Thank you for choosing this Mitsubishi Electric inverter.

This Instruction Manual describes handling and cautions about the hardware, such as installation and wiring, for the FR-A802

In addition to this manual, please read the manuals on the enclosed CD-ROM carefully. Do not use this product until you have full knowledge of the equipment, safety information and instructions. Please forward this Instruction Manual to the end user.

**Fire prevention**

Do not attempt to install, operate, examine or inspect the product unless you have read this instruction manual and performed the installation, operation, maintenance and inspection carefully. Do not use this product if you do not understand the contents of this instruction manual and the manuals enclosed with the product.

Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, we designate a person who has read and familiarized him/herself with the manuals.

A person who has not read the instruction manuals is not qualified to perform installation, operation, maintenance and inspection of this product.

- A person who can access operating manuals for the control system. A person who has read and familiarized him/herself with the manuals.
- A person who can access operating manuals for the control system. A person who has read and familiarized him/herself with the manuals.
- A person who can access operating manuals for the control system. A person who has read and familiarized him/herself with the manuals.

**WARNING**

- The power of the inverter is OFF. Any person who is involved in wiring or inspection must be instructed to perform the following work:
  - Before wiring or inspection, check that the display of the inverter is OFF. Any person who is involved in wiring or inspection must be instructed to perform the following work:
  - Before wiring or inspection, check that the display of the inverter is OFF. Any person who is involved in wiring or inspection must be instructed to perform the following work:
  - Before wiring or inspection, check that the display of the inverter is OFF. Any person who is involved in wiring or inspection must be instructed to perform the following work:

**CAUTION**

- Setting dial and key operations must be performed with dry hands. Otherwise burst, damage, etc. may occur.
- Setting dial and key operations must be performed with dry hands. Otherwise burst, damage, etc. may occur.
- Setting dial and key operations must be performed with dry hands. Otherwise burst, damage, etc. may occur.
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- Setting dial and key operations must be performed with dry hands. Otherwise burst, damage, etc. may occur.
- Setting dial and key operations must be performed with dry hands. Otherwise burst, damage, etc. may occur.
**Safety instructions**

**Trial run**
- Before starting the test operation, confirm or adjust the parameter settings. Failure to do so may cause some machines to make unexpected motions.
- Perform pre-excitation (LX signal and X13 signal) under the conditions in case of failure of this product or an external device. A safety backup such as an emergency brake must be provided for devices or equipment in a system to prevent hazardous conditions in case of failure of this product or an external device.

**Usage**
- Do not modify this product. This product must be treated as industrial waste.
- The temporary storage temperature (applicable to a short limited time such as a transportation time) must be between -20 and +65°C. Otherwise this product may be damaged.
- The output terminals (terminals U, V, and W) must be connected to a motor correctly. Otherwise the motor will rotate inversely.
- Do not install a power factor correction capacitor, surge absorber, or radio noise filter on the output side of this product. Do not use this product at an altitude above 2500 m. Vibration should not exceed 2.9 m/s² at 10 to 55 Hz in X, Y, and Z directions. Otherwise the product may be damaged.
- Do not install an external thermal relay or a PTC thermistor for overheat protection of the motor from overloading. Additionally, start or stop this product with a magnetic contactor or its inbuilt relay. Doing so may shorten the life of this product.

**Transportation and installation**
- Do not start or stop this product from an altitude above 2000 m. Inclination (vertical) has to be 0 in a car or truck and less than 5° in any other direction. Otherwise the product may be damaged.
- Do not transport this product to be used in an environment (including bores, chlorine, hydrogen, acetylene, etc.) which may cause any safety problems before performing pre-excitation.
- Do not repeatedly start or stop this product with a magnetic contactor or its inbuilt relay. Otherwise this product may be damaged.
- Do not install an external thermal relay or a PTC thermistor for overheat protection of the motor from overloading. Additionally, start or stop this product with a magnetic contactor or its inbuilt relay. Doing so may shorten the life of this product.

**Wiring**
- To avoid damage to this product due to static electricity, static electricity in your body must be discharged before you touch this product. Otherwise, a spark may occur across your body and this may damage the product. Proper protective devices to prevent static electricity such as wrist straps and antistatic Benzene rubber mats are recommended. Otherwise, you may be electrocuted.
- If the breaker installed on the input side of this product trips, this product will be used in and any safety issues related to its use.

**Maintenance, inspection and parts replacement**
- Do not use this product on the system to which an Ethernet network interface is attached. Depending on the Ethernet network environment, this product may be damaged if any certain type of network equipment or operating system is used. Carefully consider what type of environment this product will be used in and any safety issues related to its use.

**Emergency stop**
- If any protective function is activated, take an appropriate measure to prevent hazardous conditions or a fire before resetting the tripped breaker and applying the power to the product again.

**Disposal**
- This product must be treated as industrial waste.
Safety instructions

Application of caution labels

Caution labels are used to ensure safety during use of Mitsubishi Electric inverters.

Apply the following labels to the machine if the “retry function” and/or “automatic restart after instantaneous power failure” have been enabled.

- For the retry function

CAUTION

When the retry function has been selected, the motor and machine will start suddenly after the reset time has elapsed. Ensure the covers and safety guards are properly installed prior to starting operation.

- For automatic restart after instantaneous power failure

CAUTION

When the automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly after instantaneous power failure. Ensure the covers and safety guards are properly installed prior to starting operation.

General instruction

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

Stay away from the motor and machine. They will start suddenly (after the given time has elapsed) when alarm occurs.
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1. **Abbreviations**

- DU: Operation panel (FR-DU08)
- Operation panel: Operation panel and LCD operation panel
- Parameter unit: Parameter unit (FR-PUD7)
- PU: Operation panel and parameter unit
- Inverter: Mitsubishi Electric inverter FR-A800 series (Separated converter type)
- FR-A800-E: Mitsubishi Electric inverter FR-A800 series (Ethernet model)
- Ethernet board: Ethernet communication board (FR-A8ETH)
- Vector control compatible option: FR-A8AP/FR-A8AL/FR-A8APR/FR-A8APS (plug-in option), FR-A8TP (control terminal option)
- Pr: Parameter number (Number assigned to function)
- PU operation: Operation using the PU (operation panel/parameter unit)
- External operation: Operation using the control circuit signals
- Combined operation: Combined operation using the PU (operation panel/parameter unit) and External operation

2. **Trademarks**

- Ethernet is a registered trademark of Fuji Xerox Corporation in Japan.
- Other company and product names herein are the trademarks and registered trademarks of their respective owners.

3. **Notes on descriptions in this Instruction Manual**

The 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 46.)

4. **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 86.
1.1 Product checking and accessories

Unpack the product and check the rating plate and the capacity plate of the inverter to ensure that the model agrees with the order and the product is intact.

Applicable inverter model

- **FR-A842-07700-1**
  - 400 V class
  - Symbol: V
  - Circuit board coating: Without
  - Structure, functionality: Separated converter type
  - Form of communication: RS-485
  - Communication: Ethernet

**NOTE**
- Specification differs by the type as follows.
- Hereinafter, the inverter model name consists of the rated current and the applicable motor capacity.
  - (Example) FR-A842-07700-1

**Rating plate**
- FR - A 842 - 07700 - 1 - R2R
- Monitor output
  - Terminal FM (pulse train output)
  - Terminal AM (analog voltage output (0 to ±10 VDC))
- Control logic
  - OFF Sink logic 60 Hz 9999 (same as the power supply voltage)
- CA
  - Terminal CA (analog current output (0 to 20 mA DC))
  - Terminal AM (analog voltage output (0 to ±10 VDC))
- Function
  - Roll to roll dedicated model: R2R

**Initial setting**

<table>
<thead>
<tr>
<th>Type</th>
<th>Monitor output</th>
<th>Built-in EMC filter</th>
<th>Control logic</th>
<th>Rated frequency</th>
<th>Rated voltage range</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td>Terminal FM (auxiliary output)</td>
<td>EMT</td>
<td>Sink logic</td>
<td>60 Hz</td>
<td>100% (same as the power supply voltage)</td>
</tr>
<tr>
<td>CA</td>
<td>Terminal CA (auxiliary output)</td>
<td>EMT</td>
<td>Source logic</td>
<td>50 Hz</td>
<td>8888 (95% of the power supply voltage)</td>
</tr>
</tbody>
</table>

**NOTE**
- Hereinafter, the inverter model name consists of the rated current and the applicable motor capacity.
  - (Example) FR-A842-07700-1

8 INTRODUCTION
Product checking and accessories

◆ How to read the SERIAL number

Rating plate example

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Year</th>
<th>Month</th>
<th>Control number</th>
</tr>
</thead>
<tbody>
<tr>
<td>㈱</td>
<td>2023-09-12</td>
<td>106466</td>
<td></td>
</tr>
</tbody>
</table>

The SERIAL consists of nine symbols, two characters indicating the production year and month, and six characters indicating the control number. The last digit of the production year is indicated as the year, and the month is indicated by 1 to 9 (January), V (May), and Z (December).

◆ Accessory

- Earthing (grounding) cable (1): For connection with a communication option (Ethernet model) (Refer to page 68.)
- CD-ROM (1): Including the Instruction Manual (Detailed) and other documents.
1.2 Inverter component names

Component names are shown below.

RS-485 model

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Description</th>
<th>Refer to pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>RS-485 terminals</td>
<td>Enables RS-485 and MODBUS RTU communication.</td>
<td>58</td>
</tr>
<tr>
<td>(b)</td>
<td>Plug-in option connector 1</td>
<td>Connects a plug-in option or a communication option.</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>Plug-in option connector 2</td>
<td>Connects a plug-in option or a communication option.</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>Plug-in option connector 3</td>
<td>Connects a plug-in option or a communication option.</td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td>Voltage/current input switch</td>
<td>Selects between voltage and current for the terminal 2 and 4 inputs.</td>
<td></td>
</tr>
<tr>
<td>(f)</td>
<td>Control circuit terminal block</td>
<td>Connects cables for the control circuit.</td>
<td></td>
</tr>
<tr>
<td>(g)</td>
<td>PU connector</td>
<td>Connects the operation panel (FR-DU08) or the parameter unit (FR-PU07).</td>
<td>56</td>
</tr>
<tr>
<td>(h)</td>
<td>USB A connector</td>
<td>Connects a USB memory device.</td>
<td>57</td>
</tr>
<tr>
<td>(i)</td>
<td>USB mini B connector</td>
<td>Connects a personal computer and enables communication with FR Configurator 2.</td>
<td>57</td>
</tr>
<tr>
<td>(j)</td>
<td>Front cover</td>
<td>Remove this cover for the installation of the product, installation of a plug-in communication option, RS-485 terminal wiring, switching of the voltage/current input switch, etc.</td>
<td>18</td>
</tr>
<tr>
<td>(k)</td>
<td>Power lamp</td>
<td>Stays ON while the power is supplied to the control circuit (R1/L11, S1/L21).</td>
<td>37</td>
</tr>
<tr>
<td>(l)</td>
<td>Alarm lamp</td>
<td>Turns ON when the protective function of the inverter is activated.</td>
<td>91</td>
</tr>
<tr>
<td>(m)</td>
<td>Charge lamp</td>
<td>Stays ON while the power is supplied to the main circuit.</td>
<td>37</td>
</tr>
<tr>
<td>(n)</td>
<td>Operation panel (FR-DU08)</td>
<td>Operates and monitors the inverter.</td>
<td></td>
</tr>
<tr>
<td>(o)</td>
<td>Terminal block cover</td>
<td>Remove this cover for wiring.</td>
<td>18</td>
</tr>
<tr>
<td>(p)</td>
<td>Main circuit terminal block</td>
<td>Connects cables for the main circuit.</td>
<td>36</td>
</tr>
<tr>
<td>(q)</td>
<td>Switching for manufacturer setting (SW3 and SW4)</td>
<td>Do not change the initial settings (OFF).</td>
<td></td>
</tr>
</tbody>
</table>

