly. Operation with incorrect settings may damage the converter units.

**Precautions for parameter setting for the parallel operation**
- Always set Pr.1001 of the master and reset the converter unit after setting Pr.1001 of the slave and resetting the converter unit. If the parameter is set in the reverse order, the communication between the master and the slave may not be performed correctly.
- Before the parallel operation, set the same values between the master and the slave in Pr.30, Pr.37, Pr.261, and Pr.598. If the settings are not correct, the parallel operation is not performed correctly.

**Resetting the converter during the parallel operation**
- When the RES signal of the master remains ON, the master keeps attempting to perform the converter reset. However, the slave performs the converter reset only once and does not keep attempting to perform the reset.
- For the converter reset, reset the master converter unit. The slave converter unit will be reset simultaneously.
Parameter setting for the parallel operation

**Parallel operation communication check time (Pr.652)**

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>652</td>
<td>Parallel operation communication check time</td>
<td>1 s</td>
<td>0.1 to 120 s</td>
<td>Set the interval of the communication check (signal loss detection) time. If a no-communication state persists for the permissible time or longer, the inverter will trip.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9999</td>
<td>0 Parallel operation communication disabled</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>0.1 to 120 s</td>
<td>Parallel operation communication disabled with a fixed check interval.</td>
</tr>
</tbody>
</table>

- If the communication between the master and the slave is lost for a certain period, the converter unit assumes it is in disconnection state and activates the protective function (E.SER) to shut off the output.
- If the communication for the time set in Pr.652 is lost while the converter unit is stopped, the signal loss detection is assumed and the protective function (E.SER) is activated.
- When the Pr.652 setting is any of 0.1 to 120 s, the signal loss detection is made.
- When the Pr.652 setting is "9999", the signal loss detection is not made.
- When the Pr.652 setting is "0", the parallel operation communication is not possible.

**Parallel operation ready (Y227) signal**

- When wiring to the RS-485 terminals and setting Pr.1001 are completed, communication between the master/slave converter units are started automatically and prepared for the parallel operation. When the converter units are ready, the Parallel operation ready (Y227) signal turns ON.
- For the Y227 signal, set "227 (positive logic) or 327 (negative logic)" in one of Pr.190 to Pr.195 (output terminal function selection) to assign the function to the 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.
3 PRECAUTIONS FOR USE OF THE CONVERTER UNIT

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

3.1 Electro-magnetic interference (EMI) and leakage currents .52
3.2 Power supply harmonics .................................................58
3.3 Power-OFF and magnetic contactor (MC) ..........................61
3.4 Checklist before starting operation ......................................62
3.1 Electro-magnetic interference (EMI) and leakage currents

3.1.1 Leakage currents and countermeasures

Capacitances exist 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. Its value depends on the static capacitances, etc. Take the following countermeasures.

To select the earth leakage circuit breaker, refer to its rated sensitivity current.

**To-earth (ground) leakage currents**

Leakage currents may flow not only into the inverter's own line or the converter unit's own line but also into the other lines through the earthing (grounding) cable, etc. These leakage currents may operate earth leakage circuit breakers and earth leakage relays unnecessarily.

**Countermeasures**

- Use an earth leakage circuit breaker with a weak sensitivity in a high frequency range.
- The output current of the inverter or the converter unit contains a high-frequency leakage current component, which gives relatively low impacts to human bodies. The detention level for this high-frequency leakage current component can be set weaker to prevent unnecessary operations.
- Minimize the stray capacitance to the earth.
  - Use the cables insulated with low dielectric constant material, and perform wiring to make the wiring length between the inverter and the motor to be as short as possible.

**Line-to-line leakage currents**

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

**Countermeasures**

- Use Pr.9 Electronic thermal O/L relay.
  - 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.
  - To suppress the external thermal (overload) relay setting by the amount of the leakage current.
- Minimize the stray capacitance between the lines.
  - Use the cables insulated with low dielectric constant material, and perform wiring to make the wiring length between the inverter and the motor to be as short as possible.

**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.
**Electro-magnetic interference (EMI) and leakage currents**

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

When using the earth leakage circuit breaker with the inverter or the converter unit, select its rated sensitivity current as follows.

- **Breaker designed for harmonic and surge suppression**
  
  \[ I_{\Delta n} = 10 \times (I_{g1} + I_{gn} + I_{gi} + I_{g2} + I_{gm}) \]

- **Standard breaker**
  
  \[ I_{\Delta n} = 10 \times (I_{g1} + I_{gn} + I_{gi} + 3 \times (I_{g2} + I_{gm})) \]

  \( I_{g1}, I_{g2} \): Leakage currents in wire path during commercial power supply operation

  \( I_{gn} \): Leakage current of inverter input side noise filter

  \( I_{gi} \): Leakage current of inverter unit

  \( I_{gm} \): Leakage current of motor during commercial power supply operation

  (When the converter unit is connected, add the leakage current of converter unit.)

  \(<\text{Example}>\)

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Breaker designed for harmonic and surge suppression</th>
<th>Standard breaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage current ( I_{g1} ) (mA)</td>
<td>1 \times ( 66 \times 5 ) m = 0.113 ( 10^3 ) m</td>
<td>( 0 ) (without noise filter)</td>
</tr>
<tr>
<td>Leakage current ( I_{gn} ) (mA)</td>
<td>0 (without noise filter)</td>
<td>0 (without noise filter)</td>
</tr>
<tr>
<td>Leakage current ( I_{gi} ) (mA)</td>
<td>1 (without EMC filter)</td>
<td>For the leakage current of the inverter, refer to the following table.</td>
</tr>
<tr>
<td>Leakage current ( I_{g2} ) (mA)</td>
<td>1 \times ( 66 \times 60 ) m = 1.323 ( 10^3 ) m</td>
<td>( 0 ) (without noise filter)</td>
</tr>
<tr>
<td>Motor leakage current ( I_{gm} ) (mA)</td>
<td>( 0.36 )</td>
<td>( 0.36 )</td>
</tr>
<tr>
<td>Total leakage current (mA)</td>
<td>2.79 \times 6.15</td>
<td>( 2.79 ) \times 6.15</td>
</tr>
<tr>
<td>Rated sensitivity current (mA)</td>
<td>( \geq 30 \times 10 )</td>
<td>( \geq 100 )</td>
</tr>
</tbody>
</table>

  **Example of leakage current per 1 km during three-phase three-wire delta connection**

  **Motor capacity (kW)**

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

  **Example of leakage current per 1 km 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**

  **(Totally-enclosed fan-cooled type motor 400 V 60 Hz)**

  **Cable size (mm²)**

<table>
<thead>
<tr>
<th>Leakage currents (mA)</th>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
<td>0.7</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>0.7</td>
<td>1.5</td>
<td>3.7</td>
<td>4.0</td>
<td>2.2</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>0.1</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td>0.9</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>2.0</td>
<td>2.1</td>
<td>2.2</td>
<td>2.3</td>
</tr>
</tbody>
</table>

  **Phase earthing (grounding)**

<table>
<thead>
<tr>
<th>Inverter/ converter unit</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-UA822-P</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>(Separated converter type)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

  **CONVERSION FOR USE OF THE CONVERTER UNIT**

  53
NOTE

- Install the earth leakage circuit breaker (ELB) on the input side of the converter unit.
- In the A connection-earthed-neutral system, the sensitivity current is blunt against a ground fault at the output side of the inverter. Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 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 are standard breakers: BV-C1, BV-C1MB, BV-NH, BV-2Z, NV-2Z, NV-2ZNA, NV-2ZT 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: N/A/MA/SMI series, N/A/FA, N/A/FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, and NV-m.
- For the motor leakage current, contact the motor manufacturer.

3.1.2 Countermeasures against EMI generated by the inverter or the converter unit

Some electromagnetic noises enter the inverter or the converter unit to cause the inverter or the converter unit malfunction, and others are radiated by the inverter or the converter unit to cause the peripheral devices to malfunction. 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. Also, since the inverter chops outputs at high carrier frequency, that could generate electromagnetic noises. If these electromagnetic noises cause peripheral devices to malfunction, EMI countermeasures should be taken to suppress noises. These techniques differ slightly depending on EMI paths.

- Basic techniques
  - 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, converter unit, motor, etc. at one point.

- Techniques to reduce electromagnetic noises that enter and cause a malfunction of the inverter or the converter unit (EMI countermeasures)
  When devices that generate many electromagnetic noises (which use magnetic contactors, electromagnetic brake, many relays, for example) are installed near the inverter or the converter unit, and the inverter or the converter unit may malfunction due to electromagnetic noises, the following countermeasures must be taken:
  - Provide surge suppressors for devices that generate many electromagnetic noises to suppress electromagnetic noises.
  - Install data line filters (page 56) to signal cables.
  - Ground (Earth) the shields of the detector connection and control signal cables with cable clamp metal.
Electro-magnetic interference (EMI) and leakage currents

PRECAUTIONS FOR USE OF THE CONVERTER UNIT

- Techniques to reduce electromagnetic noises that are radiated by the inverter or the converter unit to cause the peripheral devices to malfunction (EMI countermeasures)

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 their main circuits (I/O), those electromagnetically and electrostatically induced to the signal cables of the peripheral devices close to the main circuit cables, and those transmitted through the power supply cables.

<table>
<thead>
<tr>
<th>Noise propagation path</th>
<th>Countermeasure</th>
</tr>
</thead>
</table>
| (a) (b) (c) | When devices that handle low-level signals 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 air-propagated electromagnetic noises. The following countermeasures must be taken:  
  - Install easily affected devices as far away as possible from the inverter or the converter unit.  
  - Do not run the signal cables and power cables (I/O cables) of the inverter or the converter unit 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. |
| (d) (e) (f) | When the signal cables are run in parallel with or bundled with the power cables, magnetic and electrostatic induction noises may flow back through the power supply cables to cause malfunction of the devices. The following countermeasures must be taken:  
  - 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 I/O cables of the inverter or the converter unit.  
  - Do not run the signal cables and power cables (I/O cables) of the inverter or the converter unit 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) | When the power supplies of the peripheral devices are connected to the power supply of the inverter or the converter unit in the same line, noises generated from the inverter or the converter unit may flow back through the power supply cables, which to cause malfunction of the devices and the following countermeasures must be taken:  
  - Install easily affected devices as far away as possible from the inverter or the converter unit.  
  - Do not run the signal cables and power cables (I/O cables) of the inverter or the converter unit 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. |
| (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. |
Electro-magnetic interference (EMI) and leakage currents

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

**Example** Data line filter: ZCAT3035-1330 (by TDK)
ESD-SR-250 (by NEC TOKIN)

**Impedance (Ω)**

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 100 MHz</td>
<td>80</td>
</tr>
<tr>
<td>100 to 500 MHz</td>
<td>150</td>
</tr>
</tbody>
</table>

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

**EMI countermeasure example**

- Install the line noise filter on inverter output side.
- Do not earth (ground) enclosure directly.
- Do not earth (ground) control cable.

*NOTE* For compliance with the EU EMC Directive, refer to page 156.
3.1.3 Built-in EMC filter

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

The filter is effective in reducing air-propagated noise on the input side of the converter unit.

Two EMC filter ON/OFF connectors are provided. The both connectors are initially set to the “disabled” (OFF) position.

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

**NOTE**
- Fit the connector to either ON or OFF position.
- Enabling (turning ON) the EMC filter increases leakage current. (Refer to page 53.)

**WARNING**
- While power is ON, do not open the front cover. Otherwise you may get an electric shock.
Power supply harmonics

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 countermeasure suppression techniques.

- The differences between harmonics and noises

<table>
<thead>
<tr>
<th>Item</th>
<th>Harmonics</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Nearly 40th to 70th degrees or less (1 kHz or less)</td>
<td>High frequency (several kHz to 1 GHz order)</td>
</tr>
<tr>
<td>Environment</td>
<td>To-electric channel, power impedance</td>
<td>To-space, distance, wiring path</td>
</tr>
<tr>
<td>Generated amount</td>
<td>Frequency proportional to load capacity</td>
<td>Changes with the output variation ratio (less larger as switching speed increases)</td>
</tr>
<tr>
<td>Affected equipment immunity</td>
<td>Specified by manufacturer's equipment</td>
<td>Different depending on each equipment's specifications</td>
</tr>
<tr>
<td>Countermeasures</td>
<td>Provide a reactor. Increase distance.</td>
<td></td>
</tr>
</tbody>
</table>

The harmonic current generated from the inverter or the converter unit to the input side differs according to various conditions such as the setting impedance, whether a reactor is used or not, and output frequency and output current 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.

![Diagram]

- The converter unit is equipped with the 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.
3.2.2 Harmonic Suppression Guidelines

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 Guidelines 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:

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

- Conversion coefficient

<table>
<thead>
<tr>
<th>Classification</th>
<th>Circuit type</th>
<th>Conversion coefficient Ki</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3-fase bridge (Capacitor smoothing)</td>
<td>K33 = 1.8</td>
</tr>
</tbody>
</table>

- Equivalent capacity limits

<table>
<thead>
<tr>
<th>Received power voltage</th>
<th>Reference capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6 kV</td>
<td>50 kVA</td>
</tr>
<tr>
<td>22/33 kV</td>
<td>300 kVA</td>
</tr>
<tr>
<td>66 kV or more</td>
<td>2000 kVA</td>
</tr>
</tbody>
</table>

PRECAUTIONS FOR USE OF THE CONVERTER UNIT 59
### Power supply harmonics

- Harmonic contents (values of the fundamental wave current is 100%)

<table>
<thead>
<tr>
<th>Applicable motor (kW)</th>
<th>Fundamental wave current (A)</th>
<th>Fundamental wave current converted from 6.6 kV (mA)</th>
<th>Rated capacity (kVA)</th>
<th>Outgoing harmonic current converted from 6.6 kV (mA) with a DC reactor, 100% operation ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>175</td>
<td>175</td>
<td>57.2</td>
<td>223</td>
</tr>
<tr>
<td>75</td>
<td>123</td>
<td>123</td>
<td>40.2</td>
<td>150</td>
</tr>
<tr>
<td>150</td>
<td>165</td>
<td>165</td>
<td>54.0</td>
<td>207</td>
</tr>
<tr>
<td>220</td>
<td>215</td>
<td>215</td>
<td>69.7</td>
<td>286</td>
</tr>
<tr>
<td>315</td>
<td>273</td>
<td>273</td>
<td>96.8</td>
<td>380</td>
</tr>
<tr>
<td>400</td>
<td>339</td>
<td>339</td>
<td>127.6</td>
<td>483</td>
</tr>
<tr>
<td>500</td>
<td>410</td>
<td>410</td>
<td>172.8</td>
<td>593</td>
</tr>
<tr>
<td>630</td>
<td>506</td>
<td>506</td>
<td>223.7</td>
<td>716</td>
</tr>
<tr>
<td>800</td>
<td>613</td>
<td>613</td>
<td>287.1</td>
<td>843</td>
</tr>
<tr>
<td>1000</td>
<td>745</td>
<td>745</td>
<td>360.7</td>
<td>1000</td>
</tr>
<tr>
<td>132</td>
<td>872</td>
<td>872</td>
<td>457.1</td>
<td>1192</td>
</tr>
<tr>
<td>160</td>
<td>1014</td>
<td>1014</td>
<td>570.7</td>
<td>1355</td>
</tr>
<tr>
<td>200</td>
<td>1255</td>
<td>1255</td>
<td>720.9</td>
<td>1600</td>
</tr>
<tr>
<td>250</td>
<td>1546</td>
<td>1546</td>
<td>917.2</td>
<td>1892</td>
</tr>
<tr>
<td>315</td>
<td>1906</td>
<td>1906</td>
<td>1167.6</td>
<td>2372</td>
</tr>
<tr>
<td>355</td>
<td>2300</td>
<td>2300</td>
<td>1480.0</td>
<td>2860</td>
</tr>
</tbody>
</table>

- Calculation of equivalent capacity $P_0$ of harmonic generating equipment

$P_0 = \sum (K_i \times P_i) \ [\text{kVA}]$

- Calculation of outgoing harmonic current

\[ \text{Outgoing harmonic current} = \text{fundamental wave current (converted from received power voltage)} \times \text{operation ratio} \times \text{harmonic content} \]

- Determining if a countermeasure is required

A countermeasure for harmonics is required if the following condition is satisfied: outgoing harmonic current $> \text{maximum value per 1 kW contract power} \times \text{contract power}$. 

- Harmonic suppression techniques

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactor installation</td>
<td>With the DC reactor equipped on its DC side, the converter unit suppresses the outgoing harmonic current.</td>
</tr>
<tr>
<td>Reactor installation</td>
<td>With a reactor connected in series, the power factor improving correction capacitor can reduce harmonic currents.</td>
</tr>
<tr>
<td>Transformer multi-phase operation</td>
<td>Use two transformers with a phase angle difference of 30° as in-(\Delta) and (\Delta-\Delta) combinations to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.</td>
</tr>
<tr>
<td>Passive filter (AC filter)</td>
<td>A capacitor and reactor are used together to reduce impedance at specific frequencies. Harmonic currents are expected to be absorbed greatly by using this technique.</td>
</tr>
<tr>
<td>Active filter (Active filter)</td>
<td>An equipment detects the current is 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.</td>
</tr>
</tbody>
</table>
3.3 Power-OFF and magnetic contactor (MC)

**Conversion unit input side magnetic contactor (MC)**

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

- 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.

If using an MC for emergency stop during operation, select an MC regarding the conversion unit input side current as JEM1038-AC-3 class rated 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/OFF the inverter start controlling terminals (STF, STR) to run/stop the inverter.

- **Inverter start/stop circuit example**

  As shown below, always use the start signal (ON or OFF of the STF or STR signal) to make a start or stop.

- **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.)

  **NOTE**

  - Do not open or close the contactor while the inverter is running (outputting).
### 3.4 Checklist before starting operation

The converter unit 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.

<table>
<thead>
<tr>
<th>Checkpoint</th>
<th>Countermeasure</th>
<th>Ref to page</th>
<th>Check by user</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crimp terminals are insulated.</td>
<td>Use crimp terminals with insulation sleeves to wire the power supply and the encoder.</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>2. Wire offcuts are left from the time of wiring.</td>
<td>Wire offcuts are removed. Wire offcuts are removed from the time of wiring.</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>3. The total wiring length is within the specified length.</td>
<td>Make the total wiring length within the specified length.</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>4. Countermeasures are taken against EMI.</td>
<td>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, activate the EMC filter.</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>5. 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.</td>
<td>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 tester, etc.</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>6. The voltage applied to the converter unit I/O signal circuits is within the specifications.</td>
<td>Application of a voltage higher than the permissible voltage to the converter unit I/O signal circuit or opposite polarity may damage the I/O devices. Check the wiring beforehand.</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>7. A magnetic contactor (MC) is installed.</td>
<td>On the converter unit's input side, connect an MC for the following purposes:</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>8. The specifications and rating match the system requirements.</td>
<td>Make sure that the specifications and rating match the system.</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>9. The converter unit and the inverter are correctly connected.</td>
<td>Connect the converter unit and the inverter correctly and securely.</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>10. The RS-485 terminals are correctly connected.</td>
<td>Always connect wiring between the RS-485 terminals of the master converter unit and the slave converter unit. If the RS-485 communication is not performed correctly, the parallel operation cannot be made.</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>
This chapter explains the "BASIC OPERATION" of this product. Always read the instructions before using the equipment.

4.1 Operation panel ...............................................................64
4.2 Monitoring the converter unit status .................................68
## 4.1 Operation panel

### 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 47.

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>—</td>
<td>—</td>
<td>Not used.</td>
</tr>
<tr>
<td>(b)</td>
<td>—</td>
<td>Operation panel status indicator</td>
<td>Monitor the inverter start-up and protective function. For mount the protective function is activated. Status bar in the display-off mode. Slowly blinks in the display-off mode.</td>
</tr>
<tr>
<td>(c)</td>
<td>—</td>
<td>—</td>
<td>Not used.</td>
</tr>
<tr>
<td>(d)</td>
<td>—</td>
<td>—</td>
<td>Not used.</td>
</tr>
<tr>
<td>(e)</td>
<td>—</td>
<td>Monitor (5-digit LED)</td>
<td>Shows the monitored status, parameter number, etc. (Using Pr.774 to Pr.776, the monitored item can be changed.)</td>
</tr>
<tr>
<td>(f)</td>
<td>—</td>
<td>—</td>
<td>Not used.</td>
</tr>
<tr>
<td>(g)</td>
<td>—</td>
<td>—</td>
<td>Not used.</td>
</tr>
<tr>
<td>(h)</td>
<td>—</td>
<td>STOP/RESET key</td>
<td>Resets the converter unit when the protective function is activated.</td>
</tr>
<tr>
<td>(i)</td>
<td>—</td>
<td>Setting dial</td>
<td>Changes the parameter settings. If pressed during the operation, perform the following operations: - Displays a monitored item set in Pr.992 - Displays a fault history number in the fault history mode</td>
</tr>
<tr>
<td>(j)</td>
<td>—</td>
<td>MODE key</td>
<td>Changes to different modes. Holding this key for 2 seconds stops the operation. The key lock is invalid when the parameter is being set. (Refer to page 40.)</td>
</tr>
<tr>
<td>(k)</td>
<td>—</td>
<td>SET key</td>
<td>Changes to different modes. If pressed during the operation, monitored item changes as the following: - Using Pr.774 to Pr.776, the monitored item can be changed.</td>
</tr>
<tr>
<td>(l)</td>
<td>—</td>
<td>ESC key</td>
<td>Goes back to the previous display. Holding this key for a long time changes this mode to the monitor mode.</td>
</tr>
</tbody>
</table>

Converter output voltage

Input current

Electric thermal relay

Function load factor
4.1.2 Basic operation of the operation panel

**Basic operation**

- **Basic operation**
  - Monitored items can be changed. (Refer to page 88.)
  - For the details of faults history, refer to page 128.

**Parameter setting**

- **Faults history**
  - Monitor
  - Converter output voltage monitor (At power-ON)
  - Input current monitor
  - Electronic thermal relay function fault history monitor
  - Electronic thermal relay function load factor monitor
  - Past eight faults can be displayed. (The latest fault is ended by ".".)
  - When no fault history exists, is displayed.

**Parameter setting mode**

- **Display the present setting**
- **Value change**
- **Parameter write is completed!!**
- **Blink** (Example)
- **Parameter copy**
- **Initial value change list**
- **Parameter clear**
  - All parameter clear
  - Faults history clear
  - Faults history1
  - Faults history2
  - Faults history8
  - Faults history9

**Group parameter setting**

- **Blinking** (Example)
- **Blinking** (Example)
- **Blinking** (Example)
- **Blinking** (Example)

- (Example)
**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.