Refer to the FR-A800 instruction manual (Detailed).
## Inverter component names

### Ethernet model

<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>Plug-in option connector 1</td>
<td>Connects a plug-in option or a communication option.</td>
<td>Instruction Manual of the option</td>
</tr>
<tr>
<td>(b)</td>
<td>Plug-in option connector 2</td>
<td>The connector is not used because the Ethernet board is installed in the initial status. The Ethernet board must be removed to install a plug-in option to the connector 2. (However, Ethernet communication is disabled in that case.)</td>
<td>58</td>
</tr>
<tr>
<td>(c)</td>
<td>Plug-in option connector 3</td>
<td>Selects between voltage and current for the terminal 2 and 4 inputs.</td>
<td>59</td>
</tr>
<tr>
<td>(d)</td>
<td>Voltage/current input switch</td>
<td>Selects between voltage and current for the terminal 2 and 4 inputs.</td>
<td>59</td>
</tr>
<tr>
<td>(e)</td>
<td>Ethernet communication connector</td>
<td>Connect the Ethernet dedicated cable for connection to the network.</td>
<td>59</td>
</tr>
<tr>
<td>(f)</td>
<td>Control circuit terminal block</td>
<td>Connects cables for the control circuit.</td>
<td>41</td>
</tr>
<tr>
<td>(g)</td>
<td>PU connector</td>
<td>Connects the operation panel or the parameter unit. This connector also enables the RS-485 communication.</td>
<td>56</td>
</tr>
<tr>
<td>(h)</td>
<td>USB A connector</td>
<td>Connects a USB memory device.</td>
<td>57</td>
</tr>
<tr>
<td>(i)</td>
<td>USB mini B connector</td>
<td>Connects a personal computer and enables communication with FR Configurator2.</td>
<td>57</td>
</tr>
<tr>
<td>(j)</td>
<td>Upper front cover</td>
<td>Remove this cover for the installation of the product, installation of a plug-in (communication) option, RS-485 terminal wiring, switching of the voltage/current input switch, etc.</td>
<td>18</td>
</tr>
<tr>
<td>(k)</td>
<td>Power lamp</td>
<td>Stays ON while the power is supplied to the control circuit (R1/L11, S1/L21).</td>
<td>37</td>
</tr>
<tr>
<td>(l)</td>
<td>Alarm lamp</td>
<td>Turns ON when the protective function of the inverter is activated.</td>
<td>37</td>
</tr>
<tr>
<td>(m)</td>
<td>Charge lamp</td>
<td>Stays ON while the power is supplied to the main circuit.</td>
<td>37</td>
</tr>
<tr>
<td>(n)</td>
<td>Operation panel (FR-DU08)</td>
<td>Operates and monitors the inverter.</td>
<td>56</td>
</tr>
<tr>
<td>(o)</td>
<td>Lower front cover</td>
<td>Remove this cover for wiring.</td>
<td>18</td>
</tr>
<tr>
<td>(p)</td>
<td>Main circuit terminal block</td>
<td>Connects cables for the main circuit.</td>
<td>36</td>
</tr>
<tr>
<td>(q)</td>
<td>Cooling fan</td>
<td>Cools the inverter.</td>
<td>102</td>
</tr>
<tr>
<td>(r)</td>
<td>Switches for manufacturer setting (SW3 and SW4)</td>
<td>Do not change the initial setting.</td>
<td>3</td>
</tr>
</tbody>
</table>

*1 Refer to the FR-A800 Instruction Manual (Detailed).
1.3 About the related manuals

The manuals related to FR-A800 are shown below.

<table>
<thead>
<tr>
<th>Manual name</th>
<th>Manual number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-A800 Instruction Manual (Detailed)</td>
<td>IB-0600503EN</td>
</tr>
<tr>
<td>Roll to Roll Function Manual</td>
<td>IB-0600622EN</td>
</tr>
<tr>
<td>FR-A800-E-R2R Ethernet Function Manual</td>
<td>IB-0600813EN</td>
</tr>
<tr>
<td>FR Configurator2 Instruction Manual</td>
<td>IB-0600516EN</td>
</tr>
<tr>
<td>FR-A800 PLC Function Programming Manual</td>
<td>IB-0600492EN</td>
</tr>
<tr>
<td>Safety Stop function instruction manual</td>
<td>BCN-A23228-001</td>
</tr>
</tbody>
</table>
This chapter explains the "installation" and the "wiring" of this product.
Always read the instructions before using the equipment.

<table>
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<th>Section</th>
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</table>
Peripheral devices

2.1 Peripheral devices

2.1.1 Inverter and peripheral devices

NOTE
• To prevent an electric shock, always earth (ground) the motor, the inverter, and the converter unit.
• 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 to trip 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 wave interference
The input/output (main circuit) of the inverter or the converter unit includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter or the converter unit. In this case, activating the EMC filter of the converter unit may minimize interference. (Refer to page 78.)
• For details of options and peripheral devices, refer to the respective Instruction Manual.

14 INSTALLATION AND WIRING
Inverter (FR-A802)
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.

Converter unit (FR-CC2)
Incorrect wiring may result in 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.

Three-phase AC power supply
Must be within the permissible power supply specifications of the converter unit.

Molded case circuit breaker (MCCB), earth leakage circuit breaker (ELB), or fuse
Must be selected carefully since an inrush current flows in the converter unit at power ON.

Magnetic contactor (MC)
Install this to ensure safety. Do not use this to start and stop the inverter. Doing so will shorten the life of the inverter and the converter unit.

AC reactor (FR-HAL)
Install this to suppress harmonics and to improve the power factor. It is required when installing the inverter near a large power supply system (1000 kVA or more). Under such conditions, the inverter and the converter unit may be damaged if you do not use it. Select the reactor according to the applied motor capacity.

Noise filter
Install this to reduce the electromagnetic noise generated from the inverter and the converter unit. The noise filter is effective in the range from about 0.5 MHz to 5 MHz.

Induction motor
Connect a squirrel-cage induction motor.
Peripheral devices

2.1.2 Peripheral devices

Select the capacity of the FR-CC2 converter unit according to the connected motor capacity.

<table>
<thead>
<tr>
<th>Motor capacity (kW)</th>
<th>Converter unit FR-CC2</th>
<th>NDL (normal duty)</th>
<th>NLD (light duty)</th>
<th>NDN (normal normal duty)</th>
<th>Rated current (A)</th>
<th>Rated current (A)</th>
<th>Rated current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>280</td>
<td>115</td>
<td>115</td>
<td>115</td>
<td></td>
<td>315</td>
<td>315</td>
<td>315</td>
</tr>
<tr>
<td>315</td>
<td>115</td>
<td>115</td>
<td>115</td>
<td></td>
<td>315</td>
<td>315</td>
<td>315</td>
</tr>
<tr>
<td>355</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td></td>
<td>355</td>
<td>355</td>
<td>355</td>
</tr>
<tr>
<td>400</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td></td>
<td>355</td>
<td>355</td>
<td>355</td>
</tr>
<tr>
<td>450</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td></td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>500</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td></td>
<td>450</td>
<td>450</td>
<td>450</td>
</tr>
<tr>
<td>560</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td></td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>630</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td></td>
<td>560</td>
<td>560</td>
<td>560</td>
</tr>
</tbody>
</table>

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

◆ Selecting the breaker/magnetic contactor

Check the model of the inverter and the converter until you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the table below to prepare appropriate peripheral devices.

- 400 V class

<table>
<thead>
<tr>
<th>Motor output (kW)</th>
<th>Applicable converter model</th>
<th>Molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB) (NF, NV type)</th>
<th>Input-side magnetic contactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>FR-CC2-H400K</td>
<td>320 A S-N600</td>
<td>S-N600</td>
</tr>
<tr>
<td>40</td>
<td>FR-CC2-H400K</td>
<td>320 A S-N600</td>
<td>S-N600</td>
</tr>
<tr>
<td>50</td>
<td>FR-CC2-H500K</td>
<td>420 A S-N600</td>
<td>S-N600</td>
</tr>
<tr>
<td>50</td>
<td>FR-CC2-H500K</td>
<td>420 A S-N600</td>
<td>S-N600</td>
</tr>
<tr>
<td>60</td>
<td>FR-CC2-H500K</td>
<td>510 A S-N600</td>
<td>S-N600</td>
</tr>
<tr>
<td>60</td>
<td>FR-CC2-H500K</td>
<td>510 A S-N600</td>
<td>S-N600</td>
</tr>
<tr>
<td>70</td>
<td>FR-CC2-H630K</td>
<td>640 A S-N600</td>
<td>S-N600</td>
</tr>
<tr>
<td>70</td>
<td>FR-CC2-H630K</td>
<td>640 A S-N600</td>
<td>S-N600</td>
</tr>
</tbody>
</table>

- NOTE

1. If the use of a Mitsubishi Electric 4-pole standard motor with the power supply voltage of 400 VAC 50 Hz.
2. Select an MCCB according to the power supply capacity. Install one MCCB per converter. (For the use in the United States or Canada, refer to page 120 to select an appropriate fuse.)
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 stop during motor driving, the electrical durability is 50 times.
4. When using an MCCB for emergency stop during motor driving, select an MCCB regarding the inverter unit's input side current as JEM T109-A (A) class rated current. When using an MCCB on the inverter output side for commercial power supply operation switching using a general-purpose motor, select an MCCB regarding the rated motor current as JEM T109-A (A) class rated current.

The above shows a selection example for the ND rating. For selecting the SLD rating, LD rating, SND rating, or HD rating, refer to the Technical News (MF-X-130) contained in the enclosed CD-ROM.

- When the converter unit's capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the converter unit model, and select cables and reactions 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 and 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 and reinstallation of the operation panel

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

To reinstall the 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: 0.4 to 0.45 N·m)

◆ Removal of the terminal block cover

(a) Remove the mounting screws to remove the terminal block cover. (The number of the mounting screws differs by the capacity.)
(b) With the terminal block cover removed, the main circuit terminals can be wired.
Removal and reinstallation of the front cover

◆ Removal of the front cover

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

◆ Reinstallation of the front cover and the terminal block cover

(a) Clip on the front cover as illustrated. Check that it is properly secured.
(b) Tighten the screws on the lower part of the front cover.
(c) Attach the terminal block cover using the screws. (The number of screws differs depending on the capacity of the inverter)

**NOTE**
- Fully make sure that the front cover and the terminal block cover are installed securely. Always tighten the mounting screws of the front cover and the terminal block cover.
Installation of the inverter and enclosure design

2.3 Installation of the inverter and enclosure design

When designing or manufacturing an inverter enclosure, 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. An inverter uses many semiconductor devices. To ensure higher reliability and long period of operation, operate the inverter in the ambient environment that completely satisfies the equipment specifications.

2.3.1 Inverter installation environment

The following table lists the standard specifications of the inverter installation environment. Using the inverter 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 inverter

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surrounding air temperature</td>
<td>10 to +50°C (non-freezing)</td>
</tr>
<tr>
<td>SLD, SND, ND (initial setting)</td>
<td>-10 to +40°C (non-freezing)</td>
</tr>
<tr>
<td>Surrounding air humidity</td>
<td>With circuit board coating: 95% RH or less (non-condensing)</td>
</tr>
<tr>
<td></td>
<td>Without circuit board coating: 90% RH or less (non-condensing)</td>
</tr>
<tr>
<td>Altitude</td>
<td>Maximum 2500 m</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>
<tr>
<td>Temperature</td>
<td>The permissible surrounding air temperature of the inverter is between -10°C and +50°C (-10°C and +40°C at the SLD rating). Always operate the inverter 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 inverter within the specified range.</td>
</tr>
<tr>
<td>(a) Measures against high temperature</td>
<td>Use a forced ventilation system or similar cooling system. (Refer to page 22.)</td>
</tr>
<tr>
<td>(b) Measures against low temperature</td>
<td>Install the enclosure in an air-conditioned electric chamber.</td>
</tr>
<tr>
<td></td>
<td>Black direct sunlight.</td>
</tr>
<tr>
<td>(c) Sudden temperature changes</td>
<td>Select an installation place where temperature does not change suddenly.</td>
</tr>
<tr>
<td>(d) Temperature changes</td>
<td>Avoid installing the inverter near the air outlet of an air conditioner.</td>
</tr>
<tr>
<td>(e) Humidity</td>
<td>Operate the inverter within the ambient air humidity of usually 45 to 90% (up to 95% with circuit board coating). Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may cause a spatial electrical breakdown. The insulation distance defined in IEC 1130-2 &quot;Control Equipment Insulator&quot; is humidity of 45 to 90%.</td>
</tr>
</tbody>
</table>

**ITEM**

1. Temperature is applicable for a short time, e.g. in transit.
2. For the installation of an air conditioner, 10% m3, ensure the wind current is 500 m³.

**ITEM**

3. Measures against high temperature
   - Use a forced ventilation system or similar cooling system. (Refer to page 22.)
   - 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.

4. Measures against low temperature
   - Provide a space heater in the enclosure.
   - Do not power OFF the inverter. (Keep the start signal of the inverter OFF.)

5. 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.

6. Temperature changes are caused by opening/closing of a door; install the inverter away from the door.

**ITEM**

7. Humidity
   - Operate the inverter within the ambient air humidity of usually 45 to 90% (up to 95% with circuit board coating). Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may cause a spatial electrical breakdown. The insulation distance defined in IEC 1130-2 "Control Equipment Insulator" is humidity of 45 to 90%.

**ITEM**

8. Installation and wiring

**ITEM**

9. Installation of the inverter and enclosure design
Installation of the inverter 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 inverter. (Keep the start signal of the inverter OFF.)

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 22.)
- Purge air:
Pump clean air from outside to make the in-enclosure air pressure higher than the outside air pressure.

Corrosive gas, salt damage
If the inverter is exposed to corrosive gas or to salt near a beach, the printed board patterns and parts will corrode or the relays and switches will result in poor contact.
In such places, take the measures given above.

Explosive, flammable gases
As the inverter is non-explosion proof, it must be contained in an explosion-proof enclosure. In places where explosion may be caused by explosive gas, dust or dirt, an enclosure cannot be used unless it structurally complies with the guidelines and has passed the specified tests. This makes the enclosure itself expensive (including the test charges). The best way is to avoid installation in such places and install the inverter in a non-hazardous place.

High altitude
Use the inverter at an altitude of within 2500 m. For use at an altitude above 1000 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 inverter is up to 2.0 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.

Precautions
- Provide the enclosure with rubber vibration isolators.
- Strengthen the structure to prevent the enclosure from resonance.
- Install the enclosure away from the sources of the vibration.
### 2.3.2 Cooling system types for inverter enclosure

From the enclosure that contains the inverter, the heat of the inverter 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 inverter.

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 heat sink (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 ventilation</td>
<td><img src="image" alt="Natural ventilation" /></td>
<td>This system is low in cost and generally used, but the enclosure size increases as the inverter capacity increases. This system is for relatively small capacities.</td>
</tr>
<tr>
<td>(totally enclosed type)</td>
<td><img src="image" alt="Totally enclosed type" /></td>
<td>Being a totally enclosed type, this system is the most appropriate for hostile environment having dust, dirt, oil mist, etc. The enclosure size increases depending on the inverter capacity.</td>
</tr>
<tr>
<td>Heat sink cooling</td>
<td><img src="image" alt="Heat sink cooling" /></td>
<td>This system has restrictions on the heat sink mounting position and area. This system is for relatively small capacities.</td>
</tr>
<tr>
<td>Forced air</td>
<td><img src="image" alt="Forced air" /></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><img src="image" alt="Heat pipe" /></td>
<td>This is a totally enclosed for enclosure downsizing.</td>
</tr>
</tbody>
</table>

---

**Installation of the inverter and enclosure design**

---

**INSTALLATION AND WIRING**
2.3.3 Inverter installation

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

- **Installation orientation of the inverter**
  - Install the inverter on a wall as specified. Do not mount it horizontally or in any other way.

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

---

*1 There needs to be a space of at least 30 cm in front of the inverter to replace the cooling fan. Refer to page 102 for fan replacement.*
Installation of the inverter and enclosure design

**Encasing multiple inverters and converter units**

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

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

**Arrangement of the ventilation fan and inverter**

Heat generated in the inverter 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 airway and airflow plates to expose the inverter to cool air.)
2.3.4 Protruding the heat sink through a panel

When encasing an inverter to an enclosure, the heat generated in the enclosure can be greatly reduced by protruding the heat sink of the inverter.

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

Panel cutting

Cut the panel of the enclosure according to the inverter capacity.
Installation of the inverter and enclosure design

- **Removal of the rear installation frame**
  Two installation frames are attached to each of the upper and lower parts of the inverter. Remove the rear side installation frame on the top and bottom of the inverter as shown on the right.

- **Installation of the inverter**
  Push the inverter heat sink portion outside the enclosure and fix the enclosure and inverter 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 inverter and cooling fan section.

- Two installation frames are attached to each of the upper and lower parts of the inverter. Remove the rear side installation frame on the top and bottom of the inverter as shown on the right.
2.4 Terminal connection diagrams

FM type (RS-485 model)
Terminal connection diagrams

- Terminals R1/L11 and S1/L21 are connected to terminals P/+ and N/- with a jumper respectively. 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 to Pr.189).
- Terminal JOG is also used as the pulse train input terminal. Use Pr.291 to choose JOG or pulse.
- The function of these terminals can be changed with the output terminal assignment (Pr.195, Pr.196).
- No function is assigned in the initial setting. Use Pr.192 for function assignment.
- The terminal FM can be used to output pulse trains as open collector output by setting Pr.291.
- Not required when calibrating the scale with the operation panel.

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.
- Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
- When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch correctly. Incorrect setting may cause a fault, failure or malfunction.
Terminal connection diagrams

**CA type (RS-485 model)**

- **Main circuit**
- **Control circuit**
- **Motor**
- **Earth (Ground)**

**Main circuit**
- Relay output 1
- Relay output 2
- Up to frequency
- Overload
- Frequency detection
- Safety monitor output
- Safety monitor output common
- Safety stop signal
- Safety stop input (Channel 1)
- Safety stop input (Channel 2)
- Shorting wire
- Safety input common
- Safety monitor output (SO)
- Safety stop input (SO)
- Safety stop output (SO)
- Safety monitor output (SO)

**Control circuit**
- Auxiliary input
- Terminal 4 input (Current input)
- Frequency setting potentiometer
- 1/2W 1kΩ
- Frequency setting signals (Analog) 10V (+5V)
- Analog signal input (0 to ±10VDC)
- Analog current input (0 to 20mADC)
- Analog signal output (0 to ±10VDC)
- Analog current output (0 to 20mADC)
- Analog signal input (0 to 10VDC)
- Analog current input (0 to 10VDC)
- Analog signal output (0 to ±10VDC)
- Analog current output (0 to ±10VDC)
- Analog signal output (0 to ±5VDC)
- Analog current output (0 to ±5VDC)
- Analog signal output (0 to 5VDC)
- Analog current output (0 to 5VDC)
- Analog signal output (0 to 10VDC)
- Analog current output (0 to 10VDC)
- Analog signal output (0 to 20mADC)
- Analog current output (0 to 20mADC)
- Analog signal output (0 to 5VDC)
- Analog current output (0 to 5VDC)
- Analog signal output (0 to ±10VDC)
- Analog current output (0 to ±10VDC)
- Analog signal output (0 to ±5VDC)
- Analog current output (0 to ±5VDC)

**Control input signals**
- (No voltage input allowed)
- 4 to 20mADC
- 0 to 5VDC
- 0 to 10VDC selectable
- 0 to 20mADC
- 0 to 5VDC
- 0 to 10VDC selectable

**Data transmission**
- **GND**
- **TXD+**
- **TXD-**
- **RXD+**
- **RXD-**

**Converter unit**
- RS-485 terminal
- USB A connector
- USB mini B connector
- Voltage/current input switch selectable
- Terminating resistor
- Initial value
- Output stop
- 24V
- Output shutoff circuit
- Common for external power supply transistor
- ±24V

**Brake unit (Option)**
- Jumper
- (Permissible load current 100mA)

**Jumper**
- (Permissible load current 100mA)
Terminal connection diagrams

1. Terminals R1/L1 and S1/L2 are connected to terminals P/+ and N/- with a jumper respectively. When using separate power supply for the control circuit, remove the jumpers from R1/L1 and S1/L2.

2. The function of these terminals can be changed with the input terminal assignment (Pr.178 to Pr.189).

3. Terminal JOG is also used as the pulse train input terminal. Use Pr.291 to choose JOG or pulse.

4. The X10 signal (VC contact input specification) is assigned to terminal MRS in the initial setting. Set Pr.599 = “0” to change the input specification of the X10 signal to NC contact.

5. Terminal input specifications can be changed by analog input specification switchover (Pr.73, Pr.267). To input a voltage (0 to 5 V/0 to 10 V), set the voltage/current input switch OFF. To input a current (4 to 20 mA), set the voltage/current input switch ON. Terminals 10 and 2 are also used as a PTC input terminal (Pr.561).

6. It is recommended to use 2 W 1 kΩ when the frequency setting signal is changed frequently.

7. The function of these terminals can be changed with the output terminal assignment (Pr.195, Pr.196).

8. The function of these terminals can be changed with the output terminal assignment (Pr.190 to Pr.194).

9. No function is assigned in the initial setting. Use Pr.192 for function assignment.

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.

Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.

• When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.

• Set the voltage/current input switch correctly. Incorrect setting may cause a fault, failure or malfunction.
FM type (Ethernet model)
Terminal connection diagrams

1. Terminals R1/L11 and S1/L21 are connected to terminals P/+ and N/- with a jumper respectively. 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 to Pr.189).
3. Terminals JOG is also used as the pulse train input terminal. Use Pr.291 to choose JOG or pulse.
4. The X10 signal (NC contact input specification) is assigned to terminal MRS in the initial setting. Set Pr.599 = "0" to change the input specification of the X10 signal to NO contact.
5. Terminal input specifications can be changed by analog input specification switchover (Pr.73, Pr.267).

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. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
• When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
• Set the voltage/current input switch correctly. Incorrect setting may cause a fault, failure or malfunction.
INSTALLATION AND WIRING

Terminal connection diagrams

• Terminals R1/L11 and S1/L21 are connected to terminals P/+ and N/- with a jumper respectively. When using separate power supply for the control circuit, reverse the jumpers from R1/L11 and S1/L21.
• The function of these terminals can be changed with the input terminal assignment (Pr.178 to Pr.189).
• Terminals JOG is also used as the pulse train input terminal. Use Pr.291 to choose JOG or pulse.
• The X10 signal (NC contact input specification) is assigned to terminal MRS in the initial setting. Set Pr.599 = "0" to change the input specification of the X10 signal to NO contact.
• Terminal input specifications can be changed by assigning input terminal assignment (Pr.190 to Pr.194).
• No function is assigned in the initial setting. Use Pr.192 for function assignment.
• The option connector 2 cannot be used because the Ethernet board is installed in the initial status. The Ethernet board must be removed to install a plug-in option to the option connector 2. (However, Ethernet communication is disabled in that case.)

**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 inverters. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
• When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the inverter.
• Set the safeguard input switch correctly. Incorrect setting may cause a fault, failure or malfunction.
Terminal connection diagrams

◆Connection between the converter unit and the inverter

Perform wiring so that the commands sent from the converter unit are transmitted to the inverter without fail. Incorrect connection may damage the converter unit and the inverter.

For the wiring length, refer to the table below:

<table>
<thead>
<tr>
<th>Wire category</th>
<th>Across terminals P and P and terminals N and N</th>
<th>50 m or lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>R/L1 S/L2 T/L3</td>
<td></td>
</tr>
<tr>
<td>Converter unit</td>
<td>M/L1 R/L11 S/L21</td>
<td></td>
</tr>
<tr>
<td>Inverter</td>
<td>MRS(X10)</td>
<td></td>
</tr>
<tr>
<td>Converter unit</td>
<td>MCCB MC</td>
<td></td>
</tr>
<tr>
<td>Inverter</td>
<td>U/V/W</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>R/L1 S/L2 T/L3</td>
<td></td>
</tr>
</tbody>
</table>

Refer to page 38 for the cable gauge of the cable across the main circuit terminals P+ and N- (P and P+, N and N), refer to page 38.

1. Do not install an MCCB across terminals P+ and N- (across terminals P+ and P+, or across N+ and N). Connecting the opposite polarity of terminals N- and P+ will damage the inverter.

2. 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.
   (The X10 signal is assigned to terminal MRS in the initial setting.)

3. 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. For RS-485 or any other form of communication where the start command is only transmitted once, use the X11 signal to save the operation mode at the time of an instantaneous power failure.

4. Always connect terminal RDA of the converter unit and terminal MRS (X10) of the inverter, and terminal SE of the converter unit and the terminal SD (sink logic) of the inverter. Not connecting these terminals may damage the converter unit.
2.5 Main circuit terminals

2.5.1 Details on the main circuit terminals of the inverter

<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>U, V, W</td>
<td>Inverter output</td>
<td>Connect these terminals to a three-phase squirrel motor</td>
<td>51</td>
</tr>
<tr>
<td>R1/L11, S1/L21</td>
<td>Power supply for the control circuit</td>
<td>Connected to terminals R1/L11 and S1/L21, and apply external power supply to these terminals. To retain the fault display and fault output, remove the jumpers installed in R1/L11 and S1/L21, and apply external power supply to these terminals. The power capacity necessary when separate power is supplied from R1/L11 and S1/L21 is 80 VA.</td>
<td></td>
</tr>
<tr>
<td>P/+, N/-</td>
<td>Converter unit connection</td>
<td>Connect the converter unit (FR-CC2), brake unit (FR-BU2), or high power factor converter (FR-HC2).</td>
<td>27, 80</td>
</tr>
<tr>
<td></td>
<td>Earth (ground)</td>
<td>For earthing (grounding) the inverter chassis. This must be earthed (grounded).</td>
<td></td>
</tr>
</tbody>
</table>

2.5.2 Details on the main circuit terminals of the converter unit (FR-CC2)

<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. (When the converter unit is connected to the 12-phase rectifier power transformer, refer to the Instruction Manual of the FR-CC2.)</td>
<td>40</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 R1/L11 and across S/L2 and 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></td>
</tr>
<tr>
<td>P/+, N/-</td>
<td>Converter connection</td>
<td>Connect to terminals P/+ and N/- of the inverter.</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Earth (ground)</td>
<td>For earthing (grounding) the converter unit chassis. This must be earthed (grounded).</td>
<td>40</td>
</tr>
</tbody>
</table>
2.5.3 Terminal layout of the main circuit terminals, wiring of power supply and the motor

**NOTE**
- Make sure the power cables are connected to the R/L1, S/L2, and T/L3 of the converter unit. (Phase need not be matched.)
- Never connect the power cable to the U, V, and W of the inverter. Doing so will damage the inverter.
- Connect the motor to the U, V, and W of the inverter. (The phases must be matched.)
- When wiring the main circuit conductor, tighten a nut from the right side of the conductor. (Refer to the diagram below.)
- When wiring two wires, place wiring on both sides of the conductor.