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>Function name</th>
<th>Description</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Parameter setting mode</td>
<td>Under this mode, the set value of the displayed parameter number is read or changed.</td>
<td>97</td>
</tr>
<tr>
<td>P_ALLCLR</td>
<td>Parameter clear</td>
<td>Clears and resets parameter settings to the initial values. However, parameters such as terminal function selection parameters are not cleared. For the details of the unclerared parameters, refer to page 104.</td>
<td>117</td>
</tr>
<tr>
<td>ALLCLR</td>
<td>All parameter clear</td>
<td>Clears and resets parameter settings to the initial values. Terminal function selection parameters are also cleared. For the details of the unclerared parameters, refer to page 104.</td>
<td>117</td>
</tr>
<tr>
<td>ErrCLR</td>
<td>Fault history clear</td>
<td>Displays the fault history.</td>
<td>125</td>
</tr>
<tr>
<td>P_ALLCPY</td>
<td>Parameter copy</td>
<td>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.</td>
<td>118</td>
</tr>
<tr>
<td>PrCHG</td>
<td>Initial value change list</td>
<td>Identifies the parameters that have been changed from their initial settings.</td>
<td>121</td>
</tr>
<tr>
<td>PrMid</td>
<td>Group parameter setting</td>
<td>Displays parameter numbers by function groups.</td>
<td>73</td>
</tr>
</tbody>
</table>

### Correspondences between digital and actual characters

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel:

- 0 1 2 3 4 5 6 7 8 9 A B C D E F G H I J K L M N O P
- Q R S T U V W X Y Z

---

66 | **BASIC OPERATION**
### 4.1.4 Changing the parameter setting value

<table>
<thead>
<tr>
<th><strong>Event</strong></th>
<th><strong>Operation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Screen at power-ON</td>
<td>The monitor display appears.</td>
</tr>
<tr>
<td>2. Change the parameter setting mode</td>
<td>Press ( \text{[set]} ) to choose the parameter setting mode. (The parameter number read previously appears.)</td>
</tr>
<tr>
<td>3. Selecting the parameter number</td>
<td>Turn ( \text{[a]...[e]} ) until ( \text{[a]...[e]} ) ( \text{[Pr.774]} ) appears. Press ( \text{[set]} ) to read the present set value. ( \text{[0000]} ) (default value) appears.</td>
</tr>
<tr>
<td>4. Changing the setting value</td>
<td>Turn ( \text{[a]...[e]} ) to change the set value to ( \text{[a]...[e]} ). Press ( \text{[set]} ) to enter the setting. ( \text{[a]...[e]} ) and ( \text{[d]...[f]} ) <strong>blinks</strong> alternately. Turn ( \text{[a]...[e]} ) to read another parameter.</td>
</tr>
<tr>
<td>( \text{[o]...[r]} ) to show the setting again.</td>
<td></td>
</tr>
<tr>
<td>( \text{[o]...[r]} ) to show the next parameter.</td>
<td></td>
</tr>
<tr>
<td>( \text{[o]...[r]} ) twice to return to the monitor display of the converter output voltage.</td>
<td></td>
</tr>
</tbody>
</table>

#### NOTE
- \( \text{[e]} \) is displayed... Why?
- \( \text{[e]} \) appears... Write disable error.
- For details, refer to page 128.
4.2 Monitoring the converter unit status

4.2.1 Monitoring of converter output voltage and input current

- Pressing the [XT] key in the monitor mode switches the monitored item to converter output voltage, input current, and then to electronic thermal relay function load factor.

**Operation**

1. Press [XT] to monitor the converter output voltage. [V] appears.

**NOTE**

- Use Pr.774 to Pr.776 Operation panel monitor selection 1 to 3 to change the monitored items. (Refer to page 88.)

4.2.2 First monitored item

The first monitored item to be displayed in the monitor mode is selectable.

To set a monitored item as the first monitored item, display a monitored item, and press [XT] for a while.

**Operation**

1. Select the monitor mode, and select the input current.
2. Press [XT] for a while (1 s). The input current is set as the first monitored item.
3. When the monitor mode is selected next time, the input current is monitored first.

**NOTE**

- Use Pr.774 Operation panel monitor selection 1 to change the monitored item. (Refer to page 88.)
This chapter explains the function setting for use of this product. Always read the instructions before using the equipment.
### 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 performed from the operation panel. Install the operation panel of the inverter on the FR-CC2-P.
- The list of FR-CC2-P parameters (including the availability for the master and the slave) is as follows.
  - O indicates the parameter in which all the settings are valid.
  - X indicates the parameter in which all the settings are invalid.

**NOTE**

Refer to Appendix 1 (page 156) for instruction codes for communication and availability of parameter clear, all clear, and parameter copy of each parameter.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Pr. group</th>
<th>Name</th>
<th>Setting range</th>
<th>Minimum setting increments</th>
<th>Initial value</th>
<th>Master station</th>
<th>Slave station</th>
<th>HMA in case</th>
<th>Customer setting</th>
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Parameter for manufacturer setting. Do not set.

Parameter for manufacturer setting. Do not set.

Parameter for manufacturer setting. Do not set.
### Parameter List

<table>
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<tr>
<th>Pr. no.</th>
<th>Pr. name</th>
<th>Parameter function selection</th>
<th>Setting range</th>
<th>Minimum setting</th>
<th>Initial value</th>
<th>Master station</th>
<th>Slave station</th>
<th>Refer to page</th>
<th>Customer setting</th>
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</thead>
<tbody>
<tr>
<td>158</td>
<td>T700</td>
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<td>2</td>
<td>0</td>
<td>0</td>
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<td>2</td>
<td>0</td>
<td>0</td>
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</table>

### Additional Data
- **Pr. Group**
- **Name**
- **Setting range**
- **Minimum setting increments**
- **Initial value**
- **Master station**
- **Slave station**
- **Refer to page**
- **Customer setting**
## Parameter List

### Parameter List (by parameter number)

<table>
<thead>
<tr>
<th>Pr. group</th>
<th>Name</th>
<th>Setting range</th>
<th>Minimum setting increments</th>
<th>Initial value</th>
<th>Master station</th>
<th>Slave station</th>
<th>Ref. to page</th>
<th>Customer setting</th>
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</thead>
<tbody>
<tr>
<td>65</td>
<td>E714</td>
<td>Maintenance timer 1</td>
<td>0 to 9999</td>
<td>1</td>
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<td>M011</td>
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<td>M013</td>
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<td>H001</td>
<td>Total energy loss protection selection</td>
<td>1 to 9999</td>
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<td>0</td>
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<tr>
<td>87</td>
<td>T220</td>
<td>OH input selection</td>
<td>0 to 2</td>
<td>1</td>
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<td>0</td>
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<td>88</td>
<td>E420</td>
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<td>0 to 9999</td>
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<td>0 to 9999</td>
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<td>5</td>
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<td>89</td>
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<td>Cumulative power monitor digit shifted times</td>
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<td>0</td>
<td>0</td>
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<td>H104</td>
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<td>0, 1</td>
<td>1</td>
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<td>0</td>
<td>5</td>
<td>5</td>
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<td>E390</td>
<td>Parallel operation selection</td>
<td>1, 2, 100, 200, 300</td>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>E021</td>
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<td>1/1 to 12/31</td>
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<td>E022</td>
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<td>Parameter clear</td>
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### Parameter List

<table>
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<tr>
<th>Pr. group</th>
<th>Name</th>
<th>Setting range</th>
<th>Minimum setting increments</th>
<th>Initial value</th>
<th>Master station</th>
<th>Slave station</th>
<th>Ref. to page</th>
<th>Customer setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>E714</td>
<td>Maintenance timer 1</td>
<td>0 to 9999</td>
<td>1</td>
<td>0</td>
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<td>5</td>
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<td>M011</td>
<td>Operation panel monitor selection 1</td>
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<td>5</td>
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<td>M013</td>
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<td>87</td>
<td>H001</td>
<td>Total energy loss protection selection</td>
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<td>T220</td>
<td>OH input selection</td>
<td>0 to 2</td>
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<td>5</td>
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<td>89</td>
<td>M023</td>
<td>Cumulative power monitor digit shifted times</td>
<td>0, 4, 9999</td>
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<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
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<tr>
<td>99</td>
<td>H104</td>
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<td>5</td>
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<td>E021</td>
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<tr>
<td>100</td>
<td>E022</td>
<td>Clock (hour, minute)</td>
<td>0:00 to 23:59</td>
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<tr>
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<td>E106</td>
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<td>0 to 60 minutes</td>
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</table>
5.1.2 Parameter display by function group

The monitor display can be changed to the parameter display by function group.

Parameter numbers are displayed by function group. The related parameters can be set easily.

◆Changing to the grouped parameter numbers

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<th>Description</th>
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<td>Parameter display by parameter number</td>
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<tr>
<td>2</td>
<td>Parameter display by function group</td>
</tr>
</tbody>
</table>

Operation

1. Screen at power-ON
   The monitor display appears.
2. Parameter setting mode
   Press [ ] to choose the parameter setting mode. (The parameter number read previously appears.)
3. Selecting the parameter number
   Turn until [ ] (parameter display method) appears.
   Press [ ] (initial value) will appear.
4. Changing to the group parameter display
   Turn [ ] to change the set value to [ ] (Parameter display by function group). Press [ ] to select the parameter setting by function group. “ ” and “ ” will be displayed alternately after the setting is completed.

◆Changing parameter settings in the group parameter display

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change the PMW10 (Pr.774) Operation panel monitor selection 1</td>
</tr>
</tbody>
</table>

Operation

1. Screen at power-ON
   The monitor display appears.
2. Parameter setting mode
   Press [ ] to choose the parameter setting mode. (The parameter number read previously appears.)
3. Parameter group selection
   Press [ ] several times until [ ] appears. Parameter groups can now be selected.
4. Parameter group selection
   Turn [ ] until [ ] (monitor parameter 1) appears. Press [ ] to display [ ] and make the group parameters of the monitor parameter 1 selectable.
5. Parameter selection
   Turn [ ] until [ ] (PMW10 Operation panel/monitor selection 1) appears. Press [ ] to read the present set value. “99999” (global value) appears.
6. Changing the setting value
   Turn [ ] to change the set value to “ . Press [ ] to enter the setting. “ ” and “ ” will be displayed alternately after the setting is completed.
5.1.3 Parameter list (by function group)

### Parameter list (by function group)

<table>
<thead>
<tr>
<th>Pr. group</th>
<th>Pr.</th>
<th>Name</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
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<td>168</td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td>168</td>
</tr>
<tr>
<td>E001</td>
<td>169</td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td>169</td>
</tr>
<tr>
<td>E020</td>
<td>1006</td>
<td>Clock (year)</td>
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</tr>
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<td>Clock (hour, minute)</td>
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</tr>
<tr>
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<td>269</td>
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<td>E030</td>
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<td>161</td>
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<tr>
<td>E102</td>
<td>163</td>
<td>Parameter write selection</td>
<td>80</td>
</tr>
<tr>
<td>E103</td>
<td>296</td>
<td>Password lock level</td>
<td>81</td>
</tr>
<tr>
<td>E104</td>
<td>990</td>
<td>PU buzzer control</td>
<td>79</td>
</tr>
<tr>
<td>E105</td>
<td>1048</td>
<td>Display-off waiting time</td>
<td>79</td>
</tr>
<tr>
<td>E106</td>
<td>160</td>
<td>Key lock operation selection</td>
<td>80</td>
</tr>
<tr>
<td>E300</td>
<td>30</td>
<td>Parameter write selection during power supply to main circuit</td>
<td>80</td>
</tr>
<tr>
<td>E301</td>
<td>161</td>
<td>Reset selection during power supply to main circuit</td>
<td>80</td>
</tr>
<tr>
<td>E390</td>
<td>1001</td>
<td>Parallel operation selection</td>
<td>48</td>
</tr>
<tr>
<td>E400</td>
<td>77</td>
<td>Parameter write selection</td>
<td>80</td>
</tr>
<tr>
<td>E410</td>
<td>297</td>
<td>Password lock/unlock</td>
<td>81</td>
</tr>
<tr>
<td>E411</td>
<td>298</td>
<td>Password lock/unlock</td>
<td>81</td>
</tr>
<tr>
<td>E420</td>
<td>888</td>
<td>Free parameter 1</td>
<td>83</td>
</tr>
<tr>
<td>E421</td>
<td>889</td>
<td>Free parameter 2</td>
<td>83</td>
</tr>
<tr>
<td>E700</td>
<td>255</td>
<td>Life alarm status display</td>
<td>83</td>
</tr>
<tr>
<td>E701</td>
<td>256</td>
<td>Inrush current limit circuit life display</td>
<td>83</td>
</tr>
<tr>
<td>E702</td>
<td>257</td>
<td>Control circuit capacitor life display</td>
<td>83</td>
</tr>
<tr>
<td>E710</td>
<td>503</td>
<td>Maintenance timer 1</td>
<td>85</td>
</tr>
<tr>
<td>E711</td>
<td>504</td>
<td>Maintenance timer 1 warning output set time</td>
<td>85</td>
</tr>
<tr>
<td>E712</td>
<td>505</td>
<td>Maintenance timer 2</td>
<td>85</td>
</tr>
<tr>
<td>E713</td>
<td>506</td>
<td>Maintenance timer 2 warning output set time</td>
<td>85</td>
</tr>
<tr>
<td>E714</td>
<td>507</td>
<td>Maintenance timer 3</td>
<td>85</td>
</tr>
<tr>
<td>E715</td>
<td>508</td>
<td>Maintenance timer 3 warning output set time</td>
<td>85</td>
</tr>
</tbody>
</table>

### Protective function parameters

<table>
<thead>
<tr>
<th>Pr. group</th>
<th>Pr.</th>
<th>Name</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>H100</td>
<td>996</td>
<td>Undervoltage level</td>
<td>86</td>
</tr>
<tr>
<td>H200</td>
<td>872</td>
<td>Overcurrent level</td>
<td>97</td>
</tr>
<tr>
<td>H300</td>
<td>67</td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td>67</td>
</tr>
<tr>
<td>H301</td>
<td>68</td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td>68</td>
</tr>
<tr>
<td>H302</td>
<td>69</td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td>69</td>
</tr>
<tr>
<td>H400</td>
<td>130</td>
<td>Parameter write selection</td>
<td>80</td>
</tr>
<tr>
<td>H410</td>
<td>296</td>
<td>Password lock level</td>
<td>81</td>
</tr>
<tr>
<td>H411</td>
<td>297</td>
<td>Password lock/unlock</td>
<td>81</td>
</tr>
</tbody>
</table>

### Monitor display and monitor output signal

<table>
<thead>
<tr>
<th>Pr. group</th>
<th>Pr.</th>
<th>Name</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>M020</td>
<td>170</td>
<td>Watt-hour meter clear</td>
<td>88</td>
</tr>
<tr>
<td>M021</td>
<td>563</td>
<td>Energization time carrying-over times</td>
<td>88</td>
</tr>
<tr>
<td>M022</td>
<td>268</td>
<td>Monitor decimal digits selection</td>
<td>88</td>
</tr>
<tr>
<td>M044</td>
<td>290</td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td>290</td>
</tr>
<tr>
<td>M060</td>
<td>653</td>
<td>Cumulative power monitor digit shifted times</td>
<td>88</td>
</tr>
<tr>
<td>M400</td>
<td>190</td>
<td>RDB terminal function selection</td>
<td>92</td>
</tr>
<tr>
<td>M401</td>
<td>191</td>
<td>RDA terminal function selection</td>
<td>92</td>
</tr>
<tr>
<td>M402</td>
<td>192</td>
<td>IPF terminal function selection</td>
<td>92</td>
</tr>
<tr>
<td>M403</td>
<td>193</td>
<td>RSO terminal function selection</td>
<td>92</td>
</tr>
<tr>
<td>M404</td>
<td>194</td>
<td>FAN terminal function selection</td>
<td>92</td>
</tr>
</tbody>
</table>

---

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### (T) Multi-function input terminal parameters
Parameters for the input terminals where converter unit commands are received through.

<table>
<thead>
<tr>
<th>Pr. group</th>
<th>Pr.</th>
<th>Name</th>
<th>Ref. to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7110</td>
<td>165</td>
<td>Multi-function input selection</td>
<td>96</td>
</tr>
<tr>
<td>7189</td>
<td>167</td>
<td>Multi-function input selection</td>
<td>96</td>
</tr>
<tr>
<td>7111</td>
<td>166</td>
<td>Multi-function input selection</td>
<td>96</td>
</tr>
</tbody>
</table>

### (A) Application parameters
Parameters to set a specific application.

<table>
<thead>
<tr>
<th>Pr. group</th>
<th>Pr.</th>
<th>Name</th>
<th>Ref. to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A005</td>
<td>248</td>
<td>Self power management selection</td>
<td>96</td>
</tr>
<tr>
<td>A005</td>
<td>249</td>
<td>Power failure stop selection</td>
<td>105</td>
</tr>
</tbody>
</table>

### (N) Operation via communication and its settings
Parameters for communication operation. These parameters set the communication specifications and operation.

<table>
<thead>
<tr>
<th>Pr. group</th>
<th>Pr.</th>
<th>Name</th>
<th>Ref. to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>N000</td>
<td>549</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N001</td>
<td>342</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N002</td>
<td>539</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N020</td>
<td>117</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N021</td>
<td>118</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N022</td>
<td>119</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N023</td>
<td>120</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N024</td>
<td>121</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N025</td>
<td>122</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N026</td>
<td>123</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N027</td>
<td>124</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N028</td>
<td>125</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N029</td>
<td>126</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N030</td>
<td>127</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N031</td>
<td>128</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N032</td>
<td>129</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N033</td>
<td>130</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N034</td>
<td>131</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N035</td>
<td>132</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N036</td>
<td>133</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N037</td>
<td>134</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N038</td>
<td>135</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N080</td>
<td>343</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
<tr>
<td>N092</td>
<td>652</td>
<td>Parameter for manufacturer setting</td>
<td>105</td>
</tr>
</tbody>
</table>
### 5.2 (E) Environment setting parameters

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Parameter to set</th>
<th>Related to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>To set the time</td>
<td>Simple clock function</td>
<td>P.E020 to P.E022, Pr.1055 to Pr.1058</td>
</tr>
<tr>
<td>To set a limit for the reset function. To shut off output if the operation panel disconnects.</td>
<td>Reset selection / disconnected PV detection / reset limit</td>
<td>P.E106, P.E107, Pr.25</td>
</tr>
<tr>
<td>To control the buzzer of the operation panel</td>
<td>PV buzzer control</td>
<td>P.E104, Pr.390</td>
</tr>
<tr>
<td>To shut off the operation panel when not using it for a certain period of time.</td>
<td>Display-off mode</td>
<td>P.E106, Pr.1046, Pr.9</td>
</tr>
<tr>
<td>To disable the operation panel.</td>
<td>Operation panel operation selection</td>
<td>P.E200, Pr.161</td>
</tr>
<tr>
<td>To set the master/slave for the parallel operation.</td>
<td>Parameter write disable selection</td>
<td>P.E380, Pr.1001, Pr.400, Pr.77</td>
</tr>
<tr>
<td>To prevent parameter rewriting</td>
<td>Parameter write function</td>
<td>P.E410 to P.E411, Pr.256 to Pr.257</td>
</tr>
<tr>
<td>To restrict parameters with a password</td>
<td>Free parameter</td>
<td>P.E420, P.E421, Pr.288 to Pr.315, Pr.49</td>
</tr>
<tr>
<td>To understand the maintenance time of converter unit parts and peripheral devices</td>
<td>Converter unit part life display</td>
<td>P.E700 to P.E702, Pr.255 to Pr.257, Pr.591 to Pr.154, Pr.88 to Pr.89</td>
</tr>
<tr>
<td>To understand the maintenance time of converter unit parts and peripheral devices</td>
<td>Maintenance output function</td>
<td>P.E710 to P.E715, Pr.255 to Pr.257, Pr.88 to Pr.89</td>
</tr>
</tbody>
</table>
### 5.2.1 Simple clock function

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

The real time clock function is enabled using an optional LCD operation panel (FR-LU08).

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1006</td>
<td>Clock (year)</td>
<td>2000</td>
<td>2000 to 2099</td>
<td>Set the year.</td>
</tr>
<tr>
<td>1007</td>
<td>Clock (month, day)</td>
<td>101 (January 1)</td>
<td>101 to 131, 201 to 208, 211 to 218, 301 to 308, 401 to 408, 501 to 508, 601 to 608, 701 to 708, 801 to 808, 901 to 908, 1001 to 1008</td>
<td>Set the month and day. 100 and 100 digits: January to December 31; 1 digit: 1 to the end of month (28, 29, 30 or 31); For December 31, set “1231”.</td>
</tr>
<tr>
<td>1008</td>
<td>Clock (hour, minute)</td>
<td>00:00</td>
<td>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</td>
<td>Set the hour and minute using the 24-hour clock. 100 and 100 digits: 0 to 23 hours 1 digit: 0 to 59 minutes For 23:59, set “2359”.</td>
</tr>
</tbody>
</table>

* When the year, month, day, hour 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 clock's count-up data 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 the control circuit.
- Converter reset is performed if supplying power to the control circuit power supply is started with power supplied only to the control circuit power supply. Thus, the clock information retained in the EEPROM is restored. Reset of the start of supplying power to the control circuit can be disabled by setting Pr.30 Reset selection during power supply to main circuit. (Refer to page 90)
- The data set in Pr.1006 to Pr.1008 is also used for the function in the faults history (Refer to page 125), etc.
5.2.2 Reset selection / disconnected PU detection / reset limit

The reset input acceptance, the disconnected operation panel connector detection function, and the reset limit function can be selected.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>Reset selection/disconnected PU detection/reset limit</td>
<td>14</td>
<td>14 to 17, 114 to 117</td>
<td>The reset input selection, reset input acceptance, and the disconnected PU detection function can be selected. The reset limit function is disabled.</td>
</tr>
<tr>
<td>E100</td>
<td>Reset selection</td>
<td>0</td>
<td>0 to 15, 115 to 117</td>
<td>Reset input is always enabled when reset input acceptance is enabled, regardless of the protective function status.</td>
</tr>
<tr>
<td>E101</td>
<td>Disconnected PU detection</td>
<td>0</td>
<td>0 to 15, 115 to 117</td>
<td>Operation continues even when the operation panel is disconnected. The inverter output is shut off when the protective function is activated.</td>
</tr>
<tr>
<td>E107</td>
<td>Reset limit</td>
<td>0</td>
<td>0 to 15, 115 to 117</td>
<td>Reset limit is enabled when the protective function is activated.</td>
</tr>
</tbody>
</table>

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

**Reset selection (P.E100)**

- When P.E100 = "1" or Pr.75 = "14", 114 to 117", reset (reset command via RES signal or communication) input is enabled only when the protective function is activated.
- When P.E100 = "0", reset input is always enabled.
- When Pr.75 = "15", 115 to 117", reset input acceptance is enabled, regardless of the protective function status.