For wiring, use bolts (nuts) provided with the inverter.

- When wiring 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.

---

**Diagram:**
- Power supply
- Charge lamp
- Jumper
- Motor
- M
- To inverter
- To converter unit
- R/L1
- S/L2
- T/L3

---

**Models:**
- FR-CC2-H315K to FR-CC2-H500K
- FR-A842-07700(315K) to FR-A842-12120(500K)
2.5.4 Applicable cables and wiring length

Select a recommended cable size to ensure that the voltage drop will be 2% or less. If the wiring distance is long between the inverter and motor, the voltage drop in the main circuit will cause the motor torque to decrease especially at a low speed.

The following table indicates a selection example for the wiring length of 20 m (440 V input power supply, ND rating).

### Converter unit (FR-CC2)

<table>
<thead>
<tr>
<th>Cable gauge</th>
<th>RI/L1, SI/L2, TL3</th>
<th>Pr, Nc</th>
<th>Earthing (grounding) cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV cables, etc. (mm²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC cables, etc. (mm²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1054</td>
<td>60</td>
<td>3/180</td>
<td>150/120</td>
</tr>
<tr>
<td>1066</td>
<td>60</td>
<td>3/180</td>
<td>150/120</td>
</tr>
<tr>
<td>1068</td>
<td>60</td>
<td>3/180</td>
<td>150/120</td>
</tr>
<tr>
<td>1050</td>
<td>60</td>
<td>3/180</td>
<td>150/120</td>
</tr>
</tbody>
</table>

### Inverter

<table>
<thead>
<tr>
<th>Cable gauge</th>
<th>U, V, W</th>
<th>U, V, W</th>
<th>Earthing (grounding) cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV cables, etc. (mm²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC cables, etc. (mm²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0701201501</td>
<td>106/10</td>
<td>106/10</td>
<td>106/10</td>
</tr>
<tr>
<td>0896000001</td>
<td>106/10</td>
<td>106/10</td>
<td>106/10</td>
</tr>
<tr>
<td>0996000001</td>
<td>106/10</td>
<td>106/10</td>
<td>106/10</td>
</tr>
<tr>
<td>1094200001</td>
<td>106/10</td>
<td>106/10</td>
<td>106/10</td>
</tr>
</tbody>
</table>

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

\[
\text{Voltage drop (V) = } 0.01\times r_{\text{wire resistance}} \times \text{wire length (m)} \times \text{current (A)}
\]

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

**NOTE**
- Tighten the terminal screw to the specified torque.
- A screw that has been tightened too loosely can cause a short circuit or malfunction.
- A screw that has been tightened too tightly can cause a short circuit or malfunction due to the unit breaking.
**Total wiring length**

Connect one or more general-purpose motors within the total wiring length 500 m. (The wiring length should be 100 m or less under vector control.)

When driving a 400 V class motor by the inverter, surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor. In this case, take one of the following measures.

- Use a “400 V class inverter-driven insulation-enhanced motor” and set Pr.72 PWM frequency selection according to the wiring length.

- If the motor capacity is 280 kW or lower, connect the sine wave filter (MT-BSL/BSC) to the output side.

**Wiring length 100 m or shorter**

<table>
<thead>
<tr>
<th>Wiring Length</th>
<th>PWM Frequency</th>
<th>Wiring Length Longer than 100 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 m or less</td>
<td>6 (6 kHz) or lower</td>
<td>500 m or less</td>
</tr>
<tr>
<td>300 m or less</td>
<td>4 (4 kHz) or lower</td>
<td>300 m</td>
</tr>
</tbody>
</table>

- If the motor capacity is 280 kW or lower, connect the sine wave filter (MT-BSL/BSC) to the output side.

- Especially for long-distance wiring, the inverter may be affected by a changing current caused by the stray capacitances of the wiring, leading to a malfunction of the overcurrent protection function or fast response current limit function or a malfunction or fault of the equipment connected on the inverter output side. If the fast response current limit function malfunctions, disable this function. (For the details of Pr.156 Stall prevention operation selection, refer to the FR-A800 Instruction Manual (Detailed)).
- A sine wave filter (MT-BSL/BSC) can be used under V/F control. Do not use the filters under different control methods.
- For the details of Pr.72 PWM frequency selection, refer to the FR-A800 Instruction Manual (Detailed).
- Refer to page 84 to drive a 400 V class motor by an inverter.
2.5.5 Earthing (grounding) precautions

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) is to prevent operators from getting an electric shock from this leakage current when touching it.

To avoid the influence of external noises, this 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 inverter's high frequency components from entering the malfunction prevention type earthing (grounding):

• Whenever possible, use the independent earthing (grounding) for the inverter.
• If independent earthing (grounding) (I) is not available, use (II) common earthing (grounding) in the figure below where the inverter 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 inverter as shown in (III).

A leakage current containing many high frequency components flows into the earthing (grounding) cables of the inverter and peripheral devices. Because of this, the inverter 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 61140 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 38.
• The earthing (grounding) point should be as close as possible to the inverter, and the earth (ground) wire length should be as short as possible.
• 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 117.
2.6 Control circuit

2.6.1 Details on the control circuit terminals of the inverter

The input signal function of the terminals in the table can be selected by setting Pr.178 to Pr.196 (I/O terminal function selection). For the parameter details, refer to the FR-A800 Instruction Manual (Detailed).

**Input signal**

<table>
<thead>
<tr>
<th>No.</th>
<th>Terminal Symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rated specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ST</td>
<td>Forward rotation start</td>
<td>Terminal 4 is also used as the pulse train input terminal. To use as a pulse train input terminal, change the Pr.291 setting. (maximum input pulse: 100k pulses/s)</td>
<td>Contact input</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC, when contacts are short-circuited: 4 to 6 mADC</td>
</tr>
<tr>
<td>2ST</td>
<td>Reverse rotation start</td>
<td>Terminal is also used as the pulse train input terminal. Turn ON the JOG signal to enable JOG operation.</td>
<td>Contact input</td>
<td>Input resistance 2 kΩ, voltage when contacts are open: 21 to 27 VDC, when contacts are short-circuited: 8 to 13 mADC</td>
</tr>
<tr>
<td>3RT</td>
<td>Second function selection</td>
<td>Turn ON the RT signal to enable the second function. When the second function such as “second torque boost” and “second V/F (base frequency)” is set, turning ON the RT signal enables the selected function.</td>
<td>Contact input</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC</td>
</tr>
<tr>
<td>4MRS</td>
<td>Output stop (Inverter operation enable)</td>
<td>Connect to terminal RDA of the converter unit (FR-CC2). When the RDA signal is turned OFF, the inverter output is shut off. The X10 signal (NC contact) is assigned to terminal MRS in the initial setting. Use Pr.599 to change the specification to NO contact.</td>
<td>Contact input</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC</td>
</tr>
<tr>
<td>5RES</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 for 0.1s or longer, then turn it OFF. In the initial setting, reset is always enabled. By setting Pr.75, reset can be enabled only at an inverter fault occurrence. The inverter recovers about 1s after the reset is released.</td>
<td>Contact input</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC</td>
</tr>
<tr>
<td>6AU</td>
<td>Terminal 4 input selection</td>
<td>The terminal 4 function is available only when the AU signal is ON. Turning ON the AU signal disables the terminal 2 function.</td>
<td>Contact input</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC</td>
</tr>
<tr>
<td>7CS</td>
<td>Selection of automatic restart after instantaneous power failure</td>
<td>When the CS signal is left ON, the inverter restarts automatically at power restoration. Note that restart setting is necessary on both the inverter and the converter unit for this operation. In the initial setting, a restart is disabled.</td>
<td>Contact input</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC</td>
</tr>
<tr>
<td>8SD</td>
<td>External transistor common (sink)</td>
<td>Connect this terminal to the power supply common terminal of a transistor output transistor (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable current. 24 VDC power supply common Can be used as a 24 VDC 0.1 A power supply.</td>
<td>Contact input</td>
<td>Power supply voltage range 18.2 to 28.8 VDC, permissible load current 100 mA</td>
</tr>
</tbody>
</table>
CONTROL CIRCUIT

42 INSTALLATION AND WIRING

∗1 Set Pr.73, Pr.267, and the voltage/current input switch correctly, then input an analog signal in accordance with the setting.

Applying a voltage with the voltage/current input switch ON (current input is selected) or a current with the switch OFF (voltage input is selected) could cause component damage of the inverter or analog circuits of output devices. (For the details, refer to the FR-A800 Instruction Manual (Detailed).)

∗2 Sink logic is initially set for the FM-type inverter.

∗3 Source logic is initially set for the CA-type inverter.

Output signal

<table>
<thead>
<tr>
<th>Type</th>
<th>Terminal Symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rated specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Frequency setting power supply</td>
<td>When connecting the frequency setting potentiometer at an initial status, connect it to terminal 10. Change the terminal specifications of terminal 2 to Pr.23 when connecting it to terminal 10E.</td>
<td>Input voltage 23 to 25.5 VDC</td>
<td>Input current 1.4 A or less</td>
</tr>
<tr>
<td>2</td>
<td>Frequency setting (voltage)</td>
<td>Setting the input frequency to 5 V (10 V, 20 mA) and setting input and output proportions. Use Pr.27 to switch among input 1 to 2 VDC (onward setting), 0 to 10 VDC, and 0 to 20 mA. Set the voltage/current input switch in the ON position to select current input (0 to 20 mA).</td>
<td>Input voltage 23 to 25.5 VDC</td>
<td>Input current 1.4 A or less</td>
</tr>
<tr>
<td>3</td>
<td>Frequency setting (current)</td>
<td>The input signal is valid only when the AC input to DC (terminal 1 to terminal 2) is in reverse. Use Pr.267 to switch among input 0 to 10 VDC (onward setting), 0 to 5 VDC, and 0 to 10 VDC. Set the voltage/current input switch in the OFF position to select voltage input (0 to 5 VDC or 0 to 10 VDC).</td>
<td>Input voltage 23 to 25.5 VDC</td>
<td>Input current 1.4 A or less</td>
</tr>
<tr>
<td>4</td>
<td>Frequency setting auxiliary</td>
<td>Adjustment of the input voltage of Pr.10 (initial setting), 0 to 5 VDC and 0 to 10 VDC (onward setting). Use Pr.858 to switch terminal functions.</td>
<td>Input voltage 23 to 25.5 VDC</td>
<td>Input current 1.4 A or less</td>
</tr>
<tr>
<td>5</td>
<td>PTC thermistor input</td>
<td>For receiving PTC thermistor outputs. When PTC thermistor is valid (Pr.561 ≠ &quot;9999&quot;), terminal 2 is not available for frequency setting.</td>
<td>PTC thermistor specification</td>
<td>Overheat detection 3.5 to 20 mA (onward setting)</td>
</tr>
<tr>
<td>6</td>
<td>24 V external power supply input</td>
<td>For connecting a 24 V external power supply. The 24 V external power supply is connected, power is supplied to the terminal circuit while the main power circuit is OFF.</td>
<td>Input voltage 23 to 25.5 VDC</td>
<td>Input current 1.4 A or less</td>
</tr>
</tbody>
</table>

×1 Use a power supply with the same voltage as the terminal to be powered (DC input power supply). You must select the models off the voltage input is selected.

×2 Maximum permissible voltage 20 VDC. When current input is required, maximum permissible voltage 24 VDC. Select the models off the voltage input is selected.

×3 Sink logic is selected for the FM-type inverters.

×4 Source logic is selected for the CA-type inverters.
## INSTALLATION AND WIRING

### Control circuit

<table>
<thead>
<tr>
<th>Terminal Symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rated specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN</td>
<td>Inverter running</td>
<td>Switched to off when the inverter output frequency is equal to or higher than the starting frequency (initial value 0.5 Hz), switched to H (HIGH) during start or if the inverter is turned on.</td>
<td>Permissible load 24 VDC. (maximum 27 VDC).</td>
</tr>
<tr>
<td>SU</td>
<td>Up to frequency</td>
<td>Switched to H (HIGH) when the output frequency is equal to or higher than the preset frequency (required initial value).</td>
<td>Permissible load 30 VDC. (maximum 40 VDC).</td>
</tr>
<tr>
<td>OL</td>
<td>Overload alarm</td>
<td>Switched to H (HIGH) when the output frequency is equal to or higher than the preset frequency (required initial value).</td>
<td>Permissible load 30 VDC. (maximum 40 VDC).</td>
</tr>
<tr>
<td>PK</td>
<td>Open collector output</td>
<td>The function can be assigned by setting Pr.199.</td>
<td>Permissible load 30 VDC. (maximum 40 VDC).</td>
</tr>
<tr>
<td>FU</td>
<td>Frequency detection</td>
<td>The function is used for the frequency detection.</td>
<td>Permissible load 30 VDC. (maximum 40 VDC).</td>
</tr>
<tr>
<td>SE</td>
<td>Open collector output</td>
<td>Common terminal for terminals RUN, SU, OL, PK, FK, PU.</td>
<td>Permissible load 30 VDC. (maximum 40 VDC).</td>
</tr>
<tr>
<td>FM</td>
<td>NPN open collector output</td>
<td>Outputs a selected monitored item (such as output frequency) among several monitored items. The signal is not output during an error.</td>
<td>Permissible load 24 VDC. (maximum 27 VDC).</td>
</tr>
<tr>
<td>AM</td>
<td>Analog voltage output</td>
<td>Output signal 0 to 10 VDC, Permissible load current 1 mA (load impedance 10 kΩ or more).</td>
<td>Permissible load 24 VDC. (maximum 27 VDC).</td>
</tr>
<tr>
<td>CA</td>
<td>Analog current output</td>
<td>Output signal 0 to 20 mA, Permissible load current 1 mA (load impedance 10 kΩ or more).</td>
<td>Permissible load 24 VDC. (maximum 27 VDC).</td>
</tr>
</tbody>
</table>

### Notes:
1. Terminal FM is provided in the FM-type inverter.
2. Terminal CA is provided in the CA-type inverter.
Control circuit

◆ Communication

<table>
<thead>
<tr>
<th>Type</th>
<th>Terminal symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet</td>
<td>— Ethernet connector</td>
<td>Communication can be made via Ethernet.</td>
<td>Category: 100BASE-TX/10BASE-T Data transmission speed: 10 Mbps (10BASE-T), 100 Mbps (100BASE-TX) Communication format: half-duplex, full-duplex Transmission speed: 100 Mbps (100BASE-TX), 10 Mbps (10BASE-T) Maximum length: 100 m (10BASE-T), 1000 m (100BASE-TX)</td>
</tr>
<tr>
<td>RS-485</td>
<td>— PU connector</td>
<td>Communication can be made through RS-485. (For connection on a 1:1 basis only)</td>
<td>Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 4800 to 115200 bps Wiring length: 500 m</td>
</tr>
</tbody>
</table>

RS-485 terminals

| TXD+ | Inverter transmission terminal | The RS-485 terminals enable the communication by RS-485. | Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 300 to 115200 bps Overall length: 500 m |
| TXD- | RXD+ | Inverter reception terminal | | |
| GND | (SG) Earthing terminal | | |

USB — USB A connector | A USB memory device enables parameter copies and the trend trace function. | Interface: Conforms to USB 1.1 (USB 2.0 full speed compatible) Transmission speed: 12 Mbps |

USB B connector | Mini B connector (receptacle) | Connected to a personal computer via USB to enable setting, monitoring, test operations of the inverter by FR Configurator2. | |

◆ Safety stop signal

For the safety stop function, refer to page 54

<table>
<thead>
<tr>
<th>Terminal Symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rated specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 Safety stop input (Channel 1)</td>
<td>Terminal S1 and S2 are used for the safety stop signal.</td>
<td>Terminal S1 and S2 are used at the same time (dual channel). Inverter output is shunted by shorting (opening) between terminals S1 and S2 and SIC, or between S2 and SIC.</td>
<td>Input resistance: 47 kΩ Input current: 4 to 6 mA (with 24 VDC input)</td>
</tr>
<tr>
<td>S2 Safety stop input (Channel 2)</td>
<td>Terminal S1 and S2 are used at the same time (dual channel). Inverter output is shunted by shorting (opening) between terminals S1 and S2 and SIC, or between S2 and SIC.</td>
<td>Terminal S1 and S2 are used at the same time (dual channel). Inverter output is shunted by shorting (opening) between terminals S1 and S2 and SIC, or between S2 and SIC.</td>
<td>Input resistance: 47 kΩ Input current: 4 to 6 mA (with 24 VDC input)</td>
</tr>
<tr>
<td>SIC Safety input terminal common</td>
<td>Common terminal for terminals S1 and S2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa (SO) Safety monitor output (Open collector output)</td>
<td>Terminal Sa (SO) is a safety monitoring output.</td>
<td>Terminal Sa (SO) is a safety monitoring output. Switched on during the internal safety circuit fail-safe function and when the output of the OP circuit is HIGH. Switched off when the transistor is OFF. Refer to the Safety stop function instruction manual [BCN022320301] for details.</td>
<td>Terminal Sa (SO) is a safety monitoring output. Switched on during the internal safety circuit fail-safe function and when the output of the OP circuit is HIGH. Switched off when the transistor is OFF. Refer to the Safety stop function instruction manual [BCN022320301] for details.</td>
</tr>
</tbody>
</table>

SOC Safety output terminal common | Common terminal for terminal Sa (SO). | | |
### 2.6.2 Details on the control circuit terminals of the converter unit (FR-CC2)

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

For the parameter details, refer to the FR-CC2 Instruction Manual.

#### Input signal

<table>
<thead>
<tr>
<th>Terminal Symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rated specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>BES</td>
<td>Reset</td>
<td>Use the signals to reset a fault output provided when a protective function is actuated. Turn OFF the RES signal for 1 s or longer, then turn it ON. In the initial setting, reset is always enabled. Setting Pr.75 makes reset possible only after the occurrence of a converter and fault. The converter will restart about 1 second after reset.</td>
<td>Input resistance 4.7 kΩ, voltage when contacts are open: 21 to 27 VDC, when contacts are short-circuited: 4 to 6 mADC</td>
</tr>
<tr>
<td>SW</td>
<td>External thermal relay input</td>
<td>The external thermal relay input signal is used when using an external thermal relay or a thermal protector built into the motor to protect the motor from overheating.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>Contact input (sink)</td>
<td>Common terminal for contact input terminal (sink logic) and terminal FM.</td>
</tr>
<tr>
<td></td>
<td>RDI</td>
<td>Contact input (source)</td>
<td>The RDI terminal is the standard connecting terminal to the output of a contact input device, such as a programmable controller, in the sink logic.</td>
</tr>
<tr>
<td></td>
<td>OH</td>
<td>External transistor common (sink)</td>
<td>Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic.</td>
</tr>
<tr>
<td></td>
<td>PC</td>
<td>External transistor common (source)</td>
<td>Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power supply voltage range 19.2 to 28.8 VDC, permissible load current 100 mA</td>
<td></td>
</tr>
</tbody>
</table>

#### Power supply input

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Function description</th>
<th>Rated specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>+24</td>
<td>24 V external power supply input</td>
<td>For connecting a 24 V external power supply. The power is supplied to the control circuit while the main power circuit is OFF. Input voltage range 20 to 28.5 VDC, input current 1 A or less.</td>
</tr>
</tbody>
</table>
Output signal

<table>
<thead>
<tr>
<th>Terminal symbol</th>
<th>Terminal name</th>
<th>Terminal function description</th>
<th>Rated specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1, B1, C1</td>
<td>Relay output 1 (sink logic)</td>
<td>Switched to LOW when the converter unit operation is ready.</td>
<td>230 VAC 0.3 A (power factor = 0.4)</td>
</tr>
<tr>
<td>88R, 88S</td>
<td>For manufacturer setting. Do not use.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RDA</td>
<td>Open collector output (NO contact)</td>
<td>Switched to LOW when the converter unit operation is ready.</td>
<td>24 VDC 0.1 A (maximum 27 VDC)</td>
</tr>
<tr>
<td>RDB</td>
<td>Open collector output (NC contact)</td>
<td>Switched to LOW when a converter unit fault occurs or the converter is reset.</td>
<td>24 VDC 0.1 A (maximum 27 VDC)</td>
</tr>
<tr>
<td>RSO</td>
<td>Inverter reset</td>
<td>Switched to LOW when the converter is reset (RES-ON).</td>
<td>24 VDC 0.1 A (maximum 27 VDC)</td>
</tr>
<tr>
<td>IPF</td>
<td>Instantaneous power failure</td>
<td>Switched to LOW when an instantaneous power failure is detected.</td>
<td></td>
</tr>
<tr>
<td>FAN</td>
<td>Cooling fan fault</td>
<td>Switched to LOW when a cooling fan fault occurs.</td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>Open collector output common</td>
<td>Common terminal for terminals RDA, RDB, RSO, IPF, FAN. Connect this terminal to terminal SD (sink logic) or PC (source logic) of the inverter.</td>
<td></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 converter unit and terminal MRS (X10) of the inverter, and terminal SE of the converter unit and terminal SD (terminal PC in the source logic) of the inverter. Not doing so may lead to damage of the converter unit.

2.6.3 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 control logic of input signals is initially set to the sink logic (SINK) for the FM type inverter.
The control logic of input signals is initially set to the source logic (SOURCE) for the CA type inverter.
(The output signals may be used in either the sink or source logic independently of the jumper connector position.)
Sink logic and source logic

- In the sink logic, a signal switches ON when a current flows from the corresponding signal input terminal.
- In the source logic, a signal switches ON when a current flows into the corresponding signal input terminal.

Terminal SD 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 inverter with terminal 0V 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 inverter. Doing so may cause a malfunction in the inverter 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 inverter with terminal +24 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 inverter. Doing so may cause a malfunction in the inverter due to undesirable currents.
Control circuit

2.6.4 Wiring of inverter control circuit

◆ Control circuit terminal layout

- This terminal operates as terminal FM for the FM type, and as terminal CA for the CA type.
- Represents terminal STOP.
- The X10 signal is assigned in the initial setting.
- No signal is assigned in the initial setting.

◆ Wiring method

- Power supply connection
  Use crimp terminals and stripped wire for the control circuit wiring. For single wire, the stripped wire can be used without crimp terminal.
  Connect the end of wires (crimp terminal or stranded wire) to the terminal block.

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

  (2) Use appropriate crimp terminals (ferrules, blade terminals, etc.). Insert wires to the crimp terminal, and check that the wires come out for about 0 to 0.5 mm from a sleeve. Check the condition of the crimp terminals after crimping. Do not use the crimp terminals of which the crimping is inappropriate, or the face is damaged.

- Crimp terminals commercially available (as of January 2017)

<table>
<thead>
<tr>
<th>Wire gauge (mm²)</th>
<th>Female part No.</th>
<th>Crimping tool model No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>AI 0,3-10</td>
<td>CRIMPFOX 6</td>
</tr>
<tr>
<td>0.5</td>
<td>AI 0,5-10</td>
<td>CRIMPFOX 6</td>
</tr>
<tr>
<td>0.75</td>
<td>AI 0,75-10</td>
<td>CRIMPFOX 6</td>
</tr>
<tr>
<td>1.0</td>
<td>AI 1-10</td>
<td>CRIMPFOX 6</td>
</tr>
<tr>
<td>0.75 (for two wires)</td>
<td>AI-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 for terminals A1, B1, C1, A2, B2, and C2 only.

48 INSTALLATION AND WIRING
When using stranded wires without a blade terminal, twist enough to avoid short circuit with a nearby terminal or wires.

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

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

NOTE:
• When using stranded wires without a blade terminal, twist enough to avoid short circuit with a nearby terminal or wires.
• Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause inverter damage or injury.