**Disconnected PU detection (P.E101)**

- If the converter unit detects that the operation panel has been disconnected for 1 or more than 16, 116, 117", the protective function (E.PUE) is activated and the inverter output is shut off.
- The cumulative value of electronic thermal O/L relay is cleared.
- When RS-485 communication operation is performed through the PU connector, the reset selection is valid but the disconnected PU detection function is invalid.

**NOTE:**
- If the operation panel is disconnected before power-on, the output is not shut off.
- To reset, confirm that the operation panel is connected and then reset the converter unit.
- When HS-485 communication operation is performed through the PU connector, the reset selection is valid but the disconnected PU detection function is invalid. (The communication is checked according to Pr.122 PU communication check time interval.)
5.2.2 Reset limit function (P.E107)

- Setting P.E107=1” or Pr.73 = any of “114 to 117” will make the inverter to refuse any reset operation (RES signal, etc.) for 3 minutes after the first activation of an electronic thermal function (E.THC).

**CAUTION**
- Restarting the converter unit power (turning OFF the control power) will clear the accumulated thermal value.

5.2.3 Buzzer control

The buzzer can be set to “beep” when the keys of the operation panel are operated.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E104</td>
<td>BU buzzer control</td>
<td>0</td>
<td>0 to 60 minutes</td>
<td>Turned OFF when the operation panel is turned OFF.</td>
</tr>
</tbody>
</table>

**NOTE**
- When with buzzer is set, the buzzer sounds if a converter unit fault occurs.

5.2.4 Display-off mode

The LED of the operation panel can be turned OFF when it has not been used for a certain period of time.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E106</td>
<td>Display-off waiting time</td>
<td>0</td>
<td>0 to 60 minutes</td>
<td>Turned OFF by installation/removal of the operation panel, power-ON/OFF of the converter unit, or converter reset.</td>
</tr>
</tbody>
</table>

- If the operation panel has not been operated for the time set in Pr.1046, the display-off mode is enabled and its LED is turned OFF.
- In the display-off mode, the “MON” LED blinks slowly.
- The count to display off is reset to “0” to restart at installation/removal of the operation panel, power-ON/OFF of the converter unit, or converter reset.
- Display-off mode and 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

6 Environment setting parameters

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5.2.5 Setting dial key lock operation selection

The key operation of the operation panel can be disabled.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>161</td>
<td>E200 Key lock operation selection</td>
<td>0</td>
<td>0/1</td>
<td>Key lock mode disabled</td>
</tr>
</tbody>
</table>

Operation using the setting dial and keys of the operation panel can be disabled to prevent unexpected parameter changes.

- Set Pr.161 to “0” and then press for 2 s to disable setting dial or key operations.
- When setting dial and key operations are disabled, appears on the operation panel. If setting dial or key operation is attempted while dial and key operations are disabled, appears. (When a setting dial or key operation is not performed for 2 s, the monitor display appears.)
- To enable the setting dial and key operation again, press for 2 s.

**NOTE**

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

5.2.6 Parameter write selection

Whether to enable the writing to various parameters or not can be selected. Use this function to prevent parameter values from being rewritten by misoperation.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>77</td>
<td>E400 Parameter write selection</td>
<td>1</td>
<td>1/2</td>
<td>Parameter writing is disabled</td>
</tr>
</tbody>
</table>

**Disabling parameter write (Pr.77=1)**

- Parameter write, parameter clear and all parameter clear are disabled. (Parameter read is enabled.)

**Writing parameters (Pr.77=2)**

- These parameters can always be written.
### 5.2.7 Password function

Registering a 4-digit password can restrict parameter reading/writing.

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

- The level of the reading/writing restriction using the operation panel or via RS-485 communication can be selected with Pr.296.

<table>
<thead>
<tr>
<th>Pr.296 setting</th>
<th>Operation panel</th>
<th>RS-485 communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 3, 5, 6</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>100 to 103, 105, 106</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>0, 100</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>1, 101</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>2, 102</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>3, 103</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>5, 105</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>6, 106</td>
<td>Read</td>
<td>Write</td>
</tr>
</tbody>
</table>

- 100 to 103, 105, 106: Password unlock error restriction
- 0 to 3, 5, 6: Always display 0

#### Parameter reading/writing restriction setting (Pr.296, Pr.297)

1. Set the parameter reading/writing restriction level: Pr.296 = "9999"

2. Write a four-digit number (1000 to 9998) to Pr.297 as a password.

- When Pr.297 = "9999", writing is always enabled, but setting is disabled. (The display cannot be changed.)

- When Pr.296 is set to a value other than "9999", parameter reading/writing is restricted with the restriction level set in Pr.296.

#### Registering a password (Pr.296, Pr.297)

- The following section describes how to register a password.

<table>
<thead>
<tr>
<th>Pr.296 setting</th>
<th>Password unlock error restriction</th>
<th>Pr.297 display</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 3, 5, 6</td>
<td>No restriction</td>
<td>Always display 0</td>
</tr>
<tr>
<td>100 to 103, 105, 106</td>
<td>Password is locked after fifth error</td>
<td>Displays the current value of Pr.297</td>
</tr>
</tbody>
</table>

- When Pr.296 = "9999", a four-digit number (1000 to 9998) can be written to Pr.297 as a password.

- When a password is registered, parameter reading/writing is restricted with the restriction level set in Pr.296 until unlocking.

#### NOTE

- After registering a password, the read value of Pr.297 is always one of "0" to "9".
- A "0" error occurs when a password-protected parameter is read/modified.
- Even if a password is registered, the parameters, which the converter unit itself writes, such as converter unit parts life are not converted as needed.
Unlocking a password (Pr.296, Pr.297)

There are two ways of unlocking the password:
1. Enter the password in Pr.297. If the password matches, it unlocks. If the password does not match, an error occurs and the password does not unlock. During Pr.296 = any of “100 to 103, 105 or 106”, if password unlock error has occurred five times, correct password will not unlock the restriction. (Password lock in operation.)
2. 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 117 for Mitsubishi inverter protocol of RS-485 communication, refer to page 106.)

**Parameter operations during password locking/unlocking**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Password unlocked</th>
<th>Password locked</th>
<th>Password lock in operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr.296</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>Pr.297</td>
<td>!</td>
<td>!</td>
<td>!</td>
</tr>
</tbody>
</table>

**NOTE**
- When the password is being locked, parameter copy using the operation panel is not enabled.
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.

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

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

5.2.9 Converter unit parts life display

The degree of deterioration of the control 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 diagnoses of this function should be used as a guideline only, because the life values are theoretical calculations.)

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>255</td>
<td>E700 Life alarm status display</td>
<td>0 (0 to 15)</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>256</td>
<td>E701 Inrush current limit circuit life display</td>
<td>100% (0 to 100%)</td>
<td>Displays the deterioration degree of the inrush current limit circuit. Read-only.</td>
<td></td>
</tr>
<tr>
<td>257</td>
<td>E702 Control circuit capacitor life display</td>
<td>100% (0 to 100%)</td>
<td>Displays the deterioration degree of the control circuit capacitor. Read-only.</td>
<td></td>
</tr>
</tbody>
</table>
### Environment setting parameters

**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 signal (Y90).

- The life alarm signal (Y90) turns ON when any of the control circuit capacitor, cooling fan, or 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 of Pr.190 to Pr.195 (Output terminal function selection).

**NOTE**

- Changing the terminal assignment using Pr.190 and 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. As soon as 10% (900,000 times) is reached, Pr.255 bit 3 is turned ON and also a warning is output to the Y90 signal.

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

- The deterioration degree of the control circuit capacitor is displayed in Pr.257.

- In the operating status, the control circuit capacitor life is calculated from the energization time and temperature, and is counted down from 100%. As soon as the control circuit capacitor life falls below 10%, Pr.255 bit 0 is turned ON and also a warning is output to the Y90 signal.

**Life display of the cooling fan**

- If a cooling fan speed of less than about 1700 r/min is detected, Fan alarm (FN) is displayed on the operation panel.

- As an alarm display, Pr.255 bit 2 is turned ON and also a warning is output to the Y90 signal and Alarm (LF) signal.

- For the terminal used for the LF signal, set "98" (positive logic) or "198" (negative logic) in any of 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 with one or more fans with the speed below the warning level.

- 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 FA center.
5.2.10 Maintenance timer alarm

The maintenance timer output signal (Y95) 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.

### Maintenance timer output signal (Y95)

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 h increments. Pr.503 is clamped at 9998 (999800 h).

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 signal (Y95) is output, and MT1 is displayed on the operation panel.

For the terminal used for Y95 signal output, assign the function by setting "95 (positive logic)" or "195 (negative logic)" in any of Pr.190 to Pr.195 (Output terminal function selection).

### Maintenance timer alarm parameters

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>503</td>
<td>Maintenance timer 1</td>
<td>0</td>
<td>0 (1 to 9998)</td>
<td>Displays the converter unit's cumulative energization time in increments of 100 h (read-only). Writing the setting of &quot;0&quot; clears the cumulative energization time while &quot;1 to 9998&quot; is displayed (Pr.503 = &quot;0&quot;). Writing is disabled when Pr.503 = &quot;0&quot;.</td>
</tr>
<tr>
<td>504</td>
<td>Maintenance timer 1 warning output set time</td>
<td>9999</td>
<td>0 to 9998</td>
<td>When the value in Pr.503 (Pr.686, Pr.688) reaches 9999 (999900 h), the maintenance timer signal (Y95) is output, MT1 is displayed on the operation panel.</td>
</tr>
<tr>
<td>686</td>
<td>Maintenance timer 2</td>
<td>0</td>
<td>0 (1 to 9998)</td>
<td>The same function as Pr.503. MT2 is displayed on the operation panel.</td>
</tr>
<tr>
<td>687</td>
<td>Maintenance timer 2 warning output set time</td>
<td>9999</td>
<td>0 to 9998</td>
<td>The same function as Pr.504. MT2 is displayed on the operation panel.</td>
</tr>
<tr>
<td>688</td>
<td>Maintenance timer 3</td>
<td>0</td>
<td>0 (1 to 9998)</td>
<td>The same function as Pr.503. MT3 is displayed on the operation panel.</td>
</tr>
<tr>
<td>689</td>
<td>Maintenance timer 3 warning output set time</td>
<td>9999</td>
<td>0 to 9998</td>
<td>The same function as Pr.504. MT3 is displayed on the operation panel.</td>
</tr>
</tbody>
</table>

**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 h increments. Pr.503 (Pr.686, Pr.688) is clamped at 9998 (999800 h).
- 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 signal (Y95) is output, and also Y95 (MT1), Y95 (MT2), or Y95 (MT3) is displayed on the operation panel.
- For the terminal used for Y95 signal output, assign the function by setting "95 (positive logic)" or "195 (negative logic)" in any of Pr.190 to Pr.195 (Output terminal function selection).

### Notes

- The Y95 signal turns OFF 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.
### 5.3 (H) Protective function parameter

#### 5.3.1 Varying the activation level of the undervoltage protective function

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

<table>
<thead>
<tr>
<th>Pr.</th>
<th>H598</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undervoltage level</td>
<td>9999</td>
<td>350 to 430 VDC</td>
<td>Set the DC voltage value at which E.UVT occurs.</td>
<td></td>
</tr>
</tbody>
</table>

#### 5.3.2 Initiating a protective function

A fault (protective function) is initiated by setting the parameter. This function is useful to check how the system operates at activation of a protective function.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>H997</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault initiation</td>
<td>9999</td>
<td>16 to 253</td>
<td></td>
<td>The setting range is valid only for fault data codes of the converter unit (which can be read through communication). Written data is not stored in EEPROM.</td>
</tr>
</tbody>
</table>

### NOTE

- To vary the operating level of the undervoltage protective function, set the assigned number of the protective function you want to initiate in Pr.997.
- To initiate an inverter protective function, set the protective function number in Pr.997.
- To disable the I/O phase loss protective function, set the protective function number in Pr.997.
- To vary the undervoltage protective function, set the protective function number in Pr.997.

### Purpose

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Parameter to set</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>To vary the operating level of the undervoltage protective function</td>
<td>Undervoltage level</td>
<td>Pr.998</td>
</tr>
<tr>
<td>To initiate an inverter protective function</td>
<td>Fault initiation</td>
<td>Pr.997</td>
</tr>
<tr>
<td>To disable the I/O phase loss protective function</td>
<td>Protection selection</td>
<td>Pr.997</td>
</tr>
</tbody>
</table>
### 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 or disabled.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H201</td>
<td>Input phase loss protection selection</td>
<td>1</td>
<td>0, 1</td>
<td>Without input phase loss protection</td>
</tr>
</tbody>
</table>

- When Pr.H201 = “1 (initial value)”, the Input phase loss (E.ILF) protection will be activated if one of the three phases is detected to be lost for 1 s continuously.

**NOTE:**
- In the case of R/L1, S/L2 phase loss, the input phase loss protection will not operate, and the inverter will trip.
- If an input phase loss continues for a long time, the converter unit capacitor life will be shortened.
5.4 Monitor display and monitor output signal

### 5.4.1 Monitor display selection using operation panel or via communication

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

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>774</td>
<td>Operation panel monitor selection 1</td>
<td>M010</td>
<td>2, 8, 13, 20, 25, 43, 44, 55, 62, 98, 9999</td>
<td>Displays the monitored value when the setting dial on the operation panel is pushed.</td>
</tr>
<tr>
<td>775</td>
<td>Operation panel monitor selection 2</td>
<td>M010</td>
<td>2, 8, 13, 20, 25, 43, 44, 55, 62, 98, 9999</td>
<td>Displays the monitored value when the setting dial on the operation panel is pushed.</td>
</tr>
<tr>
<td>776</td>
<td>Operation panel monitor selection 3</td>
<td>M010</td>
<td>2, 8, 13, 20, 25, 43, 44, 55, 62, 98, 9999</td>
<td>Displays the monitored value when the setting dial on the operation panel is pushed.</td>
</tr>
<tr>
<td>992</td>
<td>Operation panel setting digit monitor selection</td>
<td>M010</td>
<td>2, 8, 13, 20, 25, 43, 44, 55, 62, 98, 9999</td>
<td>Displays the monitored value when the setting dial on the operation panel is pushed.</td>
</tr>
<tr>
<td>170</td>
<td>Watt-hour meter clear</td>
<td>M020</td>
<td>0 to 9999</td>
<td>The watt-hour meter is cleared when the watt-hour meter is cleared.</td>
</tr>
<tr>
<td>393</td>
<td>Energization time carrying-over times</td>
<td>M021</td>
<td>0 to 9999</td>
<td>The energization time carrying-over times are displayed in the monitor mode on the operation panel.</td>
</tr>
<tr>
<td>395</td>
<td>Monitor decimal digits selection</td>
<td>M022</td>
<td>0 to 9999</td>
<td>The monitor decimal digits are cleared when the monitor decimal digits are cleared.</td>
</tr>
<tr>
<td>391</td>
<td>Cumulative power monitor digit shifted times</td>
<td>M023</td>
<td>0 to 9999</td>
<td>The cumulative power monitor digit shifted times are cleared when the cumulative power monitor digit shifted times are cleared.</td>
</tr>
<tr>
<td>290</td>
<td>Monitor negative output selection</td>
<td>M044</td>
<td>0, 2, 4, 6</td>
<td>The monitor negative output selection is cleared when the monitor negative output selection is cleared.</td>
</tr>
</tbody>
</table>

### Parameter Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Purpose</th>
<th>Parameter to set</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.M044, P.M064, P.M080 to P.M102</td>
<td>Cumulative monitor clear</td>
<td>M010</td>
<td>p.180 to p.185</td>
</tr>
<tr>
<td>P.M060 to P.M402</td>
<td>Output terminal function assignment</td>
<td>M010</td>
<td>p.186 to p.195</td>
</tr>
<tr>
<td>P.M060 to P.M402</td>
<td>Control circuit temperature monitor</td>
<td>M010</td>
<td>p.186 to p.195</td>
</tr>
</tbody>
</table>
Monitor display and monitor output signal

The monitor items of the FR-CC2-P (including the availability for the master and the slave during the parallel operation) is as follows. "O" indicates that the monitor is valid; "-" indicates that the monitor is invalid ("-" is displayed). Use Pr.774 to Pr.776 and Pr.992 to select a monitored item to be displayed on the operation panel.

Refer to the following table and set the monitor to be displayed. (The item with "-" is not available for monitoring.) The circle in the minus ("-") display column denotes availability of the minus sign display.

### Monitor description list (Pr.774 to Pr.776, Pr.992)

- The monitor items of the FR-CC2-P (including the availability for the master and the slave during the parallel operation) is as follows. "O" indicates that the monitor is valid; "-" indicates that the monitor is invalid ("-" is displayed). Use Pr.774 to Pr.776 and Pr.992 to select a monitored item to be displayed on the operation panel.
- Refer to the following table and set the monitor to be displayed. (The item with "-" is not available for monitoring.) The circle in the minus ("-") display column denotes availability of the minus sign display.

#### Types of monitor

- **RS-485 communication dedicated monitor (hexadecimal)**
- **Pr.774 to Pr.776, Pr.992**

#### Types of monitor and their unit

<table>
<thead>
<tr>
<th>Pr.774</th>
<th>Pr.775</th>
<th>Pr.776</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>Displays the converter output current effective value.</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>Displays the DC bus voltage value.</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>0</td>
<td>Displays the converter output current effective value.</td>
</tr>
<tr>
<td>25</td>
<td>0</td>
<td>0</td>
<td>Displays the cumulative energy value in kWh.</td>
</tr>
<tr>
<td>45</td>
<td>0</td>
<td>0</td>
<td>Displays which station number (0 to 31) can currently be used for communication from the PU connector.</td>
</tr>
<tr>
<td>46</td>
<td>0</td>
<td>0</td>
<td>Displays the input terminal status of the converter unit. (For operation panel indication, refer to page 90.)</td>
</tr>
<tr>
<td>47</td>
<td>0</td>
<td>0</td>
<td>Displays the output terminal status of the converter unit. (For operation panel indication, refer to page 90.)</td>
</tr>
<tr>
<td>50</td>
<td>0</td>
<td>0</td>
<td>Displays the on-time (PTC thermal relay) value in hours.</td>
</tr>
<tr>
<td>51</td>
<td>0</td>
<td>0</td>
<td>Displays the off-time (thermal relay) value in hours.</td>
</tr>
<tr>
<td>52</td>
<td>0</td>
<td>0</td>
<td>Displays the on-time (PTC thermal relay) value in hours.</td>
</tr>
<tr>
<td>53</td>
<td>0</td>
<td>0</td>
<td>Displays the off-time (thermal relay) value in hours.</td>
</tr>
<tr>
<td>54</td>
<td>0</td>
<td>0</td>
<td>Displays the temperature of the control circuit board.</td>
</tr>
<tr>
<td>55</td>
<td>0</td>
<td>0</td>
<td>Displays the cumulative energy value in kWh.</td>
</tr>
<tr>
<td>56</td>
<td>0</td>
<td>0</td>
<td>Displays the cumulative energy value in kWh.</td>
</tr>
<tr>
<td>57</td>
<td>0</td>
<td>0</td>
<td>Displays the cumulative energy value in kWh.</td>
</tr>
</tbody>
</table>

#### Monitored values

- The cumulative energization time is accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.
- Since the voltage and current display on the operation panel is shown in four digits, a monitor value of more than "9999" is displayed as "----".
- 0 A appears during regenerative driving.
- Input terminal monitor details ("1" denotes terminal ON, "0" denotes terminal OFF, and "-" denotes undetermined value.)
- Output terminal monitor details ("1" denotes terminal ON, "0" denotes terminal OFF, and "-" denotes undetermined value.)
- The monitored values are retained even if a converter unit fault occurs. Resetting will clear the retained values.
- The total input current of the master and slave converter units is displayed. If the current is 5% or less of the rated input current of the converter unit multiplied by the number of units operated in parallel, "0" is displayed.
- The total input power value of the master and slave converter units is displayed.
- The total cumulative power value of the master and slave converter units is displayed.
(M) Monitor display and monitor output signal

**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 that will be the first monitor, and continue pressing for 1 s. (To return to the converter output voltage monitor, display the converter output voltage monitor and press for 1 s.)
- Pr.774 sets the first monitor, Pr.775 sets the second monitor, and Pr.776 sets the third monitor to be displayed.

**Operation panel setting dial push monitor selection (Pr.992)**
- The monitored item to be displayed at the operation panel’s setting dial push can be selected with Pr.992. In the initial setting (Pr.992 = “8”), the converter output voltage monitor is displayed.

**Operation panel I/O terminal monitor (Pr.774 to Pr.776)**
- When Pr.774 to Pr.776 = “55”, the I/O terminal status can be monitored on the operation panel.
- The LED is ON when the terminal is ON, and the LED is OFF when the terminal is OFF. The center line of LED is always ON.
- On the I/O terminal monitor (Pr.774 to Pr.776 = “55”), the upper LEDs denote the input terminal state, and the lower LEDs denote the output terminal state.

**Cumulative power monitor and clear (Pr.170, Pr.891)**
- On the cumulative power monitor (Pr.774 to Pr.776 = “25”), the input power monitor value is added up and updated in 100 ms increments. (The values are saved in EEPROM every hour.)
- Display increments and display ranges of the operation panel and communication (RS-485 communication) are as indicated below.