Common terminals of the control circuit (SD, PC, 5, SE)
• Terminals SD (sink logic), PC (source logic), 5, and SE are common terminals (0V) for I/O signals. (All common terminals are isolated from each other.) Do not earth (ground) these terminals. Avoid connecting terminal SD (sink logic) with 5, terminal PC (source logic) with 5, and terminal SE with 5.
• In the sink logic, terminal SD is a common terminal for the contact input terminals (STF, STR, RH, RM, RL, JOG, RT, MRS, RES, AU, CS) and the pulse train output terminal (FM). 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 (STF, STR, RH, RM, RL, JOG, RT, MRS, RES, AU, CS). The open collector circuit is isolated from the internal control circuit by photocoupler.
• Terminal 5 is a common terminal for the frequency setting terminals (2, 1 or 4) and the analog output terminals (AM, CA). It should be protected from external noise using a shielded or twisted cable.
• Terminal SE is a common terminal for the open collector output terminals (RUN, SU, OL, IPF, FU). The contact input circuit is isolated from the internal control circuit by photocoupler.

Wire gauge (mm²) Blade terminal part No. Insulation cap part No. Crimping tool model No.
0.3 to 0.75 BT 0.75-11 VC 0.75 NH 69

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

(2) Insert the wires into a socket.

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

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

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>
Control circuit

**Signal inputs by contactless switches**
The contact input terminals of the inverter (STF, STR, STOP, RH, RM, RL, JOG, RT, MRS, RES, AU, CS) can be controlled using a transistor instead of a contact switch as shown below.

![External signal input using transistor (sink logic)](image1)

![External signal input using transistor (source logic)](image2)

### 2.6.5 Wiring precautions
- It is recommended to use a cable of 0.75 mm² for the connection to the control circuit terminals.
- The wiring length should be 30 m (200 m for terminal FM) 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 200V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A1, B1, C1, A2, B2, C2) via a relay coil, lamp, etc.
- Separate the wiring of the control circuit away from the wiring of the main circuit.
- Make cuts in rubber bush of the inverter side and lead the wires through.

![Wiring example](image3)
2.6.6 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 N·m

- **Connected to**
  When a fault occurs, opening of the electromagnetic contactor (MC) on the inverter 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. Terminals R1/L11 and S1/L21 are connected to terminals P/+ and N/- with a jumper respectively. Do not connect the power cable to incorrect terminals. Doing so may damage the inverter.

- **Connection diagram**

  ![Connection diagram](image)

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

- **NOTE**
  - When using separate power supplies, always remove the jumpers from terminals R1/L11 and S1/L21. The inverter 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 inverter is reset and a fault output will not be held.
Control circuit

2.6.7 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 inverter’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>Model</th>
<th>Product overview</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>S8FS-GS5024C</td>
<td>Capacity: 50 W, output voltage 24 VDC, output current 2.2 A</td>
<td>OMRON Corporation</td>
</tr>
<tr>
<td>S8VK-S06024</td>
<td>Capacity: 60 W, output voltage 24 VDC, output current 2.5 A</td>
<td>OMRON Corporation</td>
</tr>
<tr>
<td>S8VK-WA24024</td>
<td>Capacity: 240 W, output voltage 24 VDC, output current 10 A</td>
<td>OMRON Corporation</td>
</tr>
</tbody>
</table>

Commercially available products (as of April 2019)

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.
• 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 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, “EL” flashes on the operation panel. The alarm LED also flashes. Thus, the 24 V external power supply operation can be confirmed even when the operation panel is removed.
  
  
  Existing

• During the 24 V external power supply operation, the 24 V external power supply operation (EV) signal is output. To use the EV signal, set “106 (positive logic) or 105 (negative logic)” in one of Pr.156 to Pr.158 (output terminal function selection) to assign function to an output terminal.
Control circuit

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

- Fault records and parameters can be read and parameters can be written (when the parameter write from the operation panel is enabled) using the operation panel keys.
- The safely stop function is disabled during the 24 V external power supply operation.
- During the 24 V external power supply operation, monitored items and signals related to inputs to main circuit power supply, such as output 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 inverter reset or turn OFF then ON the power to reset the faults.
- The output data is retained when “1 or 11” is set in Pr.495 Remote output selection.

**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 inverter 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 inverters, the current increases when it flows through the inverter wiring near the power supply. The increase of the current causes voltage to drop further. Use the inverter 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.
- “E.SAF” or “E.P24” may appear when the start-up time of the 24 V power supply is too long (less than 1.5 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 contacted). Otherwise you may get an electric shock or burn.
2.6.8 Safety stop function

Function description

The terminals related to the safety stop function are shown below.

<table>
<thead>
<tr>
<th>Terminal symbol</th>
<th>Terminal function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>For input of the safety stop channel 1.</td>
</tr>
<tr>
<td>S2</td>
<td>For input of the safety stop channel 2.</td>
</tr>
<tr>
<td>SIC</td>
<td>Common terminal for terminals S1 and S2.</td>
</tr>
<tr>
<td>So (SO)</td>
<td>Output when an alarm or failure is detected. The signal is output when no internal safety circuit failure exists.</td>
</tr>
<tr>
<td>SOC</td>
<td>Open collector output terminal So (SO).</td>
</tr>
</tbody>
</table>

*1 In the initial status, terminals S1 and S2, SIC and SD are respectively shorted with shorting wires. To use the safety stop function, remove all the shorting wires and then connect to the safety relay module as shown in the connection diagram.

*2 At an internal safety circuit failure, the operation panel displays one of the faults shown on the next page.

NOTE
• Use terminal So (SO) to output a fault and to prevent resetting of the inverter. The signal cannot be used as safety stop input terminal to other devices.

Connection diagram

To prevent restart at fault occurrence, connect terminals So (SO) and SOC to the reset button, which are the feedback input terminals of the safety relay module.
**Control circuit**

### INSTALLATION AND WIRING

#### Safety stop function operation

<table>
<thead>
<tr>
<th>Input power</th>
<th>Internal safety circuit status</th>
<th>Input terminal</th>
<th>Output terminal</th>
<th>Inverter running status</th>
<th>Operation panel indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td></td>
<td>S1</td>
<td>S2</td>
<td>So (SO)</td>
<td>SAFE</td>
</tr>
<tr>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. When the safety stop function is in operation, the operation is not restarted.
2. When the safety stop function is not in operation, the operation is not restarted.
3. Short across terminals S1 and PC, S2 and PC, and SIC and SD to use the inverter. (In the initial status, terminals S1 and PC, S2 and PC, and SIC and SD are respectively shorted with shorting wires.)
4. Any of the faults shown in the following table occur and the SAFE signal is OFF.
5. When the internal safety circuit is operated normally (no faults occur), terminal So (SO) and the SAFE signal remains ON until "E.SAF" is displayed. Terminal So (SO) and the SAFE signal turns OFF when "E.SAF" is displayed.
6. SA is displayed when terminals S1 and S2 are identified as OFF due to the internal safety circuit failure.
7. If another fault occurs at the same time as E.SAF, the other fault can be displayed.
8. If another warning occurs at the same time as SA, the other warning can be displayed.
9. The table shows the signal status in positive logic. In negative logic, the signal status is opposite.
10. For SAFE signal, refer to the following table and assign the function by Pr.190 to Pr.196 (output terminal function selection).

#### Fault type

<table>
<thead>
<tr>
<th>Fault type</th>
<th>Operation panel indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation panel indication</td>
<td></td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.OP1 to E.OP3</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.PE</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.13</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.P24</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.SAF</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.OS</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.OSD</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.ECT</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.EP</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.CPU</td>
</tr>
<tr>
<td>Communication error fault</td>
<td>E.5 to E.7</td>
</tr>
</tbody>
</table>

For more details, refer to the Safety Stop Function Instruction Manual.

Find a PDF file of the manual in the CD-ROM included with the product.
2.7 Communication connectors and terminals

2.7.1 PU connector

Mounting the operation panel (FR-DU08) or parameter unit (FR-PU07) on the enclosure surface

- Having an operation panel (FR-DU08) or a parameter unit (FR-PU07) on the enclosure surface is convenient. With a connection cable, the operation panel (FR-DU08) or the parameter unit (FR-PU07) can be mounted to the enclosure surface and connected to the inverter.

- Use the option FR-CB2[] or connectors and cables available on the market.

- To install the operation panel (FR-DU08), the optional connector (FR-ADP) is required.

- Securely insert one end of the connection cable until the stoppers are fixed.

NOTE

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

| Name                      | Model          | Manufacturer
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication cable</td>
<td>SGLPEV-T</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>Operation panel connection cable</td>
<td>FR-CB2[] (option)</td>
<td></td>
</tr>
<tr>
<td>Operation panel connection connector</td>
<td>FR-ADP (option)</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 be run to monitor the inverter or read and write parameters.

- Communication can be performed with the Mitsubishi inverter protocol (computer link operation).

(For details, refer to the FR-A800 Instruction Manual (Detailed).)
2.7.2 USB connector

USB host communication

<table>
<thead>
<tr>
<th>Interface</th>
<th>Conforms to USB 1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission speed</td>
<td>12 Mbps</td>
</tr>
<tr>
<td>Wiring length</td>
<td>Maximum 5 m</td>
</tr>
<tr>
<td>Connector</td>
<td>USB A connector (receptacle)</td>
</tr>
</tbody>
</table>

Compatible USB memory

- Format: FAT32
- Capacity: 1 GB or more (used in the recorder mode of the trace function)
- Encryption function: Not available

Function

- Parameter copy: Copies the parameter setting from the inverter to the USB memory device. A maximum of 99 parameter setting files can be saved in a USB memory device. The parameter setting data copied in the USB memory device can be copied to other inverters. This function is useful in backing up the parameter setting or for sharing the parameter setting among multiple inverters.
- Trace: The monitored data and output status of the signals can be saved in a USB memory device. The saved data can be imported to FR Configurator 2 to diagnose the operating status of the inverter.
- PLC function data copy: The PLC function project data copied in the USB memory device can be copied to other inverters. This function is useful in backing up the parameter setting and for allowing multiple inverters to operate by the same sequence programs.

LED display

- Status:
  - OFF: No USB connection.
  - ON: The communication is established between the inverter and the USB device.
  - Fast blinking: The USB memory device is being accessed. Do not remove the USB memory device.
  - Slow blinking: Error in the USB connection.

- Operating status:
  - USB host: The USB host communication is enabled. The USB host communication enables the following functions.
    - Different inverters can be saved in a USB memory device.
    - The USB host communication enables the following functions:
      - When the inverter recognizes the USB memory device without any problem, OFF - is briefly displayed on the operation panel.
      - When the USB memory device is removed, OFF - is briefly displayed on the operation panel.
      - The operating status of the USB host can be checked on the LED display of the inverter.

- NOTE:
  - Do not connect devices other than a USB memory device to the inverter.
  - If a USB device is connected to the inverter via a USB hub, the inverter cannot recognize the USB memory device properly.
  - For details of usage, refer to the FR-A800 Instruction Manual (Detailed).
Communication connectors and terminals

**USB device communication**

A USB (Ver. 1.1) cable connects the inverter with a personal computer. Parameter setting and monitoring can be performed by FR Configurator 2.

<table>
<thead>
<tr>
<th>Interface</th>
<th>Location of USB 1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission speed</td>
<td>12 Mbps</td>
</tr>
<tr>
<td>Wiring length</td>
<td>Maximum 5 m</td>
</tr>
<tr>
<td>Connector</td>
<td>USB mini B connector (receptacle)</td>
</tr>
<tr>
<td>Power supply</td>
<td>Self-powered</td>
</tr>
</tbody>
</table>

**NOTE**
- For the details of FR Configurator2, refer to the Instruction Manual of FR Configurator2.

### 2.7.3 RS-485 terminal block (RS-485 model)

**Communication operation**

<table>
<thead>
<tr>
<th>Conforming standard</th>
<th>EIA-485 (RS-485)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission format</td>
<td>Binary data</td>
</tr>
<tr>
<td>Communication speed</td>
<td>115200 bps (maximum)</td>
</tr>
<tr>
<td>Overall length</td>
<td>500 m</td>
</tr>
<tr>
<td>Connection cable</td>
<td>Twisted pair cable (4 pairs)</td>
</tr>
<tr>
<td>Terminating resistor switch</td>
<td>Initially set to &quot;OPEN&quot;. Set only the terminating resistor switch of the remotest inverter to the &quot;100Ω&quot; position.</td>
</tr>
</tbody>
</table>

To avoid malfunction, keep the RS-485 terminal wire away from the control circuit board.
- For wiring of the RS-485 terminals used with a plug-in option, lead the wires on the left side of the plug-in option.
2.7.4 Ethernet port (Ethernet model)

Ethernet communication specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>10BASE-T, 100BASE-TX</td>
</tr>
<tr>
<td>Data transmission speed</td>
<td>10 Mbps (10BASE-T), 100 Mbps (100BASE-TX)</td>
</tr>
<tr>
<td>Transmission medium</td>
<td>Unshielded</td>
</tr>
<tr>
<td>Maximum segment length</td>
<td>100 m between hub and the inverter</td>
</tr>
<tr>
<td>Number of cascade connection</td>
<td>Up to 2 (100BASE-TX), up to 4 (10BASE-T)</td>
</tr>
<tr>
<td>Network</td>
<td>Wired</td>
</tr>
<tr>
<td>Number of interfaces available</td>
<td>1</td>
</tr>
<tr>
<td>IPv version</td>
<td>IPv4</td>
</tr>
</tbody>
</table>

Connection cable

Use Ethernet cables compliant with the following standards.