<table>
<thead>
<tr>
<th>Operation panel</th>
<th>Communication</th>
<th>Range</th>
<th>Unit</th>
<th>Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Pr.174 = 10</td>
<td>0 to 999.99 kWh</td>
<td>0.01 kWh</td>
<td>0 to 65535 kWh</td>
<td>1 kWh</td>
</tr>
<tr>
<td>Value range</td>
<td>Pr.174 = 9990</td>
<td>0 to 99999.99 kWh</td>
<td>1 kWh</td>
<td>0 to 65535 kWh</td>
<td></td>
</tr>
</tbody>
</table>

**Note**: Power is measured in the range of 0 to 65535 kWh and displayed in the display. The [0.01 kWh] value is added up every hour. The value is saved in EEPROM every hour. If the value for 65535 kWh is selected, the value is displayed as “99999 kWh”.
Monitor display and monitor output signal

- Digits in the cumulative power monitor can be shifted to the right for the numerical set in Pr.891 Cumulative power monitor digit shifted times. For example, if the cumulative power value is 1278.56 kWh when Pr.891 = "2", the operation panel display is 12.78 (display in 100 kWh increments) and the communication data is 12.
- If the maximum value is exceeded at Pr.891 = "0 to 4", the monitor value is clamped at the maximum value, indicating that a digit shift is necessary. If the maximum value is exceeded at Pr.891 = "9999", the monitor value returns to 0, and the counting starts again.
- Writing "0" in Pr.170 clears the cumulative power monitor.

**NOTE**: Either "0" is written to Pr.170, and Pr.170 is read again, "0000" or "10" is displayed.

**Cumulative energization time monitor (Pr.563)**

- Cumulative energization time monitor (Pr.774 to Pr.776 = "20") accumulates energization time from shipment of the converter unit every one hour.
- If the number of monitor value exceeds 65535, it is added up from 0. Use Pr.563 to check the numbers of times that the cumulative energization time monitor exceeded 65535 h.
- Writing "0" in Pr.171 clears the actual operation time monitor. (The energization time monitor cannot be cleared.)

**NOTE**: The cumulative energization time does not increase if the power is ON for 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.

**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.

**Minus sign display for the monitors (Pr.290)**

- Values with minus signs can be displayed on the monitor indicator of the operation panel. For a list of monitored items that can be displayed with minus signs, refer to the monitor description list (on page 89).

<table>
<thead>
<tr>
<th>Pr.268 setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No function</td>
</tr>
<tr>
<td>1</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>When monitoring with the second decimal place (0.01 increments), the 0.01 decimal place is dropped and the display will not change.</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Minus sign on operation panel</th>
<th>Monitoring via communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr.290 setting</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Displayed with minus sign</td>
</tr>
<tr>
<td>1</td>
<td>Displayed with minus sign</td>
</tr>
<tr>
<td>2</td>
<td>Displayed with minus sign</td>
</tr>
</tbody>
</table>

**NOTE**: Output without minus sign (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.

#### Output signal list

1. The functions of the output terminals can be set.
2. Refer to the following table and set the parameters. (0 to 99: Positive logic, 100 to 199: Negative logic)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Setting range</th>
<th>Setting parameter</th>
<th>Related parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>M400</td>
<td>RDB terminal function selection</td>
<td>0 to 99</td>
<td>Pr.57</td>
</tr>
<tr>
<td>191</td>
<td>M401</td>
<td>RDA terminal function selection</td>
<td>0 to 99</td>
<td>Pr.248, Pr.30</td>
</tr>
<tr>
<td>192</td>
<td>M402</td>
<td>IPF terminal function selection</td>
<td>0 to 99</td>
<td>—</td>
</tr>
<tr>
<td>193</td>
<td>M403</td>
<td>RSO terminal function selection</td>
<td>0 to 99</td>
<td>Pr.121</td>
</tr>
<tr>
<td>194</td>
<td>M404</td>
<td>FAN terminal function selection</td>
<td>0 to 99</td>
<td>—</td>
</tr>
<tr>
<td>195</td>
<td>M405</td>
<td>ABC1 terminal function selection</td>
<td>0 to 99</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Function</th>
<th>Operation</th>
<th>Related parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>IPF</td>
<td>Instantaneous power failure/undervoltage</td>
<td>Pr.100</td>
</tr>
<tr>
<td>8</td>
<td>THP Electronic thermal O/L relay pre-alarm</td>
<td>Output when the cumulative electronic thermal O/L relay value reaches 85% of the trip level. (Electronic thermal O/L relay protection (E.THC) is activated when the value reaches 100%).</td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>RDA</td>
<td>Inverter operation enable (NO contact)</td>
<td>Output when the converter unit operation is ready.</td>
</tr>
<tr>
<td>17</td>
<td>Y17</td>
<td>Control signal for main circuit power supply MC</td>
<td>Output while the self power management function is enabled. Turns OFF when a fault activating the self power management operation occurs.</td>
</tr>
<tr>
<td>25</td>
<td>FAN</td>
<td>Fan fault output</td>
<td>Output when a fan fault occurs.</td>
</tr>
<tr>
<td>26</td>
<td>FIN</td>
<td>Heatsink overheat pre-alarm</td>
<td>Output when the heatsink temperature reaches about 85% of the heatsink overheat protection operation temperature.</td>
</tr>
<tr>
<td>125</td>
<td>M1</td>
<td>24 V external power supply operation</td>
<td>Output while operating with a 24 V power supply input from an external source.</td>
</tr>
<tr>
<td>126</td>
<td>M2</td>
<td>5 V external power supply operation</td>
<td>Output while operating with a 5 V power supply input from an external source.</td>
</tr>
<tr>
<td>190</td>
<td>M3</td>
<td>Life alarm</td>
<td>Output when any of the internal circuits is not functioning. The circuit is not dead, but there is a low voltage on the output.</td>
</tr>
<tr>
<td>194</td>
<td>M3D</td>
<td>Red output 2</td>
<td>Output when the fault reset relay output is activated to stop the output of fault occurrence.</td>
</tr>
<tr>
<td>195</td>
<td>M4</td>
<td>Operation start/stop signal</td>
<td>Output when the start/stop function of the system is activated.</td>
</tr>
<tr>
<td>198</td>
<td>M5</td>
<td>Error</td>
<td>Output when an error or fault is detected.</td>
</tr>
<tr>
<td>199</td>
<td>M6</td>
<td>Fault</td>
<td>Output when the converter unit protection function is activated to stop the output of fault occurrence.</td>
</tr>
</tbody>
</table>
### Signal operation and operation signal

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Function</th>
<th>Operation</th>
<th>Related parameter</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>026 336 1336</td>
<td>Motor display and monitor output signal</td>
<td>Output when the cooling fan operation is commanded</td>
<td>—</td>
<td>84</td>
</tr>
<tr>
<td>027 337 1337</td>
<td>Ambient temperature signal</td>
<td>Output when the ambient temperature reaches the detection level or higher</td>
<td>—</td>
<td>85</td>
</tr>
<tr>
<td>050 352 1552</td>
<td>Parameter unit ready signal</td>
<td>Output when the parameter function is ready</td>
<td>—</td>
<td>86</td>
</tr>
<tr>
<td>204 320 1204</td>
<td>Electronic thermal O/L relay pre-alarm (TH) and warning signal (THP)</td>
<td>Output when the accumulated electronic thermal value reaches 85%, Electronic thermal 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.</td>
<td>Pr.261</td>
<td>101</td>
</tr>
<tr>
<td>207 327 1207</td>
<td>Control circuit operation signal</td>
<td>Output when the temperature of the control circuit board reaches the detection level or higher.</td>
<td>Pr.663</td>
<td>95</td>
</tr>
<tr>
<td>209 309 RSO Inverter reset signal</td>
<td>Output at the converter reset.</td>
<td>—</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>210 310 PWF Power failure stop signal</td>
<td>Output during instantaneous power failure, undervoltage, or input phase loss.</td>
<td>Pr.261</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>214 — Y214 Converter unit fault (E.OHT, E.CPU)</td>
<td>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 (at fault occurrence).</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>227 327 Y227 Parallel operation ready signal</td>
<td>Output when the converter unit is set ready for the parallel operation.</td>
<td>—</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>9999 — No function</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**

- The same function may be set to more than one terminal.
- The terminal conducts during function operation when the setting is "1" to "99, 200 to 299", and 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 signals which frequently repeat switching between ON and OFF to terminals A1B1C1. Otherwise the life of the relay contacts decreases.

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

- If the accumulated electronic thermal value reaches 85%, Electronic thermal 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.
- For the terminal used for THP signal output, set "B (positive logic)" or "10B (negative logic)" in any of Pr.190 to Pr.195 (Output terminal function selection) to assign the function.

![Electronic thermal O/L relay function operation level](image-url)

- 100%: Electronic thermal O/L relay activation value

**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 (FAN) is displayed on the operation panel, and the Fan fault output (FAN) and Alarm (LF) signals are output.
- To assign the FAN signal to the terminal, set "25 (positive logic) or 125 (negative logic)" in one of Pr.190 to Pr.195 (Output terminal function selection). To assign the LF signal, set "98 (positive logic) or 198 (negative logic)".

Cooling fan operation command signal (Y206)

- 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.
- 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 of Pr.190 to Pr.195 (Output terminal function selection) to assign the function to the 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 (RDA) signal (NO contact) turns ON when the converter unit operation is ready, and turns OFF when a converter unit fault occurs, the Y227 signal is turned OFF (refer to page 48) or the converter is reset.
- A logic inverse to that of RDA is applied to the Inverter operation enable (RDB) signal (NC contact). (However, the RDB signal is in the OFF status while the converter unit power supply is turned OFF.)
- When the RDA and RDB signals of the slave are turned OFF, the RDA and RDB signals of the master are also turned 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 either 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 also be assigned to other terminals by setting "209 (positive logic) or 309 (negative logic)" in any of Pr.190 to Pr.195 (Output terminal function selection).
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.

**Control circuit temperature monitor**

- The operation panel can be used to monitor the temperature of the control circuit board within the range of 0 to 100°C.
- The range becomes -20 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.
- For the Y207 signal, set “207 (positive logic) or 307 (negative logic)” in any of 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.

---

### Parameter Table

<table>
<thead>
<tr>
<th><strong>Pr.</strong></th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>663</td>
<td>Control circuit temperature signal output level</td>
<td>OFF</td>
<td>0°C to 100°C</td>
<td>Set the temperature where the Y207 signal turns ON.</td>
</tr>
</tbody>
</table>

---

**Fault output signals (ALM, ALM2)**

- The Fault (ALM, ALM2) signals are output when the converter unit protective function is activated.
- The ALM signal stays ON during the reset period after the fault occurs.
- To use the ALM2 signal, set “94 (positive logic) or 194 (negative logic)” in any of Pr.190 to Pr.195 (Output terminal function selection) to assign the function to the output terminal.
- The ALM signal is assigned to the A1/B1/C1 contacts in the initial status.

**NOTE**

- For the details of converter unit faults, refer to page 128.
(T) Multi-function input terminal parameters

5.5 (T) Multi-function input terminal parameters

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Parameter to set</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>To assign functions to input terminals</td>
<td>Input terminal function selection</td>
<td>Pr.178, Pr.179, Pr.187, Pr.189</td>
</tr>
<tr>
<td>To change operation when the OH signal is input</td>
<td>OH input selection</td>
<td>Pr.7723</td>
</tr>
</tbody>
</table>

5.5.1 Input terminal function selection

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

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Initial signal</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>T74</td>
<td>T750</td>
<td>No function</td>
<td>No function</td>
<td>7, 62, 9999</td>
</tr>
<tr>
<td>T79</td>
<td>T709</td>
<td>T7 (balanced thermal relay input)</td>
<td>T7, 62, 9999</td>
<td></td>
</tr>
<tr>
<td>T88</td>
<td>T711</td>
<td>RES (Converter reset)</td>
<td>RES (Converter reset)</td>
<td></td>
</tr>
</tbody>
</table>

◆ 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:

<table>
<thead>
<tr>
<th>Setting value</th>
<th>Signal name</th>
<th>Function</th>
<th>Related parameter</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>OH</td>
<td>T7 (balanced thermal relay input)</td>
<td>Pr.876</td>
<td>97</td>
</tr>
<tr>
<td>62</td>
<td>RES</td>
<td>Converter reset</td>
<td>-</td>
<td>78</td>
</tr>
<tr>
<td>9999</td>
<td>-</td>
<td>No function</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- OH signal is compatible with the snap contact "open".

- If one function is assigned to two or more terminals, the logic of terminal input is OR.
- When the terminal assignment is changed using Pr.178, Pr.187, and Pr.189 (Input terminal function selection), the terminal name will be different, which may result in an error of wiring, or 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.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>876</td>
<td>OH input selection</td>
<td>0</td>
<td>0, 1, 2</td>
<td>No function</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The inverter unit output is shut off by turning OFF the OH signal (NC contact)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The inverter unit output is shut on by turning OFF the OH signal (NO contact)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>OH signal input status (external terminal)</th>
<th>Converter unit operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>OH</td>
<td>No function</td>
</tr>
<tr>
<td>OH</td>
<td>Continuous operation</td>
</tr>
<tr>
<td>OH</td>
<td>Inverter trip (E.OHT)</td>
</tr>
</tbody>
</table>

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. Set "F" in any of Pr.178, Pr.187, or Pr.189 (input terminal function selection) to assign the OH signal to another terminal.

◆Operation selection for the OH signal (Pr.876)
- The OH signal input status and the Pr.876 setting for the converter operation are as shown below.
5.6 (A) Application parameters

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Parameter to set</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>To reduce the standby power</td>
<td>Self power management</td>
<td>Pr.30, Pr.248</td>
</tr>
<tr>
<td>To restart after instantaneous power failure</td>
<td>Automatic restart operation after instantaneous power failure</td>
<td>Pr.37</td>
</tr>
<tr>
<td>To decelerate the motor to a stop at instantaneous power failure</td>
<td>Power failure time deceleration-to-stop function</td>
<td>Pr.261</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>248</td>
<td>A098</td>
<td>0</td>
<td>0</td>
<td>Self power management function disabled</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>0 to 2</td>
<td>Self power management function enabled (main circuit OFF at protective function activation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>0 to 2</td>
<td>Self power management function enabled (main circuit OFF at protective function activation due to a circuit failure or at protective function activation of the slave)</td>
</tr>
<tr>
<td>30</td>
<td>E300</td>
<td>0</td>
<td>0</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td>0</td>
<td>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.</td>
</tr>
</tbody>
</table>

Connection diagram

- For sink logic and Pr.192=“1” (terminal R1, S1 inputs)
- For sink logic and Pr.192=“1” (24V external power supply input)
Operation of the self power management function

- This is a function to control the input side magnetic contactor (MC) with an output relay to reduce 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 42) and 24 V external power supply input (refer to page 43). 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 immediately turns OFF according to the Pr.248 setting.
  - When Pr.244 = “1”, the Y17 signal turns OFF whenever a protective function is activated.
  - When Pr.244 = “2”, the Y17 signal turns OFF only when a protective function is activated by a fault originating in the converter unit circuit or a connection fault (refer to the table below). (For the fault details, refer to page 128.)
- If the protective function of the slave is activated, the Y17 signal turns OFF regardless of the fault contents.

<table>
<thead>
<tr>
<th>Fault record</th>
<th>Fault code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.IOH</td>
<td>Inrush current limit circuit fault (E.IOH)</td>
<td></td>
</tr>
<tr>
<td>E.CPU</td>
<td>CPU fault (E.CPU)</td>
<td></td>
</tr>
<tr>
<td>E.6</td>
<td>CPU fault (E.6)</td>
<td></td>
</tr>
<tr>
<td>E.7</td>
<td>CPU fault (E.7)</td>
<td></td>
</tr>
<tr>
<td>E.PE</td>
<td>Parameter storage device fault (E.PE)</td>
<td></td>
</tr>
<tr>
<td>E.PE2</td>
<td>Parameter storage device fault (E.PE2)</td>
<td></td>
</tr>
<tr>
<td>E.P24</td>
<td>24 VDC power fault (E.P24)</td>
<td></td>
</tr>
<tr>
<td>E.CTE</td>
<td>Operation panel power supply short circuit (E.CTE)</td>
<td></td>
</tr>
<tr>
<td>E.13/E.PBT</td>
<td>Internal circuit fault (E.13/E.PBT)</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**
- Repeated operation of the magnetic contactor due to frequent start and stop or activation of the protective functions may shorten the inverter and the converter unit life.
- 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 (R/L1, S/L2, T/L3 input) is started when power is supplied only to the control circuit (R1/L11, S1/L21 input, 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 waiting time 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 92

Fault record

- Inrush current limit circuit fault (E.IOH)
- CPU fault (E.CPU)
- CPU fault (E.6)
- CPU fault (E.7)
- Parameter storage device fault (E.PE)
- Parameter storage device fault (E.PE2)
- 24 VDC power fault (E.P24)
- Operation panel power supply short circuit (E.CTE)
- Internal circuit fault (E.13/E.PBT)
5.6.2 Automatic restart after instantaneous power failure selection

The converter unit can be restarted after power restoration from instantaneous power failure.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>A702 Restart selection</td>
<td>9999</td>
<td>0</td>
<td>Restarts the motor after power restoration from instantaneous power failure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9999</td>
<td></td>
<td>Does not restart the motor.</td>
</tr>
</tbody>
</table>

- 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 set, the motor is restarted after power restoration from instantaneous power failure or undervoltage condition. (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 function is selected on the inverter side. (Refer to page 128 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. The IPF signal can also be assigned to other terminals by setting “2 (positive logic) or 102 (negative logic)” in any of Pr.190 to Pr.195 (Output terminal function selection).

**CAUTION**
- If the automatic restart after instantaneous power failure function has been selected, motor suddenly restarts at the power restoration after an instantaneous power failure (after the reset time has elapsed).
- Stay away from the motor and machine.
- If the automatic restart after instantaneous power failure function has been selected, apply the CAUTION stickers, which are supplied with the Inverter Manual, to easily visible places.
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.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>261</td>
<td>Power failure stop selection</td>
<td>0</td>
<td>0, 1, 11, 12, 21, 22</td>
<td>Power failure time deceleration-to-stop function when the automatic restart after instantaneous power failure is enabled (Pr.57 ≠ “9999”)</td>
</tr>
</tbody>
</table>

**Connection and parameter setting**

- Remove the jumpers between terminals RL1 and RL11 and terminals SS2 and SS121 of the converter unit, and connect terminals RL11 and RL11 and terminal SS121 of the inverter. (In the initial status of the inverter, terminals P and RL111 and terminals N and S121 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.

**Power failure stop (PWF) signal**

- Power failure stop (PWF) signal turns ON during instantaneous power failure, undervoltage, or input phase loss.

- For the PWF signal, assign the function by setting “210 (positive logic)” or “310 (negative logic)” in any of Pr.190 to Pr.195 (Output terminal function selection). When the input specification of the Power failure stop external (X48) signal is the NO contact, set the negative logic for the PWF signal of the converter unit. When the input specification of the X48 signal is the NC 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-to-stop function is selected, undervoltage protection (E.UVT), instantaneous power failure protection (E.IPF) and input phase loss protection (E.ILF) are not 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 92
- Pr.872 Input phase loss protection selection page 87
5.7 (N) Operation via communication and its settings

5.7.1 Wiring and configuration of PU connector

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

PU connector pin-outs

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SG</td>
<td>Earthing (grounding)</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>Operation panel power supply</td>
</tr>
<tr>
<td>3</td>
<td>RDA</td>
<td>Converter unit receive+</td>
</tr>
<tr>
<td>4</td>
<td>SDB</td>
<td>Converter unit send-</td>
</tr>
<tr>
<td>5</td>
<td>SDA</td>
<td>Converter unit send+</td>
</tr>
<tr>
<td>6</td>
<td>RDB</td>
<td>Converter unit receive-</td>
</tr>
<tr>
<td>7</td>
<td>SG</td>
<td>Earthing (grounding)</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>Operation panel power supply</td>
</tr>
</tbody>
</table>

- Pins No. 2 and 8 provide power to the operation panel. Do not use these pins during RS-485 communication.
- Do not connect the cable to a computer’s LAN board, to a fax modem socket, or to a telephone connector. Doing so may damage the product due to the differences in the electric specifications.
◆ Configuration and wiring of PU connector communication system

- System configuration

- Wiring of computer by RS-485

- Computer-converter unit connection cable

Refer to the following for the connection cable (RS-232C ↔ RS-485 converter) between the computer with an RS-232C interface and a converter unit. Commercially available products (as of February 2015)

- Computer-converter unit connection cable

Refer to the following table when fabricating the cable on the user side.

Commercially available products (as of February 2015)

<table>
<thead>
<tr>
<th>Name</th>
<th>Model</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication cable</td>
<td>DAFXIH-CAB (D-SUB25P for personal computer side)</td>
<td>Diatrend Corp.</td>
</tr>
<tr>
<td>Converter unit cable</td>
<td>DINV-CABV</td>
<td>Mitsubishi Cable Industries, Ltd.</td>
</tr>
</tbody>
</table>

- Conversion cable cannot connect multiple converter units. (The computer and the converter unit are connected in a 1:1 pair.) This product is a RS-232C ↔ RS-485 converter cable that has a built-in converter. No additional cable or connector is required. For the product details, contact the cable manufacturer.

- Do not use pins No. 2 and No. 8 of the communication cable.
5.7.2 EEPROM write selection during communication operation

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

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>342</td>
<td>Communication EEPROM write selection</td>
<td>0</td>
<td>0, 1</td>
<td>Parameter values written by communication are written to both EEPROM and RAM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>Parameter values written by communication are written to the RAM only</td>
</tr>
</tbody>
</table>

**Communication EEPROM write selection (Pr.342)**

- When parameter write is performed from RS-485 communication with the converter unit PU connector, parameters storage device can be changed from EEPROM and RAM to RAM only. 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, parameter settings at next power-ON will be the ones that are last stored in EEPROM.
- 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.)
5.7.3 Initial settings and specifications of RS-485 communication

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

- Parameter setting, monitoring, etc. can be performed using the Mitsubishi inverter protocol.
- To make communication between the personal computer and the converter unit, initial 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 made or if there is any setting error.

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Initial value</th>
<th>Setting range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>117</td>
<td>PU communication station number</td>
<td>0</td>
<td>0 to 31</td>
<td>Specify the converter station number. Set the converter station numbers when two or more converter units are connected to one personal computer.</td>
</tr>
<tr>
<td>118</td>
<td>PU communication speed</td>
<td>46, 48, 96, 192</td>
<td>48, 96, 192</td>
<td>The setting value 46 x 100 equals the communication speed. For example, if 192 is set, the communication speed is 19.200 bps.</td>
</tr>
<tr>
<td>119</td>
<td>PU communication data length</td>
<td>0</td>
<td>0 to 31</td>
<td>Set the communication data length.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>7 bits</td>
<td>Data length 7 bits</td>
</tr>
<tr>
<td>120</td>
<td>PU communication parity check</td>
<td>0</td>
<td>0 to 31</td>
<td>Set the parity check.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>1 bit</td>
<td>Bit (0 or 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>2 bit</td>
<td>Bit (0 or 1)</td>
</tr>
</tbody>
</table>

**NOTE:**
- Always reset the converter after making the initial settings of the parameters. After changing the communication-related parameter, communication cannot be made until the converter is reset.
5.7.4 Mitsubishi inverter protocol (computer link communication)

**Parameter settings and monitoring are possible by using the Mitsubishi inverter protocol (computer link communication) via inverter PU connector.**

**Communication specifications**
- The communication specifications are given below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Related parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication protocol</td>
<td>Mitsubishi protocol (computer link)</td>
<td></td>
</tr>
<tr>
<td>Conforming standard</td>
<td>EIA-485 (RS-485)</td>
<td></td>
</tr>
<tr>
<td>Connectable units</td>
<td>1:N (maximum 32 units), setting is 0 to 31 stations</td>
<td>Pr.117</td>
</tr>
<tr>
<td>Communication speed</td>
<td>Selected among 4800/9600/19200/38400 bps</td>
<td>Pr.118</td>
</tr>
<tr>
<td>Control procedure</td>
<td>Start-stop synchronization method</td>
<td></td>
</tr>
<tr>
<td>Communication specifications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character system</td>
<td>ASCII (7 bits or 8 bits can be selected.)</td>
<td>Pr.119</td>
</tr>
<tr>
<td>Stop bit length</td>
<td>1 bit or 2 bits can be selected.</td>
<td>Pr.119</td>
</tr>
<tr>
<td>Parity check</td>
<td>Check (even or odd) or no check can be selected</td>
<td>Pr.120</td>
</tr>
<tr>
<td>Error check</td>
<td>Sum code check</td>
<td>Pr.120</td>
</tr>
<tr>
<td>Terminator</td>
<td>CR/LF (presence/absence selectable)</td>
<td>Pr.124</td>
</tr>
<tr>
<td>Waiting time setting</td>
<td>Selectable between presence and absence</td>
<td></td>
</tr>
</tbody>
</table>

**Communication procedure**
- Data communication between the computer and the converter unit is made in the following procedure.
- (a) Request data is sent from the computer to the converter unit. (The converter unit will not send data unless requested.)
- (b) After waiting for the waiting time,
- (c) The converter unit sends reply data to the computer in response to the computer request.
- (d) After waiting for the converter unit data processing time,
- (e) An answer from the computer in response to reply data (c) of the converter unit is transmitted. (Even if (e) is not sent, subsequent communication is made properly.)

![Diagram](image)

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 when the number of consecutive retries exceeds the parameter setting.
2. On receipt of a data error occurrence, the converter unit returns reply data (c) to the computer again. The converter unit output is shut off when the number of consecutive data errors exceeds the parameter setting.
operation via communication and its settings

communication operation presence/absence and data format types

- data communication between the computer and the converter unit is made in ASCII code (hexadecimal code).
- communication operation presence/absence and data format types are as follows.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Operation</th>
<th>Special write</th>
<th>Converter write</th>
<th>Monitor</th>
<th>Pr. read</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Communication request is sent to the converter unit in accordance with the user program in the computer.</td>
<td>A</td>
<td>A</td>
<td>D</td>
<td>B</td>
</tr>
<tr>
<td>C</td>
<td>Reply data from the converter unit (data is checked for an error)</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>Reply data from the converter unit (data error detected)</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>D</td>
<td>Communication processing delay time</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>E</td>
<td>Answer from computer in response to reply data, (data is checked for error)</td>
<td>E</td>
<td>E1</td>
<td>E2</td>
<td>E3</td>
</tr>
<tr>
<td>E</td>
<td>Answer from computer in response to reply data, (data error detected)</td>
<td>E</td>
<td>E1</td>
<td>E2</td>
<td>E3</td>
</tr>
<tr>
<td>F</td>
<td>Converter unit data processing time</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>

- data error: indicates a control code.
- specifies the converter unit station numbers in the range of H00 to H1F (stations 0 to 31) in hexadecimal.
- when Pr.123 (waiting time setting) \neq 9999, create a communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
- CR, LF code: when data is transmitted from the computer to the converter unit, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must be also made on the converter unit according to the computer. Whether the CR and LF codes will be present or absent can be selected using Pr.124 (CR/LF selection).

communication request data from the computer to the converter unit

<table>
<thead>
<tr>
<th>Format</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>ENQ</td>
<td>Converter unit station No.</td>
<td>Instruction code</td>
<td>Data</td>
<td>Sum check</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>ENQ</td>
<td>Converter unit station No.</td>
<td>Instruction code</td>
<td>Data</td>
<td>Sum check</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>ACK</td>
<td>Converter unit station No.</td>
<td>Error code</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>NAK</td>
<td>Converter unit station No.</td>
<td>Error code</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- indicates a symbol code.
- specifies the converter unit station numbers in the range of H00 to H1F (stations 0 to 31) in hexadecimal.
- \* when Pr.123 (waiting time setting) \neq 9999, create a communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
- CR, LF code: when data is transmitted from the computer to the converter unit, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. When data setting is made in the converter unit according to the computer. Whether the CR and LF codes will be present or absent can be selected using Pr.124 (CR/LF selection).
### (N) Operation via communication and its settings

**Data reading format**

<table>
<thead>
<tr>
<th>Format</th>
<th>Number of characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

- **Operation via communication** and its settings
- **Data reading format**
  - a. Communication request data from the computer to the converter unit
  - b. Reply data from the converter unit to the computer (No data error detected)
  - c. Reply data from the converter unit to the computer (Data error detected)
  - e. Transmission data from the computer to the converter unit

<table>
<thead>
<tr>
<th>Format</th>
<th>Number of characters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Format for Data reading format:

- B: **ENQ**
  - Converter unit station No.
  - Instruction code
  - Sum check

- C:
  - Converter unit station No.
  - Instruction code
  - Sum check

- D:
  - Converter unit station No.
  - Instruction code
  - Sum check

### Transmit data from the computer to the converter unit

<table>
<thead>
<tr>
<th>Format</th>
<th>Number of characters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- D: **NAK**
  - Converter unit station No.
  - Error code

- E: **ACK**
  - Converter unit station No.

- F: **F**
  - Converter unit station No.

---

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. When Pr.123 (Waiting time setting) ≠ 9999, create a communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
4. CR, LF code: When data is transmitted from the computer to the converter unit, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must be also made on the converter unit according to the computer. Whether the CR and LF codes will be present or absent can be selected using Pr.124 (CR/LF selection)
Data definitions

- Control code
  - 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)

Instruction code

- Data
  - Indicates the data such as frequency and parameters transferred to and from the converter unit. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer page 114.)

- Waiting time
  - Specify the waiting time between the receipt of data at the converter unit from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer in the range of 0 to 150 ms in 10 ms increments. (Example: 1: 10 ms, 2: 20 ms)

NOTE
- When Pr.123 (Waiting time setting) ≠ 9999, create a communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
- The data check time varies depending on the instruction code. (Refer page 110.)

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

Computer Converter unit Converter unit Computer

Converter unit data processing time = Waiting time + (setting 10 ms)

Data check time (About 10 to 30 ms, which depends on the instruction code)

Example 1
Computer     Converter unit
ENQ H05 H30 H31 H31 H45 H31 H30 H37 H41 H44 H46 H34
Converter unit

STX H02 H30 H31 H31 H37 H31 H37 H30 H03 H33 H30
ETX H03

Example 2
Computer

STX H02 H30 H31 H31 H37 H31 H37 H30 H03 H33 H30
Converter unit

STX H02 H30 H31 H31 H37 H31 H37 H30 H03 H33 H30
Converter unit

ASCI Code

Binary code

H30+H31+H31+H37+H37+H30 = H130

Sum check code

H30+H31+H45+H31+H31+H30+H37+H41+H44

= H1F4

Computer
**Operation via communication and its settings**

1. **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.

<table>
<thead>
<tr>
<th>Error code</th>
<th>Error definition</th>
<th>Converter unit operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Computer NAK error</td>
<td>The transmission/received data from the computer was containing errors for the permissible number of retries or more.</td>
</tr>
<tr>
<td>H1</td>
<td>Parity error</td>
<td>The parity check result does not match the specified parity.</td>
</tr>
<tr>
<td>H2</td>
<td>Sum check error</td>
<td>The sum check code in the computer does not match that of the data received by the converter unit.</td>
</tr>
<tr>
<td>H3</td>
<td>Protocol error</td>
<td>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 set as in the parameter.</td>
</tr>
<tr>
<td>H4</td>
<td>Character error</td>
<td>The character received is invalid (other than 0 to 9, A to F, control code).</td>
</tr>
<tr>
<td>H5</td>
<td>Overrun</td>
<td>New data has been sent by the computer before the converter unit completes receiving the preceding data.</td>
</tr>
<tr>
<td>H6</td>
<td>— — —</td>
<td>Does not accept the received data. The converter unit output is not stopped by this fault.</td>
</tr>
<tr>
<td>H7</td>
<td>Character error</td>
<td>The character received is invalid (other than 0 to 9, A to F, control code).</td>
</tr>
<tr>
<td>H8</td>
<td>— — —</td>
<td>Does not accept the received data. The fault does not occur.</td>
</tr>
<tr>
<td>H9</td>
<td>— — —</td>
<td>Does not accept the received data. The fault does not occur.</td>
</tr>
<tr>
<td>HA</td>
<td>Mode error</td>
<td>Parameter write was attempted in other than the computer link operation mode, when operation command source is not selected or during converter unit operation.</td>
</tr>
<tr>
<td>HB</td>
<td>Instruction code error</td>
<td>The specified instruction code does not exist.</td>
</tr>
<tr>
<td>HC</td>
<td>Data range error</td>
<td>Invalid data has been specified for parameter writing, etc.</td>
</tr>
<tr>
<td>HD</td>
<td>— — —</td>
<td></td>
</tr>
<tr>
<td>HE</td>
<td>— — —</td>
<td></td>
</tr>
<tr>
<td>HF</td>
<td>Normal (no error)</td>
<td>— —</td>
</tr>
</tbody>
</table>

2. **Communication specifications**

   - **Data sending time (refer to the following formula)**
   - **Converter unit data processing time** + **Waiting time** + **Data check time** (depends on the instruction code (see the following table))

   - **Check times**
     - Various monitored values: 12 ms
     - Parameter read/write: 46 ms
     - Parameter clear / all clear: 15 s
     - Reset command: No answer

   - **Minimum number of total bits**: 9 bits
   - **Maximum number of total bits**: 12 bits

---

**Error code**

Error definition:
- **H0**: Computer NAK error
- **H1**: Parity error
- **H2**: Sum check error
- **H3**: Protocol error
- **H4**: Character error
- **H5**: Overrun
- **H6**: — — —
- **H7**: Character error
- **H8**: — — —
- **H9**: — — —
- **HA**: Mode error
- **HB**: Instruction code error
- **HC**: Data range error
- **HD**: — — —
- **HE**: — — —
- **HF**: Normal (no error)
Retry count setting (Pr.121)
- Set the permissible number of retries for data receive error occurrence. (Refer to page 110 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 (E.PUE) occurs and the inverter output is shut off.
- When a data transmission error occurs while "9999" is set, the inverter output is not shut off but outputs the Alarm (LF) signal. To use the LF signal, set "98 (positive logic) or 198 (negative logic)" in any of Pr.190 to Pr.195 (Output terminal function selection) to assign the function to an output terminal.

Signal loss detection (Pr.122)
- If a signal loss (communication stop) is detected between the converter unit and the computer as a result of a signal loss detection, a communication fault (E.PUE) occurs and the inverter output is shut off.
- When the setting is "9999", communication check (signal loss detection) is not made.
- When the setting is "0", the communication is not possible.
- A signal loss detection is made when the setting is any of "0.1 s to 999.8 s". To make a signal loss detection, it is necessary to send data (for details on control codes, refer to page 109) from the computer within the communication check time interval. (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.)
Operation via communication and its settings

Instructions for the program

- 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, are 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 "01B910000" in Pr.57

Microsoft® Visual C++® (Ver. 6.0) programming example

```c
#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; // Even parity
        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
            SetCommTimeouts(hCom,&hTim); // Setting of changed timeout values

            // Setting a command to write "01B910000" in Pr.57 of the station number 1 converter unit
            sprintf(szCommand,"01B910000"); // 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,\"%s%02X\",szCommand,nSum);// ENQ code + send data + sum code
            nTx = 1 + nTx + 2; // Number of ENQ codes + 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
                    }
                    printf("\n\r");
                }
            }
        }
    }
    CloseHandle(hCom); // Close communication port
}
```

PARAMETER
**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 etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter output will be shut off (E.PUE).
- The inverter can be coasted to a stop by switching ON the RES signals or by switching the power OFF.
- If communication is broken due to signal cable breakage, computer fault etc., the converter unit does not detect such a fault. This should be fully noted.
### Setting items and set data

After completion of parameter settings, set the instruction codes and data, then start communication from the computer to allow reading and setting of parameters and monitoring.

<table>
<thead>
<tr>
<th>Item</th>
<th>Read/Write</th>
<th>Instruction Code</th>
<th>Data Description</th>
<th>Number of Data Digits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Converter output voltage</td>
<td>Read</td>
<td>H0F</td>
<td>Hexadecimal to HFFFF: Converter output voltage in 0.1 V increments</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td>Input current</td>
<td>Read</td>
<td>H0C</td>
<td>Hexadecimal to HFFFF: Input current in 0.1 A increments</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td>Electronic thermal relay function load factor</td>
<td>Read</td>
<td>H01</td>
<td>Hexadecimal to HFFFF: Electronic thermal relay function load factor in 0.1% increments</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td>Converter output</td>
<td>Read</td>
<td>H02</td>
<td>Hexadecimal to HFFFF: Monitor data selected in the instruction code 0F3</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td>Special monitor selection No.</td>
<td>Write/Read</td>
<td>H6F</td>
<td>Monitor selection data (Refer to page 88 for selection No.)</td>
<td>2 digits (A, CD)</td>
</tr>
<tr>
<td></td>
<td>Write</td>
<td>H73</td>
<td>Monitor selection data (Refer to page 88 for selection No.)</td>
<td>2 digits (A, CD)</td>
</tr>
<tr>
<td>Converter status monitor (extended)</td>
<td>Read</td>
<td>H79</td>
<td>Status of the output signals can be monitored. (Refer to page 116 for details.)</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td>Converter status monitor</td>
<td>Read</td>
<td>H7A</td>
<td></td>
<td>2 digits (A, CD)</td>
</tr>
<tr>
<td>Converter reset</td>
<td>Write</td>
<td>HFD</td>
<td>Converter unit reset</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td>Converter reset</td>
<td>Write</td>
<td>H9696</td>
<td>Converter unit reset</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td>Fault record</td>
<td>Read</td>
<td>H74 to H77</td>
<td>Two latest fault records</td>
<td>4 digits (A, CD)</td>
</tr>
<tr>
<td></td>
<td>Write</td>
<td>HF4</td>
<td>Fault history batch clear</td>
<td>4 digits (A, CD)</td>
</tr>
</tbody>
</table>

Fault record display example (Instruction code 74H)

```
<table>
<thead>
<tr>
<th>Present fault</th>
<th>Last fault</th>
</tr>
</thead>
<tbody>
<tr>
<td>01100000</td>
<td>01100000</td>
</tr>
<tr>
<td>b15</td>
<td>b0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>b8</td>
<td>b7</td>
</tr>
<tr>
<td>0</td>
<td>1000000</td>
</tr>
<tr>
<td>b0</td>
<td>b7</td>
</tr>
<tr>
<td>0</td>
<td>1100000</td>
</tr>
<tr>
<td>b0</td>
<td>b7</td>
</tr>
<tr>
<td>0</td>
<td>0110000</td>
</tr>
</tbody>
</table>
```

With the read data 74H (Fault record), the present fault and the last fault is shown.
### Parameter clear

<table>
<thead>
<tr>
<th>Item</th>
<th>Read/ write</th>
<th>Instruction code</th>
<th>Data description</th>
<th>Number of data digits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter clear</td>
<td>Read</td>
<td>HFC</td>
<td>All parameters return to initial values. Whether to clear communication parameters or not can be selected according to the data.</td>
<td>8 digits (A, C, D)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Parameter clear: H9696, Communication parameters are cleared.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- H996A: Communication parameters are not cleared.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For details of whether or not to clear parameters, refer to page 154.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When a clear is performed with H9696 or H996A, 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, HF and HFF which are used in all clear. Only H9696 and H996A (all parameter clear) are valid during the password lock (refer to page 81).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When a clear is performed with H9696 or H996A, 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, HF and HFF which are used in all clear. Only H9696 and H996A (all parameter clear) are valid during the password lock (refer to page 81).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For the details of whether or not to clear parameters, refer to page 154.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When a clear is performed with H9696 or H996A, 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, HF and HFF which are used in all clear. Only H9696 and H996A (all parameter clear) are valid during the password lock (refer to page 81).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For the details of whether or not to clear parameters, refer to page 154.</td>
<td></td>
</tr>
<tr>
<td>Link parameter extended setting</td>
<td>Read</td>
<td>H9D (or H6D)</td>
<td>When writing Pr.100 and later, the link parameter extended setting must be set.</td>
<td>8 digits (B, D, C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H5A5A</td>
<td>Write H9D (H6D) to H9F (H6F). Parameter settings are switched according to the H9D to H6D settings. For details of the settings, refer to the instruction code (page 154).</td>
<td>8 digits (B, D, C)</td>
</tr>
<tr>
<td>Model</td>
<td>Read</td>
<td>HFF</td>
<td>Reading the converter capacity in ASCII code. Data is read in increments of 0.1 kW.</td>
<td>8 digits (B, D, C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- &quot;H20&quot; (blank code) is set for blank area.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For the instruction codes, HFF, HF and HFC, their values are held since written but cleared to zero when a converter reset or all clear is performed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When a clear is performed with H9696 or H996A, 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, HF and HFF which are used in all clear. Only H9696 and H996A (all parameter clear) are valid during the password lock (refer to page 81).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For the details of whether or not to clear parameters, refer to page 154.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When a clear is performed with H9696 or H996A, 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, HF and HFF which are used in all clear. Only H9696 and H996A (all parameter clear) are valid during the password lock (refer to page 81).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For the details of whether or not to clear parameters, refer to page 154.</td>
<td></td>
</tr>
</tbody>
</table>
Converter status monitor

<table>
<thead>
<tr>
<th>Item</th>
<th>Instruction code</th>
<th>Bit length</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Converter status monitor</td>
<td>H7A</td>
<td>8 bits</td>
<td>RDA: inverter operation enable signal (NC contact)</td>
<td>Example 1: H01...Inverter operation enable signal (NC contact) ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S2: inverter reset signal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3: RDA (inverter operation enable signal (NC contact))</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S6: RDA (inverter operation enable signal (NC contact))</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S10: FAN (fan fault signal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S13: FAN (fan fault signal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S16: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td>Converter status monitor (extended)</td>
<td>H79</td>
<td>16 bits</td>
<td>RDA: inverter operation enable signal (NC contact)</td>
<td>Example 1: H01...Inverter operation enable signal (NC contact) ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S2: inverter reset signal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3: RDA (inverter operation enable signal (NC contact))</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S6: RDA (inverter operation enable signal (NC contact))</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S10: FAN (fan fault signal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S15: FAN (fan fault signal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S16: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S17: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S18: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S19: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S20: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S21: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S22: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S23: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S24: ABC1 (Fault)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S25: ABC1 (Fault)</td>
<td></td>
</tr>
</tbody>
</table>

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)}. The description is also affected by the setting of Pr.405 (Parameter number selection).
5.8 Parameter clear / all parameter clear

- Set Pr.117 to Pr.CLR Parameter clear, 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 with Pr.CLR.
- Refer to the parameter list on page 154 for availability of parameter clear and all parameter clear for each parameter.

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
</table>
| Screen at power-ON
The number display appears. |
| Parameter setting mode
Press [AW] to choose the parameter setting mode. (The parameter number read previously appears.) |
| Selecting the parameter number
To perform a parameter clear, turn \( \bullet \) to P-CLR and to perform all parameter clear, turn it to ALL-CLR and press. “\( \bullet \)” (initial value) appears. |

Parameter clear
- Turn \( \bullet \) to change the set value to “\( \bullet \)” Press [AW] to enter the setting. “\( \bullet \)” and \( \bullet \) blink alternatively after parameters are cleared.
- Turn \( \bullet \) to read another parameter.
- Press \( \bullet \) once to show the setting again.
- Press \( \bullet \) twice to show the next parameter.

<table>
<thead>
<tr>
<th>Setting value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr.CLR Parameter clear</td>
<td>ALL.CL All parameter clear</td>
</tr>
<tr>
<td>0 Initial display (Parameters are not cleared.)</td>
<td>0 Initial display (Parameters are not cleared.)</td>
</tr>
<tr>
<td>1 Returns parameters excluding terminal function selection parameters, etc. to their initial values.</td>
<td>Returns all parameters which can be cleared excluding terminal function selection parameters to their initial values.</td>
</tr>
</tbody>
</table>

5 PARAMETER 117
5.9 Copying and verifying parameters

<table>
<thead>
<tr>
<th>C/P/Y setting value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.---</td>
<td>Initial display.</td>
</tr>
<tr>
<td>1.RD</td>
<td>Copy the source parameter to the operation panel.</td>
</tr>
<tr>
<td>2.WR</td>
<td>The parameters copied to the operation panel can be also copied to the destination converter units.</td>
</tr>
<tr>
<td>3.VFY</td>
<td>Verify parameters in the converter unit and the operation panel. (Refer to page 109.)</td>
</tr>
</tbody>
</table>

**NOTE**
- When the destination is other than the FR-CC2-P series or when parameter copy is attempted after the parameter copy reading was stopped, "model error ( )" appears.
- Refer to the parameter list on page 154 for 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.
- 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 that case, those parameters operate as if they were set to their initial values.

### 5.9.1 Parameter copy

- The converter unit parameter settings can be copied to other converter units.

#### Reading the parameter settings of the converter unit to the operation panel

1. Connect the operation panel to the source converter unit.
2. Parameter setting mode
   - Press \( \text{[P]} \) to choose the parameter setting mode. (The parameter number read previously appears.)
3. Selecting the parameter number
   - Turn \( \text{[P]} \) to \( \text{[P]} \) (parameter copy), and press \( \text{[P]} \).
   - \( \text{[P]} \) appears.
4. Reading to the operation panel
   - Turn \( \text{[P]} \) to change the set value to " \( \text{[P]} \)." Press \( \text{[P]} \) to start reading of the converter unit parameter settings by the operation panel. (It takes about 30 seconds to read all the settings. During reading, \( \text{[P]} \) blinks.)
5. End reading
   - \( \text{[P]} \) and \( \text{[P]} \) blink alternately after settings are read.