<table>
<thead>
<tr>
<th>Communication speed</th>
<th>Cable</th>
<th>Connector</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Mbps</td>
<td>Category 5 or higher, shielded straight</td>
<td>RJ-45</td>
<td>10BASE-TX</td>
</tr>
<tr>
<td>10 Mbps</td>
<td>Category 5 or higher, unshielded straight</td>
<td>RJ-45</td>
<td>10BASE-TX</td>
</tr>
<tr>
<td>10 Mbps</td>
<td>Category 3 or higher, straight UTP</td>
<td>RJ-45</td>
<td>10BASE-TX</td>
</tr>
<tr>
<td>10 Mbps</td>
<td>Category 3 or higher, UTP straight</td>
<td>RJ-45</td>
<td>10BASE-TX</td>
</tr>
<tr>
<td>10 Mbps</td>
<td>Category 3 or higher, STP straight</td>
<td>RJ-45</td>
<td>10BASE-TX</td>
</tr>
<tr>
<td>10 Mbps</td>
<td>Category 3 or higher, STP straight</td>
<td>RJ-45</td>
<td>10BASE-TX</td>
</tr>
</tbody>
</table>

Hub

Use a hub that supports transmission speed of the Ethernet.
2.8 Connection of motor with encoder (vector control)

Using encoder-equipped motors together with a vector control compatible option enables speed and torque control operations under orientation control, encoder feedback control, and full-scale vector control.

This section explains wiring for use of the FR-A8AP.

**Appearance and parts name of FR-A8AP**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Mounting hole</td>
<td>Used for installation to the inverter.</td>
</tr>
<tr>
<td>b</td>
<td>Terminal block</td>
<td>Connected with the encoder.</td>
</tr>
<tr>
<td>c</td>
<td>Encoder type selection switch (SW3)</td>
<td>Switches the encoder type (differential line driver/complementary).</td>
</tr>
<tr>
<td>d</td>
<td>CON2 connector</td>
<td>Used for extension.</td>
</tr>
<tr>
<td>e</td>
<td>Terminating resistor selection switch (SW1)</td>
<td>Switches ON or OFF the internal terminating resistor.</td>
</tr>
<tr>
<td>f</td>
<td>Switch for manufacturer setting (SW2)</td>
<td>Do not change from the initially-set status. (Switches 1 and 2 are OFF.)</td>
</tr>
<tr>
<td>g</td>
<td>Connector</td>
<td>Connected to the option connector of the inverter.</td>
</tr>
<tr>
<td>h</td>
<td>LED for manufacturer check</td>
<td>Not used.</td>
</tr>
</tbody>
</table>

**Terminals of the FR-A8AP**

<table>
<thead>
<tr>
<th>Terminal symbol</th>
<th>Terminal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA1</td>
<td>Encoder A-phase signal input terminal</td>
<td>Terminal for inputting encoder A-phase signal.</td>
</tr>
<tr>
<td>PA2</td>
<td>Encoder A-phase inverse signal input terminal</td>
<td>Terminal for inputting encoder A-phase inverse signal.</td>
</tr>
<tr>
<td>PB1</td>
<td>Encoder B-phase signal input terminal</td>
<td>Terminal for inputting encoder B-phase signal.</td>
</tr>
<tr>
<td>PB2</td>
<td>Encoder B-phase inverse signal input terminal</td>
<td>Terminal for inputting encoder B-phase inverse signal.</td>
</tr>
<tr>
<td>PZ1</td>
<td>Encoder Z-phase signal input terminal</td>
<td>Terminal for inputting encoder Z-phase signal.</td>
</tr>
<tr>
<td>PZ2</td>
<td>Encoder Z-phase inverse signal input terminal</td>
<td>Terminal for inputting encoder Z-phase inverse signal.</td>
</tr>
<tr>
<td>PG</td>
<td>Encoder power supply (positive side) input terminal</td>
<td>Terminal for inputting the encoder power supply.</td>
</tr>
<tr>
<td>SD</td>
<td>Encoder power supply ground terminal</td>
<td>Terminal for grounding the encoder power supply.</td>
</tr>
<tr>
<td>PIN</td>
<td>Encoder power supply ground terminal</td>
<td>Terminal for grounding the encoder power supply.</td>
</tr>
<tr>
<td>PO</td>
<td>Not used.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**

- When the encoder's output voltage differs from its input power supply voltage, the signal loss detection (E.ECT) may occur.
- Incorrect wiring or faulty setting to the encoder will cause a fault such as overcurrent (E.OC) and an inverter overload (E.THT).
- Correctly perform the encoder wiring and setting.

- Refer to page

---

Connection of motor with encoder (vector control)
Connection of motor with encoder (vector control)

◆ Switches of the FR-A8AP

+ Encoder type selection switch (SW3)
  Select either the differential line driver or complementary setting. It is initially set to the differential line driver. Switch its position according to the output circuit.

+ Terminating resistor selection switch (SW1)
  Selects ON/OFF of the internal terminating resistor.
  Set the switch to ON (initial status) when an encoder output type is differential line driver, and set to OFF when complementary.
  ON: with internal terminating resistor (initial status)
  OFF: without internal terminating resistor

**NOTE**
- Set all switches to the same setting (ON/OFF).
- Set the switch "OFF" when sharing an encoder with another unit (NC, computerized numerical controller, etc.) having a terminating resistor under the differential line driver setting.
- Prepare an encoder's power supply (5 V, 12 V, 15 V, 24 V) according to the encoder's output voltage. When the encoder output is the differential line driver type, only 5 V can be input.
- The SW2 switch is for manufacturer setting. Do not change the setting.

+ Encoder specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>0 to 4096 Pulse/Rev (set by Pr.369)</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>5 V, 12 V, 15 V, 24 V</td>
</tr>
<tr>
<td>Output signal form</td>
<td>A, B phases (90° phase shift)</td>
</tr>
<tr>
<td>Output circuit</td>
<td>Differential line driver or complementary</td>
</tr>
</tbody>
</table>
Encoder cable

- **FR-JCBL**
- **FR-V7CBL**

<table>
<thead>
<tr>
<th>Terminal screw size</th>
<th>Wire gauge</th>
<th>Female part No.</th>
<th>Crimping tool model</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2</td>
<td>0.3, 0.5</td>
<td>AI 0.5-6WH</td>
<td>CRIMPFOX 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>0.3 to 0.75</td>
<td>BT 0.75-7</td>
<td>VC 0.75 NH 69</td>
</tr>
</tbody>
</table>

**NOTE**

- When using a blade terminal (without insulation sleeve), take caution that the twisted wires do not come out.

---

**Earth cable**

- FR-JCBL: 0.2 mm²
- FR-V7CBL: 0.2 mm²

<table>
<thead>
<tr>
<th>Model</th>
<th>Length L (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-JCBL5</td>
<td>5</td>
</tr>
<tr>
<td>FR-JCBL15</td>
<td>15</td>
</tr>
<tr>
<td>FR-JCBL30</td>
<td>30</td>
</tr>
</tbody>
</table>

**Shield earthing P-clip** is included.

---

When using an encoder cable (FR-JCBL, FR-V7CBL, etc.) dedicated to the conventional motor, the cables need to be treated as the terminal block of the FR-A8AP is an insertion type. Cut the crimp terminal of the encoder cable and strip its sheath to make its cable wires loose. Also, treat the shielding wires of the shielded twisted pair cable to ensure that they will not contact conductive areas. Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it.
Connection of motor with encoder (vector control)

INSTALLATION AND WIRING

Connection terminal compatibility table

<table>
<thead>
<tr>
<th>Encoder cable</th>
<th>FR-VFCBAL</th>
<th>FR-VFCL</th>
<th>FR-JCBAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-ANMV terminal</td>
<td>PA1</td>
<td>PA2</td>
<td>PA1</td>
</tr>
<tr>
<td>PA2</td>
<td>PB1</td>
<td>PB2</td>
<td>PB1</td>
</tr>
<tr>
<td>PB2</td>
<td>PZ1</td>
<td>PZ2</td>
<td>PZ1</td>
</tr>
<tr>
<td>PZ2</td>
<td>PG</td>
<td>SD</td>
<td>SD</td>
</tr>
</tbody>
</table>

- Wiring example
  - Speed control

  Standard motor with encoder, 5 V differential line driver

  Vector control dedicated motor, 12 V complementary

- Torque control

  Standard motor with encoder, 5 V differential line driver

  Vector control dedicated motor, 12 V complementary
Instructions for encoder cable wiring

- Use shielded twisted pair cables (0.2 mm² or larger) to connect the FR-A8AP. For the wiring to terminals PG and SD, use several cables in parallel or use a thick cable, according to the wiring length.

  - To protect the cables from noise, run them away from any source of noise (such as the main circuit and power supply voltage).

  - The wiring length can be extended to 100 m by increasing the 5 V power supply (approximately to 5.5 V) while using six or more 0.2 mm² gauge cables in parallel or a 1.25 mm² or larger gauge cable. The voltage applied must be within power supply specifications of encoder.

- To reduce noise of the encoder cable, earth (ground) the encoder's shielded cable to the enclosure (as close as possible to the inverter) with a P-clip or U-clip made of metal.

- When one encoder is shared between FR-A8AP and CNC (computerized numerical controller), its output signal should be connected as shown below. In this case, the wiring length between FR-A8AP and CNC should be as short as possible, within 5 m.

- For the details of the optional encoder dedicated cable (FR-JCBL, FR-V7CBL), refer to page 62.

  - The FR-V7CBL is provided with a P-clip for earthing (grounding) shielded cables.

  - A separate power supply of 5 V / 12 V / 24 V is necessary according to the encoder power specification. When the encoder output is the differential line driver type, only 5 V can be input.

  - The pin number differs according to the encoder used. The control works properly with or without the Z-phase being connected.

  - Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio must be 1 : 1.

  - Earth (ground) the shield of the encoder cable to the enclosure using a lead such as a P-clip. (See page 61.)

  - The voltage of the external power supply must be within power supply specifications of encoder.

  - The FR-V7CBL is provided with a P-clip for earthing (grounding) shielded cables.

  - Earth (ground) the shield of the encoder cable to the enclosure using a tool such as a P-clip. (Refer to page 64.)

  - For terminal compatibility of the FR-JCBL, FR-V7CBL, and FR-A8AP, refer to page 63.
2.9 Parameter settings for a motor with encoder

◆Parameter for the encoder (Pr.359, Pr.369, Pr.851, Pr.852)

- Set the encoder specifications.

<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>259</td>
<td>Encoder rotation direction</td>
<td>1</td>
<td>0 to 1</td>
<td>Set when using a motor for which forward rotation (encoder) is clockwise (CW) viewed from the shaft. Set for the operation at 120 Hz or less.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>Set for the operation at a frequency higher than 120 Hz.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Set when using a motor for which forward rotation (encoder) is counterclockwise (CCW) viewed from the shaft. Set for the operation at 120 Hz or less.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>101</td>
<td>Set for the operation at a frequency higher than 120 Hz.</td>
</tr>
<tr>
<td>269</td>
<td>Number of encoder pulses</td>
<td>1 (fixed pulses of 1024)</td>
<td>0 to 4096</td>
<td>Set the number of encoder pulses output. Set the number of pulses before it is multiplied by 4.</td>
</tr>
</tbody>
</table>

The parameters above can be set when a vector control compatible option is installed.