**NOTE**
- \( \text{[P]} \) appears. Why?
  - Parameter read error. Perform the operation from step 2 again.
Copying and verifying parameters

◆ Copying parameter settings read to the operation panel to the converter unit

1. Connect the operation panel to the destination converter unit.
2. Press [ ] to choose the parameter setting mode. (The parameter number read previously appears.)
3. Turn [ ] to [ ] (parameter copy), and press [ ].

" " appears.

Selecting parameter copy

4. Turn [ ] to change the set value to " " (parameter copy), then press [ ].

" " appears.

Copying to the converter unit

5. Press [ ] to start copying to the converter unit. (It takes about 60 seconds to copy all the settings. During copying, " " blinks.)

Ending copying

6. " " and " " blink alternating 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.

NOTE
- " " appears... Why?
- Parameter write error. Perform the operation from step 3 again.
Copying and verifying parameters

5.9.2 Parameter verification

- Whether the parameter settings of converter units are the same or not can be checked.

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Copy the parameter settings of the verification source converter unit to the operation panel according to the procedure on page 118.</td>
</tr>
<tr>
<td>2. Move the operation panel to the converter unit to be verified.</td>
</tr>
<tr>
<td>3. Screen at power-ON: The monitor display appears.</td>
</tr>
<tr>
<td>4. Parameter setting mode: Press ( P_{\text{p}} ) to choose the parameter setting mode. (The parameter number read previously appears.)</td>
</tr>
<tr>
<td>5. Parameter setting mode: Press ( P_{\text{p}} ) to choose the parameter setting mode. (The parameter number read previously appears.)</td>
</tr>
<tr>
<td>6. Parameter verification: Press ( P_{\text{p}} ) to change to the setting value ( 3/P_{\text{p}} ). (parameter copy verification mode)</td>
</tr>
</tbody>
</table>

- "\( P_{\text{p}} \)" blinks. 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, "\( 3/P_{\text{p}} \)" blinks.)

- If there are different parameters, the different parameter number and "\( 3/P_{\text{p}} \)" blinks.

- To continue verification, press \( P_{\text{p}} \) "\( P_{\text{p}} \)" and "\( 3/P_{\text{p}} \)" blink alternately after verification ends.

**NOTE**

- The parameter settings may be different between the verification source converter unit and the verification destination converter unit. To continue verification, press \( P_{\text{p}} \).
5.10 Checking parameters changed from their initial values (Initial value change list)

Parameters changed from their initial values can be displayed.

1. Screen at power-ON
   The monitor display appears.

2. Parameter setting mode
   Press [mode] to choose the parameter setting mode. (The parameter number read previously appears.)

3. Selecting the parameter number
   Turn [sel] to P[1]<E<HG, (initial value change list), and press [set].
   “-” appears.

4. Checking the initial value change list
   Turn [sel] The parameter numbers that have been changed from their initial value appear in order.
   • If [set] is pressed with parameters that have been changed, the parameter settings can be changed as they are. (Parameter numbers are no longer displayed in the list when they are returned to their initial values.)
   Other changed parameters appear by turning [sel].
   • “-” appears again when the last changed parameter is displayed.

NOTE
• The initial value change list can be used also for parameter setting.
6 PROTECTIVE FUNCTIONS

This chapter explains the "PROTECTIVE FUNCTION" that operates in this product.
Always read the instructions before using the equipment.

6.1 Converter unit fault and alarm indications ....................... 124
6.2 Reset method for the protective functions ....................... 124
6.3 Check and clear of the faults history .................. 125
6.4 Faults history and the list of fault displays ....................... 127
6.5 Causes and corrective actions ................................................ 128
6.6 Check first when you have trouble ......................................... 135
6.1 Converter unit fault and alarm indications

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

When a protective function is activated, take an appropriate corrective action, then reset the converter unit (inverter), and resume the operation. Restarting the operation without a reset may break or damage the converter unit (inverter).

When a protective function is activated, note the following points.

Converter unit fault or alarm indications are categorized as below.

<table>
<thead>
<tr>
<th>Displayed Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error message</td>
<td>A message regarding an operational fault and setting fault by the operation panel is displayed. The inverter output is not shut off by this. Even if a warning is displayed, failure to take appropriate measures results in a fault.</td>
</tr>
<tr>
<td>Warning</td>
<td>The inverter output is not shut off. However, an alarm (L F) signal can be output with a parameter setting.</td>
</tr>
<tr>
<td>Alarm</td>
<td>A protective function is activated to shut off the inverter output and output an alarm (L F) signal.</td>
</tr>
<tr>
<td>Fault</td>
<td>A protective function is activated to shut off the inverter output.</td>
</tr>
</tbody>
</table>

On the operation panel, press [RES] to reset the converter unit. (This may only be performed when a fault occurs.) Refer to page 130 of the Instruction Manual for faults.

Switch power OFF once, then switch it ON again.

Turn OFF the reset signal (RES) for 0.1 s or more. If the RES signal is kept ON, "Err" appears (blinks) to indicate that the converter unit is in a reset status.

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.

6.2 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 is cleared (erased) by resetting the inverter. The converter unit recovers about 1 s after the reset is released.

Converter unit

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The past eight faults can be displayed on the operation panel. (Faults history) (For the operation, refer to page 125.)</td>
</tr>
</tbody>
</table>

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 faults history

The operation panel stores the fault indications which appear when a protective function is activated to display the fault record for the past eight faults. (Faults history)

◆ Check for the faults history

When there is no faults history, “E0” is displayed.

Press the setting dial.

Fault history number

Fault history number

Fault history number

Fault history number

Faults history 1

Faults history 2

Faults history 3

Faults history 4

Faults history 5

Faults history 6

Faults history 7

Faults history 8

Converter output voltage

Input current

Electric thermal relay

Function load factor

NOTES:

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

2. The faults history can be checked when the operation panel of the inverter is installed on the converter unit.
Check and clear of the faults history

◆ Faults history clearing procedure

**POINT**
- Set Err CL Fault history clear = “1” to clear the faults history.

<table>
<thead>
<tr>
<th>Screen at power-ON</th>
<th>Parameter setting mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>The monitor display appears.</td>
<td>Press [SET] to choose the parameter setting mode. (The parameter number read previously appears.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selecting the parameter number</th>
<th>Faults history clear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn [&lt;] until &quot;Err CL&quot; (faults history clear) appears. Press [SET] to read the present set value. &quot;1&quot; (default value) appears.</td>
<td>Turn [&lt;] to change the set value to “1”. Press [SET] to start clear.</td>
</tr>
<tr>
<td>&quot;1&quot; and &quot;Err CL&quot; blink alternately after parameters are cleared.</td>
<td>*Turn [&lt;] to read another parameter.</td>
</tr>
<tr>
<td>*Press [SET] to show the setting again.</td>
<td>*Press [SET] twice to show the next parameter.</td>
</tr>
<tr>
<td>*Press [SET] twice to show the next parameter.</td>
<td></td>
</tr>
</tbody>
</table>
6.4 Faults 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 an operational fault and setting fault by the operation panel is displayed. The inverter output is not shut off.
- **Error message**
  - A message regarding an 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.
- **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 be output with a parameter setting.
- **Alarm**
  - The inverter output is not shut off. An Alarm (LF) signal can be output with a parameter setting.

**Fault**
- A protective function is activated to trip the inverter and output a Fault (ALM) signal.
- A protective function is activated to trip the inverter and output a Fault (ALM) signal.
- The data code is used for checking the fault via communication or for setting Pr.997 Fault initiation.
- The data code is used for checking the fault via communication or for setting Pr.997 Fault initiation.

**Others**
- The faults history and the operation status of the converter unit are displayed. It is not a fault.
- The faults history and the operation status of the converter unit are displayed. It is not a fault.
### 6.5 Causes and corrective actions

**Error message**
A message regarding operational troubles is displayed. The inverter output is not shut off.

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>Description</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HOLD</strong></td>
<td>Operation lock is set. Operation other than HOLD is invalid. (Refer to page 96.)</td>
<td>Press [W/O] for 2 s to release lock.</td>
</tr>
<tr>
<td><strong>LOCd</strong></td>
<td>Password lock is set. Operation other than LOCd is invalid.</td>
<td>Enter the password in Pr.297 Password lock/unlock to unlock the password function before operating. (Refer to page 81.)</td>
</tr>
<tr>
<td><strong>Er1</strong></td>
<td>Parameter write error • Parameter setting was attempted while Pr.77 Parameter write selection is set to disable parameter write. • The operation panel and converter unit cannot make normal communication.</td>
<td>Check the parameter setting of Pr.77. (Refer to page 80.) • Check the connection between the operation panel and the converter unit.</td>
</tr>
<tr>
<td><strong>rE1</strong></td>
<td>Parameter read error • A failure has occurred at the operation panel side while reading the copied parameter. • The operation panel may be faulty. Contact your sales representative.</td>
<td>Perform parameter verification again. (Refer to page 120.)</td>
</tr>
<tr>
<td><strong>rE2</strong></td>
<td>Parameter write error • A failure has occurred at the operation panel side while writing the copied parameter. • The operation panel may be faulty. Contact your sales representative.</td>
<td>Perform parameter verification again. (Refer to page 120.)</td>
</tr>
<tr>
<td><strong>rE3</strong></td>
<td>Parameter verification error • The data in the converter side is different from that in the operation panel. • A failure has occurred at the operation panel side during parameter verification. • The operation panel may be faulty. Contact your sales representative.</td>
<td>Continue the verification by pressing [W/O]. Perform parameter verification again. (Refer to page 120.)</td>
</tr>
</tbody>
</table>
Causes and corrective actions

**PROTECTIVE FUNCTIONS**

### PROTECTIVE FUNCTIONS

**Warning**

The inverter output is not shut off when a protective function is activated.

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>rE4</th>
<th>rE4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>Model error</td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>The data in the operation panel were not correct when parameter copy from the operation panel or parameter verification was performed.</td>
<td></td>
</tr>
<tr>
<td><strong>Check point</strong></td>
<td>- Check that the operation panel and converter unit are of the same model.</td>
<td></td>
</tr>
<tr>
<td><strong>Corrective action</strong></td>
<td>- Perform parameter copy and parameter verification between converter units of the same model (FR-CC2-P series).</td>
<td></td>
</tr>
</tbody>
</table>

#### Operation panel indication: rE4

**Description**

- The inverter output is not shut off when a protective function is activated.

**Operation panel indication:** rE4

**Name**

- rE4: The operation panel and converter unit cannot make normal communication. (Transmission error)

**Description**

- **.Check point:** Check that the parameter copy to the operation panel was not interrupted by switching OFF the power or by disconnecting the operation panel.

**Corrective action**

- Perform parameter copy and parameter verification between converter units of the same model (FR-CC2-P series).

#### Operation panel indication: Err.

**Description**

- The RES signal is turned ON.
- The operation panel and 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, this error may appear at turning ON of the main circuit. It is not a fault.)

**Corrective action**

- 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.

#### Operation panel indication: TH

**Name**

- Electronic thermal relay function pre-alarm

**Description**

- If the accumulated electronic thermal value reaches 85%, TH is displayed and the THP signal is output. If the specified value is reached, the protection circuit is activated and Converter overload trip (electronic thermal relay function) (E.THC) occurs.

**Check point**

- Set the time until the MT is displayed by setting 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).

**Corrective action**

- Take appropriate countermeasures according to the purpose of the maintenance timer setting.
- Setting "0" in Pr.503: Maintenance timer 1, Pr.686: Maintenance timer 2, and Pr.688: Maintenance timer 3 erases the indication.
Causes and corrective actions

**Alarm**

The inverter output is not shut off when a protective function is activated. An alarm can also be output with a parameter setting.

(Set “5” in Pr. 156 to Pr. 159 (Output terminal function selection). (Refer to page 92.)

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>FN</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>FN</td>
<td>Name</td>
</tr>
<tr>
<td>Description</td>
<td>FN</td>
<td><strong>Check point</strong></td>
</tr>
<tr>
<td>Corrective action</td>
<td>FN</td>
<td><strong>Check for failure.</strong> Consider your sales representative.</td>
</tr>
</tbody>
</table>

**Fault**

When a protective function activates, the inverter output is not shut off and a fault signal is output.

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.OVT</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>E.OVT</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>E.OVT</td>
<td></td>
</tr>
<tr>
<td>Check point</td>
<td>E.OVT</td>
<td></td>
</tr>
<tr>
<td>Corrective action</td>
<td>E.OVT</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.THC</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>E.THC</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>E.THC</td>
<td></td>
</tr>
<tr>
<td>Check point</td>
<td>E.THC</td>
<td></td>
</tr>
<tr>
<td>Corrective action</td>
<td>E.THC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.FIN</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>E.FIN</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>E.FIN</td>
<td></td>
</tr>
<tr>
<td>Check point</td>
<td>E.FIN</td>
<td></td>
</tr>
<tr>
<td>Corrective action</td>
<td>E.FIN</td>
<td></td>
</tr>
</tbody>
</table>
Causes and corrective actions

### PROTECTIVE FUNCTIONS

#### Operation panel indication: E.IPF

**Name**: Instantaneous power failure  
**Description**: If a power failure occurs for longer than 15 ms (this also applies to converter unit shut-off), the instantaneous power failure protective function is activated to trip the inverter 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 inverter start signal is ON upon power restoration. (The inverter continues operating if an instantaneous power failure is within 15 ms.) In some operating status (load magnitude, acceleration/deceleration time setting, etc.), overcurrent or other protection may be activated by the inverter upon power restoration.

**Check point**: Check if the instantaneous power failure occurred.

**Corrective action**:
- Recover from the instantaneous power failure condition.
- Prepare a backup power supply in case of an instantaneous power failure.
- Set the function of automatic restart after instantaneous power failure (Pr.57). (Refer to page 100.)

#### Operation panel indication: E.UVT

**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, if the power supply voltage decreases to about 300 VAC or below, this function shuts off the inverter output.

**Check point**: Check if a high-capacity motor is driven.

**Corrective action**:
- Check the power supply system equipment such as the power supply.
- If the problem still persists after taking the above measure, contact your sales representative.

#### Operation panel indication: E.ILF

**Name**: Input phase loss  
**Description**: The inverter output is shut off if one of the three power input phases is lost when Pr.872 Input phase loss protection selection = “1 (initial value)” (Refer to page 87.)

**Check point**: Check for a break in the cable for the three-phase power supply input.

**Corrective action**:
- Wire the cables properly.
- Repair a break portion in the cable.

#### Operation panel indication: 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).

**Check point**: 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**:
- 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.PA1

**Name**: Parallel operation slave 1 fault  
**Description**: Appears on the operation panel of the master at an occurrence of a slave 1 converter fault during the parallel operation. Appears on the master converter unit even when the RS-485 terminals are incorrectly connected.

**Check point**: Check that the protection function of the slave 1 is activated.

**Corrective action**:
- Remove the fault of the slave 1.
- Perform correct wiring of the RS-485 terminals.
Causes and corrective actions

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.PA2</th>
<th>E.PR2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>PROTECTIVE FUNCTIONS</td>
<td>PROTECTIVE FUNCTIONS</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Appears on the operation panel of the master at an occurrence of a slave 2 converter fault during the parallel operation. Appears on the master converter unit even when the RS-485 terminals are incorrectly connected.</td>
<td></td>
</tr>
<tr>
<td><strong>Check point</strong></td>
<td>- Check that the protective function of the slave 2 is activated.</td>
<td></td>
</tr>
<tr>
<td><strong>Corrective action</strong></td>
<td>- Remove the fault of the slave 2.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.PE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>Parameter storage device fault (control circuit board)</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>The inverter output is shut off if a fault occurs in the parameter stored (EEPROM failure).</td>
</tr>
<tr>
<td><strong>Check point</strong></td>
<td>- Check for too many number of parameter write times.</td>
</tr>
<tr>
<td><strong>Corrective action</strong></td>
<td>Contact your sales representative. When performing parameter writing for communication purposes, set “1” in Pr.340 Communication EEPROM write selection and enable RAM write. Note that writing to RAM goes back to the initial state at power OFF.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.PUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>Parameter storage device fault (main circuit board)</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>The inverter output is shut off if a fault occurs in the parameter stored (EEPROM failure).</td>
</tr>
<tr>
<td><strong>Check point</strong></td>
<td>- Check that the operation panel is connected properly.</td>
</tr>
<tr>
<td><strong>Corrective action</strong></td>
<td>Connect the operation panel securely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.PE2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>Parameter storage device fault (control circuit board)</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>The inverter output is shut off if a fault occurs in the parameter stored (EEPROM failure).</td>
</tr>
<tr>
<td><strong>Check point</strong></td>
<td>- Check that the operation panel is connected properly.</td>
</tr>
<tr>
<td><strong>Corrective action</strong></td>
<td>Contact your sales representative.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>E.CPU</th>
<th>E.5</th>
<th>E.6</th>
<th>E.7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>CPU fault</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>The inverter output is shut off if a communication fault in the built-in CPU occurs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Check point</strong></td>
<td>- Check the operation panel for proper operation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Corrective action</strong></td>
<td>Contact your sales representative.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Causes and corrective actions

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>Description</th>
<th>Check point</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.CTE</td>
<td>When the power supply for the operation panel (PU connector) is shorted, the power output stops, 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, reset via communication through the RS-485 terminals, or switch power OFF then ON again.</td>
<td>• Check that the RS-485 terminals are connected correctly.</td>
<td>• Check the operation panel and the cable.</td>
</tr>
<tr>
<td>E.P24</td>
<td>A 24 VDC power fault occurs when the 24 VDC power supply output from terminal PC is shorted, or the voltage of the external 24 VDC power supply is low. The inverter output is shut off. At this time, all external contact inputs turn OFF. The inverter cannot be reset by inputting the RES signal. To reset it, use the operation panel, switch power OFF then ON again.</td>
<td>• Check for a short circuit in the PC terminal output.</td>
<td>• Repair the short-circuited portion.</td>
</tr>
<tr>
<td>E.IOH</td>
<td>Inrush current limit circuit failure occurs when the resistor of the inrush current limit circuit is overheated.</td>
<td>• 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.</td>
<td>• Configure a circuit where power ON/OFF is not repeated. • If the situation does not improve after taking the above measure, contact your sales representative.</td>
</tr>
<tr>
<td>E.SER</td>
<td>Communication fault (inverter) occurs when the RS-485 terminals are incorrectly connected.</td>
<td>• Check the RS-485 terminal wiring. • Make sure the time set in Pr.652 is appropriate. • Check for excessive noise around the converter unit.</td>
<td>• Perform wiring of the RS-485 terminals properly. • Set the time set in Pr.652 longer. • Take measures against noises if there are devices producing excessive electrical noises around the converter unit.</td>
</tr>
<tr>
<td>E.PBT</td>
<td>Internal circuit fault occurs in the converter unit.</td>
<td></td>
<td>Contact your sales representative.</td>
</tr>
</tbody>
</table>
Causes and corrective actions

### Others

**Operation panel indication**: 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**
- Check if a plug-in option is connected.
- Check for excessive noise around the converter unit.

**Corrective action**
- Disconnect the plug-in option. (Plug-in options cannot be used.)
- Take measures against noises if there are devices producing excessive electrical noise around the converter unit.
- If the situation does not improve after taking the above measures, contact your sales representative.

**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**
- 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 too low.

**Operation panel indication**: SLV.1

**Name**: Parallel operation slave 1

**Description**: Appears on the monitor data screen at power-ON (first monitor) of the slave 1 converter unit (Pr.1001 Parallel operation selection = “1”).

**Operation panel indication**: SLV.2

**Name**: Parallel operation slave 2

**Description**: Appears on the monitor data screen at power-ON (first monitor) of the slave 2 converter unit (Pr.1001 Parallel operation selection = “2”).

**NOTE**: If faults other than the above appear, contact your sales representative.
6.6 Check first when you have trouble

**POINT**

- If the cause is still unknown after every check, it is recommended to initialize the parameters (initial value) then set the required parameter values and check again.

### 6.6.1 Converter unit does not operate properly

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main circuit</td>
<td>Wiring or installation is improper.</td>
<td>Check for the wiring and the installation.</td>
</tr>
<tr>
<td>Control Circuit</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Main circuit</td>
<td>Inappropriate power supply voltage is not applied. (Operation panel display is not provided.)</td>
<td>Power on a molded case circuit breaker (MCCB) or a magnetic contactor (MC). — Check for the decreased input voltage, input phase loss, and wiring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Main circuit</td>
<td>Power lamp is lit when power is supplied to the control circuit (R1/L11, S1/L21).</td>
<td>Check for the wiring and the installation.</td>
</tr>
<tr>
<td>Control Circuit</td>
<td></td>
<td>31</td>
</tr>
</tbody>
</table>

### 6.6.2 The power lamp is OFF

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main circuit</td>
<td>Wiring or installation is improper.</td>
<td>Check for the wiring and the installation. Power lamp is lit when power is supplied to the control circuit (R1/L11, S1/L21).</td>
</tr>
<tr>
<td>Control Circuit</td>
<td></td>
<td>31</td>
</tr>
</tbody>
</table>

### 6.6.3 The charge lamp is OFF

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main circuit</td>
<td>Wiring or installation is improper.</td>
<td>Check for the wiring and the installation. Charge lamp is lit when power is supplied to the control circuit (R1/L1, S/L2, T/L3).</td>
</tr>
<tr>
<td>Control Circuit</td>
<td></td>
<td>31</td>
</tr>
</tbody>
</table>

### 6.6.4 Operation panel display is not operating

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main circuit</td>
<td>Power is not input.</td>
<td>Check that the front cover is installed securely.</td>
</tr>
<tr>
<td>Control Circuit</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>
Check first when you have trouble

### 6.6.5 Inverter cannot be operated

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Circuit</td>
<td>Terminals RDA and SE of the converter unit are not connected to terminals MRS (X10 signal) and SD of the inverter respectively.</td>
<td>Check for the wiring.</td>
<td>24</td>
</tr>
<tr>
<td>PARAMETER</td>
<td>Inverter parameter settings are incorrect.</td>
<td>Check for the inverter parameter settings.</td>
<td>80</td>
</tr>
</tbody>
</table>

### 6.6.6 Unable to write parameter setting

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter setting</td>
<td>Parameter is disabled by the Pr.77 Parameter write selection setting.</td>
<td>Check the Pr.77 setting.</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Key lock mode is enabled by the Pr.161 Key lock operation selection setting.</td>
<td>Check the Pr.161 setting.</td>
<td>80</td>
</tr>
</tbody>
</table>

### 6.6.7 Breaker trips

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main circuit</td>
<td>Wiring or installation is improper.</td>
<td>Check for the wiring and the installation.</td>
<td>24</td>
</tr>
</tbody>
</table>

### 6.6.8 Converter unit generates abnormal noise

<table>
<thead>
<tr>
<th>Checkpoints</th>
<th>Cause</th>
<th>Countermeasure</th>
<th>Refer to page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan</td>
<td>Fan cover was not correctly installed when a cooling fan was replaced.</td>
<td>Install a fan cover correctly.</td>
<td>143</td>
</tr>
</tbody>
</table>
This chapter explains the "PRECAUTIONS FOR MAINTENANCE AND INSPECTION" for this product. Always read the instructions before using the equipment.

7.1 Inspection item...............................................................138
7.2 Measurement of main circuit voltages, currents and powers .........................................................145
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 because the smoothing capacitor voltage remains high for a while, and then make sure that the voltage across the main circuit terminals P+ and N- of the converter unit is not more than 30 VDC using a tester, etc.

### 7.1 Inspection item

#### 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 33.)

- Check the conductors and insulating materials for corrosion and damage.
- Measure the insulation resistance.
- Check and change the cooling fan and relay.
### Daily and periodic inspection

<table>
<thead>
<tr>
<th>Area of inspection</th>
<th>Inspection item</th>
<th>Description</th>
<th>Inspection interval</th>
<th>Corrective action at fault occurrence</th>
<th>Check by the user</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>Daily</td>
<td>Check the surrounding or temperature (humidity, dust, corrosive gas, oil mist, etc.)</td>
<td>Daily</td>
<td>○ I: Improve the environment.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check the surrounding or temperature (humidity, dust, corrosive gas, oil mist, etc.)</td>
<td>Periodic</td>
<td>○ C: Check field moisture and humidity</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Daily</td>
<td>Power supply voltage</td>
<td>Daily</td>
<td>○ C: Inspect the power supply.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Power supply voltage</td>
<td>Periodic</td>
<td>○ C: Inspect the power supply.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Overall unit</strong></td>
<td>Daily</td>
<td>Check for unusual vibration and noise.</td>
<td>Daily</td>
<td>○ C: Check fault location and retighten.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check for unusual vibration and noise.</td>
<td>Periodic</td>
<td>○ C: Check fault location and retighten.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Main circuit</strong></td>
<td>Daily</td>
<td>Check for dirt, oil, and other foreign material.</td>
<td>Daily</td>
<td>○ C: Clean.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check for dirt, oil, and other foreign material.</td>
<td>Periodic</td>
<td>○ C: Clean.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Transformer/reactor</strong></td>
<td>Daily</td>
<td>Check for unusual vibration and noise.</td>
<td>Daily</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check for unusual vibration and noise.</td>
<td>Periodic</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Terminal block</strong></td>
<td>Daily</td>
<td>Check for a damage.</td>
<td>Daily</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check for a damage.</td>
<td>Periodic</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Conductors, cables</strong></td>
<td>Daily</td>
<td>Check conductors for distortion.</td>
<td>Daily</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check conductors for distortion.</td>
<td>Periodic</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Daily</td>
<td>Check cable sheaths for breakage and deterioration (crack, discoloration, etc.).</td>
<td>Daily</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check cable sheaths for breakage and deterioration (crack, discoloration, etc.).</td>
<td>Periodic</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Relay/contactor</strong></td>
<td>Daily</td>
<td>Check that the operation is normal and no chattering sound is heard.</td>
<td>Daily</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check that the operation is normal and no chattering sound is heard.</td>
<td>Periodic</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Operation check</strong></td>
<td>Daily</td>
<td>Check for unusual odor and discoloration.</td>
<td>Daily</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check for unusual odor and discoloration.</td>
<td>Periodic</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>Daily</td>
<td>Check for unusual vibration and discoloration.</td>
<td>Daily</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check for unusual vibration and discoloration.</td>
<td>Periodic</td>
<td>○ C: Stop the equipment and contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Aluminum electrolytic capacitor</strong></td>
<td>Daily</td>
<td>Check for liquid leakage in a capacitor and deformation trace.</td>
<td>Daily</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check for liquid leakage in a capacitor and deformation trace.</td>
<td>Periodic</td>
<td>○ C: Contact the manufacturer.</td>
<td>○ user.</td>
</tr>
<tr>
<td><strong>Cooling system</strong></td>
<td>Daily</td>
<td>Check the surrounding or temperature (humidity, dust, corrosive gas, oil mist, etc.)</td>
<td>Daily</td>
<td>○ C: Improve the environment.</td>
<td>○ user.</td>
</tr>
<tr>
<td></td>
<td>Periodic</td>
<td>Check the surrounding or temperature (humidity, dust, corrosive gas, oil mist, etc.)</td>
<td>Periodic</td>
<td>○ C: Improve the environment.</td>
<td>○ user.</td>
</tr>
</tbody>
</table>
Inspection item

<table>
<thead>
<tr>
<th>Area of Inspection</th>
<th>Inspection Item</th>
<th>Description</th>
<th>Inspection interval</th>
<th>Corrective action at fault occurrence</th>
<th>Check by the user</th>
</tr>
</thead>
</table>
| Display            | Indicator      | [1] Check that display is normal  
                    |                | (D)                | Contact the manufacturer. Clear.     |                   |
|                    |                | [2] Check for noise.                | (D)                |                                      |                   |
| Meter              |                | Check that reading is normal.      | (D)                | Stop the equipment and contact the manufacturer. |                   |
| Load meter         | Operation check| Check for vibration and abnormal increase in operation noise. | (D)                | Stop the equipment and contact the manufacturer. |                   |

- 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.
- It is recommended to install a voltage monitoring device for checking the voltage of the power supplied to the converter unit.
- 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 module

**Preparation**
- Disconnect the external power supply cables (RL1, SL2, TL3, P+, and N-).
- Prepare a tester. (For the resistance measurement, use the 100 Ω range.)

**Checking method**
Change the polarities of the tester alternately at the converter unit terminals RL1, SL2, TL3, P+, and N- and check the electric continuity.

- 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. If all measured values are almost the same, although these values are not constant depending on the module type and tester type, the modules are without fault.

**Module device numbers and terminals to be checked**

<table>
<thead>
<tr>
<th>Module device number</th>
<th>Terminals</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>R/L1, P+</td>
<td>Discontinuity</td>
</tr>
<tr>
<td>D2</td>
<td>S/L2, P+</td>
<td>Continuity</td>
</tr>
<tr>
<td>D3</td>
<td>T/L3, P+</td>
<td>Continuity</td>
</tr>
<tr>
<td>D4</td>
<td>R/L1, N-</td>
<td>Continuity</td>
</tr>
<tr>
<td>D5</td>
<td>S/L2, N-</td>
<td>Continuity</td>
</tr>
<tr>
<td>D6</td>
<td>T/L3, N-</td>
<td>Continuity</td>
</tr>
</tbody>
</table>

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.

- 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.

<table>
<thead>
<tr>
<th>Part name</th>
<th>Estimated lifespan</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling fan</td>
<td>10 years</td>
<td>Replace (as required)</td>
</tr>
<tr>
<td>Main circuit smoothing capacitor</td>
<td>10 years</td>
<td>Replace (as required)</td>
</tr>
<tr>
<td>Inrush current limit circuit</td>
<td>10 years</td>
<td>Replace (as required)</td>
</tr>
<tr>
<td>Relay</td>
<td>As required</td>
<td>Replace (as required)</td>
</tr>
<tr>
<td>Main circuit fuse</td>
<td>As required</td>
<td>Replace (as required)</td>
</tr>
</tbody>
</table>

- Estimated lifespan for when the yearly average surrounding air temperature is 40°C (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
- Input current: 80% of the converter unit rating

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

*Converter unit parts life display*

The converter unit diagnoses the control circuit capacitor, cooling fan, and inrush current limit circuit by itself and estimates their lives. The self-diagnostic warning is output when the life span of each part is near its end. It gives an indication of replacement time.

The life warning output can be used as a guideline for life judgment.

<table>
<thead>
<tr>
<th>Parts</th>
<th>Judgment level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control circuit capacitor</td>
<td>Estimated remaining life ≥ 50%</td>
</tr>
<tr>
<td>Cooling fan</td>
<td>Estimated remaining life ≥ 50%</td>
</tr>
<tr>
<td>Inrush current limit circuit</td>
<td>Estimated remaining life ≥ 50%</td>
</tr>
</tbody>
</table>

**NOTE**
- Refer to page 83 to perform the life check of the converter unit parts.
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.

- **Reinstallation**
  1. After confirming the orientation of the fan, reinstall the fan so that the "AIR FLOW" faces up.
  2. For reconnection of the fan, refer to the above figure.

**NOTE**
- Installing the fan in the opposite direction of air flow can cause the converter unit life to be shorter.
- Prevent the cable from being caught when installing a fan.
- Switch the power OFF before replacing fans. Since the converter unit circuits are charged with voltage even after power OFF, replace fans only when the converter unit cover is on the converter unit to prevent an electric shock accident.
Inspection item

◆ Smoothing capacitors
A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc. The replacement intervals greatly vary with the surrounding air temperature and operating conditions. When the converter unit is operated in air-conditioned, normal environment conditions, replace the capacitors about every 10 years.

The appearance criteria for inspection are as follows:
- Case: Check the side and bottom faces for expansion.
- Sealing plate: Check for remarkable warp and extreme crack.
- Check for external crack, discoloration, liquid leakage, etc. Judge that the capacitor has reached its life when the measured capacitance of the capacitor reduced below 80% of the rating.

NOTE
- The converter unit diagnoses the control circuit capacitor by itself and can judge its life. (Refer to page 6.)

◆ Relays
- To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).
- The control terminal block must be replaced in case of failure of the relay connected to the relay output terminals A1, B1, and C1. (After installing a new control terminal block, set up the control logic for input signals with the jumper connector (control logic selector). (Refer to page 37.)

◆ Main circuit fuse
A fuse is used inside the converter unit. The replacement intervals vary with the surrounding air temperature and operating conditions. When the converter unit is operated in air-conditioned, normal environment conditions, replace the capacitors about every 10 years.

7.1.7 Converter unit replacement
The converter unit can be replaced with the control circuit wiring kept connected.

1) Loosen the two mounting screws at the both side 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 mounting screws.

NOTE
- Before starting converter unit replacement, switch power OFF, wait for at least 10 minutes, and then check the voltage with a tester and such to ensure safety.
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 converter unit output side
- When the wiring length between the converter unit and the inverter is large, 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.

---

### Examples of measuring points and instruments

![Diagram of measuring points and instruments](image)

#### Measuring points and instruments

<table>
<thead>
<tr>
<th>Item</th>
<th>Measuring point</th>
<th>Measuring instrument</th>
<th>Remarks (reference measured value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage</td>
<td>V1</td>
<td>Across R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1</td>
<td>Moving-iron type AC voltmeter</td>
</tr>
<tr>
<td>Power supply side current</td>
<td>I1</td>
<td>R/L1, S/L2, T/L3 line current</td>
<td>Moving-iron type AC ammeter</td>
</tr>
<tr>
<td>Power supply side power</td>
<td>P1</td>
<td>R/L1, S/L2, T/L3 and Across R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1</td>
<td>Digital power meter (for inverter) or electrodynamic type single-phase wattmeter</td>
</tr>
<tr>
<td>Power supply side power factor</td>
<td>Pf1</td>
<td>Calculate after measuring power supply voltage, power supply side current and power supply side power.</td>
<td>Converter unit LED is ON. 1.35 ( V1 \times \frac{P1}{I1} \times 100% )</td>
</tr>
<tr>
<td>Fault signal</td>
<td>Across A1 and C1, Across B1 and C1</td>
<td>Moving-coil type (such as tester)</td>
<td>Continuity check</td>
</tr>
</tbody>
</table>

---

### Additional Notes

- A digital power meter designed for harmonics can also be used to measure.
- When the setting of a 7VF-600 3DV terminal function (continuity) is in the position "ON".
Measurement of main circuit voltages, currents and powers

7.2.1 Measurement of powers

Use a digital power meter (for inverter) for the input side of converter unit. Alternatively, measure using electrodynamic type single-phase wattmeters for the input side of the converter unit in two-wattmeter or three-wattmeter method. Since current on the input side tends to be especially unbalanced, measurement using the three-wattmeter method is recommended.

Examples of measured value differences produced by different measuring meters are shown below.

An error will be produced by difference between measuring instruments, e.g. power calculation type and two- or three-wattmeter type three-phase wattmeter. When a CT is used in the current measuring side or when the meter contains a PT on the voltage measurement side, an error will also be produced due to the frequency characteristics of the CT and PT.

- Converter unit input side
  - As the input side voltage has a sine wave and it is extremely small in distortion, accurate measurement can be made with an ordinary AC meter.

- PT
  - A PT can be used in the input side of the converter unit.

Example of measuring inverter input power

Example of measuring inverter output power

7.2.2 Measurement of voltages and use of PT

- Converter unit input side
  - As the input side voltage has a sine wave and it is extremely small in distortion, accurate measurement can be made with an ordinary AC meter.

- PT
  - A PT can be used in the input side of the converter unit.

Example of measuring inverter input power

Example of measuring inverter output power
7.2.3 Measurement of currents

Use moving-iron type meter on the input side of the converter unit. Since current on the converter unit input side tends to be unbalanced, measurement of three phases is recommended. Correct value cannot be obtained by measuring only one or two phases. When a clamp ammeter is used, always use an effective value detection type. A mean value detection type produces a large error and may indicate an extremely smaller value than the actual value. The value monitored on the operation panel is accurate. It is recommended to monitor values using the operation panel.

Examples of measured value differences produced by different measuring meters are shown below.

[Measurement conditions]

Indicated value of the moving-iron type ammeter is 100%.

Example of measuring converter unit input current

7.2.4 Use of CT and transducer

A CT may be used on the input side of the converter unit. Use the one with the largest possible VA ability. When using a transducer, use the effective value calculation type which is immune to harmonics.

7.2.5 Example of measuring converter unit input power factor

Calculate using effective power and apparent power. A power-factor meter cannot indicate an exact value.

\[
\text{Power factor of the converter unit} = \frac{\text{Effective power}}{\text{Apparent power}}
\]

Three-phase input power found by the 3-wattmeter method

\[
\text{P} = V \times I \cos \phi
\]

7.2.6 Measurement of converter output voltage (across terminals P and N)

The output voltage of the converter is output across terminals P and N and can be measured with a moving-coil type meter (tester). Although the voltage varies according to the power supply voltage, approximately 540 to 600 V is output when no load is connected. The voltage decreases when a load is applied. When energy is regenerated from the motor during deceleration, for example, the converter output voltage rises to nearly 800 to 900 V maximum.
7.2.7 Insulation resistance test using megger

- For the converter unit, conduct the insulation resistance test on the main circuit only as shown below and do not perform the test on the control circuit. (Use a 500 VDC megger.)

**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 (high resistance range) and do not use the megger or buzzer.

7.2.8 Pressure test

Do not conduct a pressure test. Deterioration may occur.
This chapter explains the "SPECIFICATIONS" of this product.
Always read the instructions before using the equipment.

8.1 Converter unit rating .......................................................... 150
8.2 Common specifications ..................................................... 150
8.3 Outline dimension drawings .............................................. 151
**Converter unit rating**

### 8.1 Converter unit rating

#### Table 8.1: Model PR-CC2-H [P]

<table>
<thead>
<tr>
<th>Feature</th>
<th>Two in parallel</th>
<th>Three in parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated input AC voltage/frequency</td>
<td>Three-phase 380 to 500 V 50/60 Hz</td>
<td>Three-phase 380 to 500 V 50/60 Hz</td>
</tr>
<tr>
<td>Permissible AC voltage fluctuation</td>
<td>Three-phase 323 to 550 V 50/60 Hz</td>
<td>Three-phase 323 to 550 V 50/60 Hz</td>
</tr>
<tr>
<td>Rated input current (A)</td>
<td>1232 1386 1539 1750 1848 2078 2309 2626</td>
<td>1232 1386 1539 1750 1848 2078 2309 2626</td>
</tr>
<tr>
<td>Power supply capacity (kVA)</td>
<td>939 1056 1173 1334 1409 1584 1759 2002</td>
<td>939 1056 1173 1334 1409 1584 1759 2002</td>
</tr>
<tr>
<td>Protective structure (IEC 60529)</td>
<td>Open type (IP00)</td>
<td>Open type (IP00)</td>
</tr>
<tr>
<td>Cooling system</td>
<td>Forced air cooling</td>
<td>Forced air cooling</td>
</tr>
<tr>
<td>DC reactor</td>
<td>Built-in</td>
<td>Built-in</td>
</tr>
<tr>
<td>Approx. mass (kg)</td>
<td>564 570 576 586 846 855 864 879</td>
<td>564 570 576 586 846 855 864 879</td>
</tr>
</tbody>
</table>

- The % value of the overload current rating indicated 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.
- 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 .
- 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) x 100)
- The input current is the total current of the master and slave converter units during the parallel operation.
- The power supply capacity is the value when at the rated output current. It varies by the impedance at the power supply side (including those of the input reactor and cables).
- The mass is the total mass of the master and slave converter units during the parallel operation.
- The input signals (three terminals)
  - External thermal relay input, Converter reset
  - The input signal can be changed using Pr.178, Pr.187, and Pr.189 (Input terminal function selection).
- Operational functions
  - Thermo protection, DC injection brake, automatic restart after instantaneous power failure, RS-485 communication, life diagnosis, maintenance timer, 24V power supply input for control circuit.
- Operational panel
  - Inverter operation enable (positive logic, negative logic), instantaneous power failure/undervoltage, inverter reset, fan fault output, fault
  - The output signal can be changed using Pr.190 to Pr.195 (Output terminal function selection).
- Protective function
  - Overvoltage trip, Converter overload trip (electronic thermal relay function), heatsink overheat, instantaneous power failure, undervoltage, input phase loss, external thermal relay operation, PU disconnection, Parameter storage device fault, CPU fault, 24V power fault, direct current limit circuit fault, communication fault (Inverter), Option fault, Operation panel power supply short circuit, RS-485 communication power supply short circuit, internal circuit fault.
- Warning function
  - Fan alarm, Electronic thermal relay function pre-alarm, Maintenance timer 1 to 3, Operation panel lock, Password locked, Parameter write error, Copy operation error, 24V external power supply operation fault.
- Environment
  - Surrounding air temperature: -10°C to +50°C (non-freezing)
  - Surrounding air humidity: 95% or less (post-condensation)
  - Storage temperature: -40°C to +70°C
  - Storage humidity: 95% or less (post-condensation)
  - Transportation
    - Vibration: 0.3 m/s² or less
    - Shock: 15G or less at 6 directions (P, S, Y axes)

---

**8.2 Common specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Two in parallel</th>
<th>Three in parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>430 to 780 VDC</td>
<td>430 to 780 VDC</td>
</tr>
<tr>
<td>Power supply capacity</td>
<td>939 1056 1173 1334 1409 1584 1759 2002</td>
<td>939 1056 1173 1334 1409 1584 1759 2002</td>
</tr>
</tbody>
</table>

- The inverter capacity indicates 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.
- 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 .
- 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) x 100)
- The input current is the total current of the master and slave converter units during the parallel operation.
- The power supply capacity is the value when at the rated output current. It varies by the impedance at the power supply side (including those of the input reactor and cables).
- The mass is the total mass of the master and slave converter units during the parallel operation.
- The input signals (three terminals)
  - External thermal relay input, Converter reset
  - The input signal can be changed using Pr.178, Pr.187, and Pr.189 (Input terminal function selection).
- Operational functions
  - Thermo protection, DC injection brake, automatic restart after instantaneous power failure, RS-485 communication, life diagnosis, maintenance timer, 24V power supply input for control circuit.
- Operational panel
  - Inverter operation enable (positive logic, negative logic), instantaneous power failure/undervoltage, inverter reset, fan fault output, fault
  - The output signal can be changed using Pr.190 to Pr.195 (Output terminal function selection).
- Protective function
  - Overvoltage trip, Converter overload trip (electronic thermal relay function), heatsink overheat, instantaneous power failure, undervoltage, input phase loss, external thermal relay operation, PU disconnection, Parameter storage device fault, CPU fault, 24V power fault, direct current limit circuit fault, communication fault (Inverter), Option fault, Operation panel power supply short circuit, RS-485 communication power supply short circuit, internal circuit fault.
- Warning function
  - Fan alarm, Electronic thermal relay function pre-alarm, Maintenance timer 1 to 3, Operation panel lock, Password locked, Parameter write error, Copy operation error, 24V external power supply operation fault.
- Environment
  - Surrounding air temperature: -10°C to +50°C (non-freezing)
  - Surrounding air humidity: 95% or less (post-condensation)
  - Storage temperature: -40°C to +70°C
  - Storage humidity: 95% or less (post-condensation)
  - Transportation
    - Vibration: 0.3 m/s² or less
    - Shock: 15G or less at 6 directions (P, S, Y axes)
8.3 Outline dimension drawings

8.3.1 Converter unit outline dimension drawings

FR-CC2-H400K, H450K, H500K, H560K-P

*1 Do not remove the cover on the side of the converter unit.
MEMO
APPENDIX provides the reference information for use of this product. Refer to APPENDIX as required.

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Appendix 3  Instructions for UL and cUL .................................159
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Appendix 5  Restricted Use of Hazardous Substances in
Electronic and Electrical Products.............................162
# Appendix 1  Instruction code list

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Instruction code</th>
<th>Copy</th>
<th>Read</th>
<th>All Clear</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Maintenance timer 1</td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Input phase loss</td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>117</td>
<td>Communication parameters that are not cleared by parameter clear (all clear) via the RS-485 communication. (For the RS-485 communication, refer to page 105.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>PU communication stop</td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256</td>
<td>Restart selection</td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>296</td>
<td>Energization time</td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>334</td>
<td>Parameter for manufacturer setting. Do not set.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Instruction codes** are used to read and write parameters by using the Mitsubishi Inverter protocol via RS-485 communication. (For the RS-485 communication, refer to page 105.)
- For “parameter copy”, “parameter clear”, and “all parameter clear”, “*” indicates the function is available, and “=” indicates the function is not available.
- Communication parameters that are not cleared by parameter clear (all clear) via the RS-485 communication. (For the RS-485 communication, refer to page 105.)
<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Instruction codes</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>501</td>
<td>Cumulative power monitor digit shifted times</td>
<td>94 95 96</td>
<td>97</td>
</tr>
<tr>
<td>502</td>
<td>PU buzzer control</td>
<td>5A 6A</td>
<td>7A</td>
</tr>
<tr>
<td>502</td>
<td>Operation panel setting dial push monitor selection</td>
<td>5B 5C</td>
<td>5D</td>
</tr>
<tr>
<td>507</td>
<td>Fault initiation</td>
<td>61 62 63</td>
<td>64</td>
</tr>
<tr>
<td>1001</td>
<td>Parallel operation selection</td>
<td>01 81 A</td>
<td>82 83</td>
</tr>
<tr>
<td>1007</td>
<td>Clock (year)</td>
<td>06 07</td>
<td>86 A</td>
</tr>
<tr>
<td>1008</td>
<td>Clock (month, day)</td>
<td>07 87 A</td>
<td>08 88 A</td>
</tr>
<tr>
<td>1048</td>
<td>Display-off waiting time</td>
<td>30 B</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

### APPENDIX

<table>
<thead>
<tr>
<th>Pr.</th>
<th>Name</th>
<th>Instruction codes</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td></td>
<td></td>
<td>94 95 96</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5A 6A</td>
<td>7A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5B 5C</td>
<td>5D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>61 62 63</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>01 81 A</td>
<td>82 83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>07 87 A</td>
<td>08 88 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 B</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>
Appendix 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.

Company 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: 2004/108/EC
• Standard(s): EN61800-3: 2004 (Second environment / PDS Category “C3”)
• Please ensure you choose the right converter unit for the intended environment.
• 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.

• Note

Set the EMC filter valid and install the converter unit and perform wiring according to the following instructions.

• The converter unit is equipped with an EMC filter. Enable the EMC filter. (For details, refer to page 57.)
• Connect the inverter and the converter unit to an earthed power supply.
• Install a motor and a control cable written in the EMC Installation Manual (BCN-A21041-204) and Technical News (MF-S-138) according to the instruction.
• Confirm that the final integrated system with the inverter and the converter unit conforms with the EMC Directive.
Low Voltage Directive

We have self-confirmed our converter units as products compliant to the Low Voltage Directive (Conforming standard EN 61800-5-1) and affix the CE marking on the converter units.

Outline of instructions

- Do not use an earth leakage current breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth (ground) securely.
- Wire the earth (ground) terminal independently. (Do not connect two or more cables to one terminal.)
- Use the earth (ground) cable and the cable sizes on page 33 under the following conditions.
  - Surrounding air temperature: 40°C maximum
  - Operation condition: Pollution degree 2 or less specified in IEC60664
- Use a tinned (plating should not include zinc) crimping terminal to connect the earth (ground) cable. When tightening the screws, be careful not to damage the threads.
- For use as a product compliant with the Low Voltage Directive, use a PVC cable whose size is indicated on page 33.
- Use the molded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
- DC current may flow from the converter unit 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.
- To use the converter unit under the conditions of pollution degree 2, install it in the enclosure of IP2X or higher.
- To use the converter unit under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.
- Control circuit terminals on page 24 are safely isolated from the main circuit.
- Environment (For the detail, refer to page 17.)

Wiring protection

Class T, Class J, Class CC, or Class L fuse must be provided.

Short circuit ratings

Suitable For Use In A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 V Maximum.
The following table shows the rated specifications per converter unit. (For the rated specifications for operating two or three units in parallel, refer to page 150.)

<table>
<thead>
<tr>
<th>Unit</th>
<th>400K</th>
<th>450K</th>
<th>500K</th>
<th>660K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable motor capacity (kW)</td>
<td>320</td>
<td>360</td>
<td>400</td>
<td>450</td>
</tr>
<tr>
<td>Overload current rating</td>
<td>150% 60 s, 200% 3 s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated voltage</td>
<td>430 to 780 VDC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated output current (A)</td>
<td>616</td>
<td>692.8</td>
<td>769.6</td>
<td>875.2</td>
</tr>
<tr>
<td>Rated input current (A)</td>
<td>381.6</td>
<td>518.3</td>
<td>645.0</td>
<td></td>
</tr>
<tr>
<td>Rated input AC voltage/frequency</td>
<td>Three-phase 380 to 500 V, 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permissible AC voltage fluctuation</td>
<td>Three-phase 323 to 550 V, 50/60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply capacity (kVA)</td>
<td>470</td>
<td>528</td>
<td>586</td>
<td>667</td>
</tr>
<tr>
<td>Protective structure (IEC 60529)</td>
<td>Open type (IP00)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx. mass (kg)</td>
<td>282</td>
<td>285</td>
<td>288</td>
<td>293</td>
</tr>
</tbody>
</table>

- The % value of the overload current rating indicates the ratio of the overload current to the inverter’s rated output current. If repeated duty allows then for the converter unit and the inverter to return to or below the temperatures under 100% load.
- The converter’s 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 2.
- 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.)
- The power supply capacity is the value when at the rated output current. It varies by the impedance at the power supply side (including those of the input reactor and cables).
Appendix 3  Instructions for UL and cUL

(Standard to comply with UL 5190, CSA C22.2 No.14)

◆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.
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.

◆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 17.)

◆Wiring protection
For installation in the United States, Class T, Class J, Class CC, or Class L fuse 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 fuse must be provided, in accordance with the Canadian Electrical Code and any applicable local codes.

◆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 crimping terminals. Crimp the crimping 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.
The following table shows the rated specifications per converter unit. (For the rated specifications for operating two or three units in parallel, refer to page 150.)

<table>
<thead>
<tr>
<th>Model</th>
<th>FR-CC2-H2P</th>
<th>400K</th>
<th>500K</th>
<th>550K</th>
<th>560K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable motor capacity (kW)</td>
<td>320</td>
<td>360</td>
<td>400</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>Overload current rating</td>
<td>150% 60 s, 200% 3 s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated voltage</td>
<td>430 to 780 VDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum frequency fluctuation</td>
<td>±5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum frequency fluctuation</td>
<td>±5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply capacity (kVA)</td>
<td>470</td>
<td>528</td>
<td>586</td>
<td>667</td>
<td></td>
</tr>
<tr>
<td>Protective structure (IEC 60529)</td>
<td>Open type (IP00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx. mass (kg)</td>
<td>282</td>
<td>285</td>
<td>288</td>
<td>293</td>
<td></td>
</tr>
</tbody>
</table>

- **1**  The % value of the overload current rating indicates 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 1.2.
- **3**  The power supply capacity is the value when at the rated output current. It varies by the impedance at the power supply side (including those of the input reactor and cables).
- **4**  The permissible voltage imbalance ratio is 3% or less.

\[
\text{Imbalance ratio} = \left( \frac{\text{highest voltage between lines} - \text{average voltage between three lines}}{\text{average voltage between three lines}} \right) \times 100
\]
Appendix 4 Instructions for EAC

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 8.)
  Example: MADE IN JAPAN

- **Manufactured year and month**
  Check the SERIAL number indicated on the rating plate of the product. (Refer to page 8.)

- **Authorized sales representative (importer) in the CU area**
  The authorized sales representative (importer) in the CU area is shown below.

  **Name:** Mitsubishi Electric (Russia) LLC
  **Address:** 52, bld 1 Kosmodamianskaya Nab 115054, Moscow, Russia
  **Phone:** +7 (495) 721-2070
  **Fax:** +7 (495) 721-2071
Appendix 5 Restricted Use of Hazardous Substances in Electronic and Electrical Products

The mark of restricted use of hazardous substances in electronic and electrical products is applied to the product 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及含量

<table>
<thead>
<tr>
<th>部件名称</th>
<th>铅</th>
<th>汞</th>
<th>镉</th>
<th>六价铬</th>
<th>多溴联苯</th>
<th>多溴二苯醚</th>
</tr>
</thead>
<tbody>
<tr>
<td>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）</td>
<td>×</td>
<td>○</td>
<td>×</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>金属壳体、金属部件</td>
<td>×</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>树脂壳体、树脂部件</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>螺丝、电线</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

• 说明

1. 表格最后一个×表示所有部件。
2. 表格中○表示该有害物质在该部件所有均质材料中的含量≤GB/T26572规定的要求限值。
3. 表格中×表示该有害物质在该部件所有的均质材料中任意一个均质材料中的含量≥GB/T26572规定的要求限值。
4. 部件名称中□表示含有该有害物质，□表示不含该有害物质。
WARRANTY

When using this product, make sure to understand the warranty described below.

1. Warranty period and coverage

The warranty period for this Product is twelve months after your purchase or delivery of the Product is a place designated by you as eighteen months from the date of manufacture of this Product (hereinafter "Warranty Period"). Warranty period for repaired Product cannot exceed beyond the original warranty period but may exceed

[Limitations]

(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.

(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.

(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.

(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

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) Our product is designed and manufactured as a general purpose product for use in 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 shall not be accepted.

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

Regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by the user.

5. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

[Text]

The text on Product in the event that your purchase or delivery of the Product is a place designated by you at eighteen months from the date of manufacture of this Product (hereinafter "Warranty Period"), Warranty period for repaired Product cannot exceed beyond the original warranty period but may exceed.
**REVISIONS**

*The manual number is given on the bottom left of the back cover.*

<table>
<thead>
<tr>
<th>Print date</th>
<th>Manual number</th>
<th>Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 2016</td>
<td>IB(NA)-0600657ENG-A</td>
<td>First edition</td>
</tr>
</tbody>
</table>

164  IB(NA)-0600657ENG-A
FR-CC2-P Series
Instruction Manual Supplement

1 Supporting 12-phase rectifier power supply

- The FR-CC2-P converter unit can be run with 12-phase rectifier power supply.

**Connection diagram for 12-phase rectifier power transformer and one converter unit**

![Connection diagram](image)

- When using separate power supply for the control circuit, remove the jumpers connected to terminals R1/L11 and S1/L21.

**NOTE**
- The 12-phase rectification specification is not certified as compliant with the Radio Waves Act (South Korea).
- The 12-phase rectification specification is not certified by UL and cUL.

**12-phase rectifier power transformer**

For 12-phase rectification, a 12-phase rectifier power transformer (3-winding transformer) is required (customer's purchase).

To prevent imbalances in output current from the power transformers, adjust the current as follows.
- Control imbalances in output voltage from the power transformers to within the range of ±0.5%.
- Control an imbalance in power impedance (%Z) to within the range of ±10%.
◆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 star connection of the 12-phase rectifier power 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.)
Recommended cables

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

The following table shows the recommended cable size for cables that are 20 m in length (440 V input power supply, 150% overload current rating for 1 minute).

<table>
<thead>
<tr>
<th>Converter model</th>
<th>Terminal screw size</th>
<th>Tightening torque N·m</th>
<th>Crimping terminal</th>
<th>Cable gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-CC2-[I]-P</td>
<td></td>
<td></td>
<td>R/L1, S/L2, T/L3 (per circuit)</td>
<td>HV cables, etc. (mm²)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R/L1, S/L2, T/L3 (per circuit)</td>
<td>P/+, N/-</td>
</tr>
<tr>
<td>H400K</td>
<td>M12 (M10)</td>
<td>46</td>
<td>150-12</td>
<td>2 × 150</td>
</tr>
<tr>
<td>H450K</td>
<td>M12 (M10)</td>
<td>46</td>
<td>150-12</td>
<td>2 × 150</td>
</tr>
<tr>
<td>H500K</td>
<td>M12 (M10)</td>
<td>46</td>
<td>150-12</td>
<td>3 × 150</td>
</tr>
<tr>
<td>H560K</td>
<td>M12 (M10)</td>
<td>46</td>
<td>C2-200</td>
<td>2 × 200</td>
</tr>
</tbody>
</table>

- 1 It is the gauge of the cable with the continuous maximum permissible temperature of 90°C or higher (LMFC (heat resistant flexible cross-linked polyethylene insulated cable), etc.). It assumes a surrounding air temperature of 50°C or lower and in-enclosure wiring.
- 2 It is the gauge of the cable with continuous maximum permissible temperature of 90°C (THHN cable). It assumes a surrounding air temperature of 40°C or lower and in-enclosure wiring. (Selection example mainly for use in the United States.)
- 3 It is the gauge of the cable with continuous maximum permissible temperature of 90°C (XLPE cable). It assumes a surrounding air temperature of 40°C or lower and in-enclosure wiring. (Selection example mainly for use in Europe.)
- 4 It is applied to the screws for terminals R/L1, S/L2, T/L3, P/+, and N/-, and a screw for earthing (grounding).

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

Line voltage drop [V] = \( \sqrt{3} \times \text{wire resistance [mΩ/m]} \times \text{wiring distance [m]} \times \text{current [A]} / 1000 \)

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

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 star/delta connection of the power transformer and the terminals of the converter unit. Otherwise a burst, damage, etc. may occur in the converter unit or the power transformer.

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 drawing on the right.)

- 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 crimping terminals with insulation sleeves to wire the power supply and motor.

- 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 drawing on the right.)

- 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 crimping terminals with insulation sleeves to wire the power supply and motor.
Selecting the breaker / magnetic contactor

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

Choose one of the options shown above or combine them to connect the power distribution control equipment. To turn ON/OFF the power supply, option 1 is recommended.

**CAUTION**

When the power supply capacity of 12-phase rectifier power transformer (3-winding transformer) exceeds 3000 kVA in total (1500 kVA for delta connection and 1500 kVA for wye connection), an excessive peak current may flow in the power input circuit, damaging the converter circuit. Observe the following precautions:

- Do not perform the power reset on the output side of the transformer.
  - If it is inevitable to do so, turn ON the power again after 1 second when the power failure stop function is disabled (Pr.261 Power failure stop selection = "0"), or after 10 minutes when the power failure stop function is enabled (Pr.261 = "1, 2, 21, or 22").
- Avoid wiring that allows charging to the main circuit capacitor of only one converter unit when power is shut off or supplied at different timings to each converter unit at the time of instantaneous power failure, repowering, or other incident.

Refer to the following to prepare appropriate equipment.

- **Option 1**
  - To connect the equipment to the input side of the 12-phase rectifier transformer before branching, prepare the same equipment as for the 6-phase rectifier transformer (refer to the FR-CC2-P Instruction Manual).

- **Option 2**
  - To connect the equipment to the output side of the 12-phase rectifier transformer before branching, refer to the following table and prepare appropriate equipment.

<table>
<thead>
<tr>
<th>Motor output (kW)</th>
<th>Number of converter units</th>
<th>Applicable converter unit FR-CC2-[P]</th>
<th>Rated input current for one circuit (A)</th>
<th>Molded case circuit breaker (MCCB) / Magnetic contactor (MC) on converter unit's input side</th>
</tr>
</thead>
<tbody>
<tr>
<td>630</td>
<td>2</td>
<td>H400K</td>
<td>650</td>
<td>S-N600</td>
</tr>
<tr>
<td>710</td>
<td>2</td>
<td>H450K</td>
<td>726</td>
<td>S-N800</td>
</tr>
<tr>
<td>800</td>
<td>2</td>
<td>H500K</td>
<td>819</td>
<td>1000 A rated product</td>
</tr>
<tr>
<td>900</td>
<td>2</td>
<td>H560K</td>
<td>922</td>
<td>1000 A rated product</td>
</tr>
<tr>
<td>945</td>
<td>3</td>
<td>H400K</td>
<td>974</td>
<td>1200 A rated product</td>
</tr>
<tr>
<td>1065</td>
<td>3</td>
<td>H450K</td>
<td>1090</td>
<td>1200A rated product</td>
</tr>
<tr>
<td>1200</td>
<td>3</td>
<td>H500K</td>
<td>1229</td>
<td>1300A rated product</td>
</tr>
<tr>
<td>1350</td>
<td>3</td>
<td>H560K</td>
<td>1382</td>
<td>1400A rated product</td>
</tr>
</tbody>
</table>
• Option 3
To connect the equipment to the output side of the 12-phase rectifier transformer after branching, refer to the following table and prepare appropriate equipment.

<table>
<thead>
<tr>
<th>Motor output (kW)</th>
<th>Applicable converter unit FR-CC2 (P)</th>
<th>Rated input current for one circuit (A)</th>
<th>Molded case circuit breaker (MCCB) - NF type (A)</th>
<th>Magnetic contactor (MC) on converter unit's input side</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>H400K</td>
<td>512</td>
<td>600</td>
<td>S-N600</td>
</tr>
<tr>
<td>450</td>
<td>H450K</td>
<td>576</td>
<td>700</td>
<td>S-N600</td>
</tr>
<tr>
<td>500</td>
<td>H500K</td>
<td>640</td>
<td>800</td>
<td>S-N600</td>
</tr>
<tr>
<td>560</td>
<td>H560K</td>
<td>728</td>
<td>900</td>
<td>S-N800</td>
</tr>
</tbody>
</table>

*1 Assumes the use of a Mitsubishi 4-pole standard motor with the power supply of 400 VAC 50 Hz.
*2 Select an MCCB according to the power supply capacity. Install one MCCB per converter circuit in the converter unit. For the use in the United States or Canada, provide appropriate fuses in accordance with any applicable local codes.
*3 The magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stops during motor driving, the electrical durability is 25 times. When using an MC for emergency stop during driving the motor, select the MC with JEM 1038-AC-3 class rated current for the converter unit input current. When providing an MC on the inverter output side for switching to commercial power supply during general-purpose motor operation, select the MC with JEM 1038-AC-3 class rated current for the rated motor current.

NOTE
• When the converter unit capacity is larger than the motor capacity, select an MCCB and an MC (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. The cause of the trip must be identified and removed before turning ON the power of the breaker.
• When the inverter is operated while the power distribution control equipment connected between the delta wiring of the transformer and terminals R2/L12, S2/L22, and T2/L32 is OFF, the converter unit may be damaged.
2 Input current monitor

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

3 Instantaneous power failure (E.IPF), input phase loss (E.ILF)

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 for 12-phase rectification. Also, E.ILF is not activated even if input is lost for one of the three phases (terminals R2/L12, S2/L22, and T2/L32).

When the inverter is operated while a power failure or signal loss occurs between the delta wiring of the transformer and terminals R2/L12, S2/L22, and T2/L32, the converter unit may be damaged.

4 Leakage currents for 12-phase rectification

- Refer to the following table for leakage currents when a 12-pulse rectifier is used.
- Leakage currents of the converter unit for 12-phase rectification

<table>
<thead>
<tr>
<th>EMC filter</th>
<th>Star/delta connection</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>37</td>
<td>3</td>
</tr>
</tbody>
</table>

(mA)

5 Harmonic suppression guidelines

- Refer to the following tables for the conversion coefficient and harmonics contents for 12-phase rectification.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Circuit type</th>
<th>Conversion coefficient Ki</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Three-phase bridge (Capacitor smoothing)</td>
<td>For 12-pulse transducer, With reactor (on DC side)</td>
</tr>
</tbody>
</table>

- Harmonics contents (values that the fundamental wave current is 100% for 12-phase rectification)

<table>
<thead>
<tr>
<th>Reactor</th>
<th>5th</th>
<th>7th</th>
<th>11th</th>
<th>13th</th>
<th>17th</th>
<th>19th</th>
<th>23rd</th>
<th>25th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used (on DC side)</td>
<td>1.4</td>
<td>1.5</td>
<td>7.2</td>
<td>4.1</td>
<td>0.8</td>
<td>0.7</td>
<td>1.6</td>
<td>1.4</td>
</tr>
</tbody>
</table>
6 Instructions for compliance with the EU Directives

◆ Low Voltage Directive

We have self-confirmed our converter units as products compliant to the Low Voltage Directive (Conforming standard EN 61800-5-1) and affix the CE marking on the converter units.

- Outline of instructions
  • Do not use an earth leakage current breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth (ground) securely.
  • Wire the earth (ground) terminal independently. (Do not connect two or more cables to one terminal.)
  • Use the earth (ground) cable and the cable sizes on page 3 under the following conditions.
    Surrounding air temperature: 40°C (104°F) 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.
  • Use the molded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
  • DC current may flow from the converter unit to a protective earth (ground) conductor. When using a residual current device (RDC) or residual current monitor (RDM), connect a type B RCD or RCM to the power supply side.
  • Use the converter unit under the conditions of overvoltage category II (usable regardless of the earth (ground) condition of the power supply), overvoltage category III (usable with the earth-neutral system power supply, 400 V class only) 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 the enclosure of IP2X or higher.
    - To use the converter unit under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.
  • On the input and output of the inverter and the converter unit, use cables of the type and size 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 25 of the Instruction Manual of the FR-CC2-P are safely isolated from the main circuit.
  • Environment (For the detail, refer to page 17 of the Instruction Manual of the FR-CC2-P.)

<table>
<thead>
<tr>
<th></th>
<th>During Operation</th>
<th>In Storage</th>
<th>During Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surrounding air temp.</td>
<td>-10 to +50°C</td>
<td>-20 to +65°C</td>
<td>-20 to +65°C</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>95% RH or less</td>
<td>95% RH or less</td>
<td>95% RH or less</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>2500 m</td>
<td>2500 m</td>
<td>10000 m</td>
</tr>
</tbody>
</table>

*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 of the output side of the transformer (wye connection) and connect all devices to the protective conductor (PEN).

**Wiring protection**

• For 12-phase rectification

**Connection diagram**

<table>
<thead>
<tr>
<th>Converter model</th>
<th>Fuse type</th>
<th>Model</th>
<th>Manufacturer</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-CC2-H400K-P</td>
<td>UL Recognized High Speed</td>
<td>170M6013, 170M6113</td>
<td>Bussmann</td>
<td>900 A, 700 VAC</td>
</tr>
<tr>
<td>FR-CC2-H450K-P</td>
<td></td>
<td>170M6014, 170M6114</td>
<td></td>
<td>1000 A, 700 VAC</td>
</tr>
<tr>
<td>FR-CC2-H500K-P</td>
<td></td>
<td>170M6015, 170M6115</td>
<td></td>
<td>1100 A, 700 VAC</td>
</tr>
<tr>
<td>FR-CC2-H560K-P</td>
<td></td>
<td>170M6016, 170M6116</td>
<td></td>
<td>1250 A, 700 VAC</td>
</tr>
</tbody>
</table>

**Short circuit ratings**

Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 500 V maximum.