<table>
<thead>
<tr>
<th>Item</th>
<th>FR-A8AP/FR-A8AL parameter</th>
<th>FR-A8APR parameter</th>
<th>FR-A8APS parameter</th>
<th>FR-AETP parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder rotation direction</td>
<td>Pr.359, Pr.852</td>
<td>Pr.359, Pr.852</td>
<td>Pr.359, Pr.852</td>
<td>Pr.359, Pr.852</td>
</tr>
<tr>
<td>Number of detector pulses</td>
<td>Pr.369</td>
<td>Pr.369</td>
<td>Pr.851</td>
<td>Pr.851</td>
</tr>
</tbody>
</table>

◆Parameter settings for the motor under vector control

<table>
<thead>
<tr>
<th>Motor name</th>
<th>Pr.9 Electronic thermal O/L relay</th>
<th>Pr.71 Applied motor</th>
<th>Pr.80 Motor capacity</th>
<th>Pr.81 Number of motor poles</th>
<th>Pr.359 Encoder rotation direction</th>
<th>Pr.266 Number of encoder pulses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard motor</td>
<td>Rated motor current 3 (5)</td>
<td>Motor capacity</td>
<td>Number of motor poles</td>
<td>1</td>
<td>Encoder rotation direction</td>
<td>1 (fixed pulses of 1024)</td>
</tr>
<tr>
<td>Constant-torque motor</td>
<td>Rated motor current 1 (5)</td>
<td>Motor capacity</td>
<td>Number of motor poles</td>
<td>1</td>
<td>Encoder rotation direction</td>
<td>1 (fixed pulses of 1024)</td>
</tr>
</tbody>
</table>

- For offline auto tuning is required. Refer to the FR-A800 Instruction Manual (Detailed).

- Set the parameters according to the motor.
Connection of stand-alone option units

2.10 Connection of stand-alone option units

The inverter accepts a variety of stand-alone option units as required. Incorrect connection will cause inverter damage or accident. Connect and operate the option unit carefully in accordance with the corresponding option unit manual.

2.10.1 Connection of the brake unit (FR-BU2)

Connect the brake unit (FR-BU2) as shown below to improve the braking capability during deceleration.

After wiring securely, set Pr.30 Regenerative function selection = "11 or 111".

Set Pr.0 Brake mode selection = "2" in the brake unit FR-BU2.

NOTE

• The stall prevention (overvoltage), oL, does not occur while Pr.30 Regenerative function selection = "11 or 111".

• For the parameter details, refer to the FR-A800 Instruction Manual (Detailed).

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

∗2 For wiring to terminals P/+ and N/- of the FR-A842-08R60(355K) or lower inverters, up to two cables can be connected. For wiring to the terminals of the FR-A842-09R20(400K) or higher inverters, up to four cables can be connected. To use more cables, use a bus bar.

∗3 When the power supply is 400V class, install a step-down transformer.

∗4 The wiring distance between the inverter and brake unit (FR-BU2), and between the brake unit (FR-BU2) and resistor unit (MT-BR5) must be within 10 m. Even when the wire is twisted, the cable length must be within 10 m.

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

∗6 The CN8 connector used with the MT-BU5 type brake unit is not used.
2.10.2 Connection of the high power factor converter (FR-HC2)

When connecting the high power factor converter (FR-HC2) to suppress power harmonics, perform wiring securely as shown below. Incorrect connection will damage the high power factor converter and the inverter.

After making sure that the wiring is correct, set "rated motor voltage" in Pr.19 Rated motor voltage (under V/F control) or Pr.83 Regenerative function selection (under other than V/F control) and "2 or 102" in Pr.30 Regenerative function selection.

1. Remove jumpers installed in terminals R1/L11 and S1/L21 of the inverter, and connect the power supply for the control circuit to terminals R1/L11 and S1/L21.
2. The voltage phases of terminals R4/L14, S4/L24, and T4/L34 and the voltage phases of terminals R/L1, S/L2, and T/L3 must be matched.
3. Do not install an MCCB across terminals P/+ and N/- (across terminals P and P/+ or across N and N/-). Connecting the opposite polarity of terminals N/- and P/+ will damage the inverter.
4. Change the FR-HC2 parameter setting to Pr.10 RDY signal logic selection = "0" (positive logic).
5. Use Pr.178 to Pr.189 (input terminal function selection) to assign the terminals used for the X10 signal. For RS-485 or any other communication where the start command is only transmitted once, use the X11 signal to save the operation mode at the time of an instantaneous power failure.
6. Assign the IPF signal to an FR-HC2 terminal. (Refer to the Instruction Manual of FR-HC2.)
7. Always connect the FR-HC2 terminal RDY to the inverter terminal MRS (X10), and the FR-HC2 terminal SE to the inverter terminal SD. Not connecting these terminals may damage the FR-HC2.
8. Always connect the R/L1, S/L2, and T/L3 terminals of FR-HC2 to the power supply. Operating the inverter without connecting them will damage the FR-HC2.
9. Do not install an MCCB or MC between the reactor 1 terminals (R/L1, S/L2, T/L3) and the FR-HC2 terminals (R4/L14, S4/L24, T4/L34). It will not operate properly.
10. Securely perform grounding (earthing) by using the grounding (earthing) terminal.
11. The number of connected peripheral devices, differs according to the capacity. For the detail, refer to the FR-HC2 Instruction Manual.

---

[Diagram of wiring connections]
Connection of stand-alone option units

- The voltage phases of terminals R/L1, S/L2, and T/L3 and the voltage phases of terminals R4/L14, S4/L24, and T4/L34 must be matched.
- The control logic (sink logic/source logic) of the high power factor converter and the inverter must be matched. (Refer to page 46.)
- When using a sine wave filter with FR-AHC4, select MT-BHC as a reactor for the sine wave filter.
- For the parameter details, refer to the FR-A800 Instruction Manual (Detailed).

2.10.3 Connection of the power regeneration converter (MT-RC)

When connecting the power regeneration converter (MT-RC), perform wiring securely as shown below. Incorrect connection will damage the power regeneration converter and the inverter. After making sure that the wiring is correct, set “1 or 101” in Pr.30 Regenerative function selection.

- For wiring to terminals P/+ and N/- of the FR-A842-08660(355K) or lower inverters, up to two cables can be connected. For wiring to the terminals of the FR-A842-09620(400K) or higher inverters, up to four cables can be connected. To use more cables, use a bus bar.

- When using the inverter with the MT-RC, install a magnetic contactor (MC) at the input side of the inverter so that power is supplied to the inverter after 1 s or more has elapsed after powering ON the MT-RC. When power is supplied to the inverter prior to the MT-RC, the inverter and the MT-RC may be damaged or the MCCB may trip or be damaged.
- When connecting the power coordination reactor and others, refer to Instruction Manual of the MT-RC for precautions.
2.11 Installing a communication option

To use a communication option, the enclosed earthing (grounding) cable needs to be installed. Install the cable according to the following procedure.

**Installation procedure**

1. Insert spacers into the mounting holes that will not be tightened with the option mounting screws.
2. Fit the connector of the communication option to the guide of the connector of the inverter, and insert the option as far as it goes. (Insert it to the inverter option connector 1.)
3. Remove the mounting screw on the Ethernet board earth plate. Fit one terminal of the earthing (grounding) cable on the Ethernet board earth plate and fix it securely to the inverter with the mounting screw (lightening torque 0.33 N·m to 0.40 N·m). See the Instruction Manual of the communication option for details.
4. Fix the left part of the communication option securely with the option mounting screw, and place the other terminal of the earthing (grounding) cable on the right part of the option and fix it securely to the inverter with the option mounting screw (lightening torque 0.33 N·m to 0.40 N·m). If the screws do not line up, the connection may not be inserted deep enough. Check the connector.

- **Note:**
  - The number and shape of the spacers used differ depending on the communication option type. Refer to the Instruction Manual of each communication option for details.
  - The earth plate enclosed with a communication option is not used.
This chapter explains the precautions for use of this product. Always read the instructions before using the equipment.

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3.2 Power supply harmonics ........................................................................................................79
3.3 Installation of a reactor ................................................................................................................82
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3.7 Fallsafe system which uses the inverter .....................................................................................88
3.1 Electro-magnetic interference (EMI) and leakage currents

3.1.1 Leakage currents and countermeasures

Capacitances exist between the inverter I/O cables, other cables and earth and in the motor, through which a leakage current flows. Since its value depends on the static capacitances, carrier frequency, etc., low acoustic noise operation at the increased carrier frequency of the inverter will increase the leakage current. Therefore, take the following countermeasures. Select the earth leakage current breaker according to its rated sensitivity current, independently of the carrier frequency setting.

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

Leakage currents may flow not only into the inverter'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**
  - If the carrier frequency setting is high, decrease the Pr.72 PWM frequency selection setting.
    - Note that motor noise increases. Selecting Pr.240 Soft-PWM operation selection makes the sound inoffensive.
  - By using earth leakage circuit breakers designed for harmonic and surge suppression in the inverter's own line and other line operation can be performed with the carrier frequency kept high (with low noise).

**Line-to-line leakage currents**

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

- **Countermeasures**
  - Use Pr.9 Electronic thermal O/L relay.
  - If the carrier frequency setting is high, decrease the Pr.72 PWM frequency selection setting.
    - Note that motor noise increases. Selecting Pr.240 Soft-PWM operation selection makes the sound inoffensive.
  - To ensure that the motor is protected against line-to-line leakage currents, it is recommended to use a temperature sensor to directly detect motor temperature.
  - Installation and selection of the molded case circuit breaker
    - Install a molded case circuit breaker (MCCB) on the power receiving side to protect the wiring at the inverter input side. 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.

---

**Diagram**

- Power supply
- MCCB
- Line-to-line leakage currents path
- Motor
- Thermal relay
- Line-to-line static capacitance

---

PRECAUTIONS FOR USE OF THE INVERTER
Electro-magnetic interference (EMI) and leakage currents

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

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

- Breaker designed for harmonic and surge suppression
  \[ I_{\text{Δn}} \geq 10 \times (I_{g1} + I_{g2} + I_{gi} + I_{gm}) \]
- Standard breaker
  \[ I_{\text{Δn}} \geq 10 \times (I_{g1} + I_{g2} + I_{gi} + 3 \times (I_{gm} + I_{gn})) \]

**Example**

- Selection-example for the A 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 Ig1 (mA)</td>
<td>1 \times 66 \times 5 m = 0.113 \text{ 1000 m}</td>
<td></td>
</tr>
<tr>
<td>Leakage current Ign (mA)</td>
<td>0 (without noise filter)</td>
<td></td>
</tr>
<tr>
<td>Leakage current Igi (mA)</td>
<td>1 (without EMC filter)</td>
<td></td>
</tr>
<tr>
<td>Leakage current Ig2 (mA)</td>
<td>1 \times 66 \times 60 m = 1.323 \text{ 1000 m}</td>
<td></td>
</tr>
<tr>
<td>Motor leakage current Igm (mA)</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>Total leakage current (mA)</td>
<td>2.79 6.15</td>
<td></td>
</tr>
<tr>
<td>Rated sensitivity current (mA)</td>
<td>(\geq Ig \times 10)</td>
<td>30 100</td>
</tr>
</tbody>
</table>
Electro-magnetic interference (EMI) and leakage currents

**NOTE**
- Install the earth leakage circuit breaker (ELB) on the input side of the converter unit.
- In the AC connection earthed-neutral system, the sensitivity current is blunt against a ground fault in the inverter output side.
- Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes (NEC section 250, IEC 61140 class 1 and other applicable standards).
- When the breaker is installed on the output side of the inverter, it may be unnecessarily operated by harmonics even if the effective value is within the rating. In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.
- The following models are standard breakers BV-C1, BC-V, NV, NV-G2N, NV-G2MA, NV-2F, earth leakage relay (except NV-ZHA), and NV with AA-neutral wire open-phase protection. The other models are designed for harmonic and surge suppression: NV-C200/SMR series, NV-000A, NV10-FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, and NV-H.
- For the leakage current of a 75 kW or higher motor, contact the motor manufacturer.
3.1.2 Precautions against inverter-generated EMI

Some electromagnetic noises enter the inverter or the converter unit to cause its 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. For prevention of malfunction of peripheral devices caused by electromagnetic noises, EMI precautions should be taken to suppress noises. These techniques differ slightly depending on EMI paths.

- **Basic 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 or the 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 brakes, many relays, for example) are installed near the inverter or the converter unit and it 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 76) to signal cables.
  - Ground (Earth) the shields of the detector connection and control signal cables with cable clamp metal.

- **Techniques to reduce electromagnetic noises that are radiated by the inverter or 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 its main circuits (I/O), those electromagnetically and electrostatically induced to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.

![Diagram of EMI paths and noise propagation](image-url)
Electro-magnetic interference (EMI) and leakage currents

<table>
<thead>
<tr>
<th>Noise propagation path</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are connected to the main output cable that contains the inverter or the converter unit, or when their signal cables are run near the inverter; the devices may malfunction due to air-propagated electromagnetic noises. The following countermeasures must be taken:</td>
<td></td>
</tr>
<tr>
<td>- Install easily affected devices as far away as possible from the inverter or the converter unit.</td>
<td></td>
</tr>
<tr>
<td>- Run easily affected signal cables as far away as possible from the inverter or the converter unit, and its I/O cables.</td>
<td></td>
</tr>
<tr>
<td>- Do not run the signal cables and power cables (inverter or converter unit I/O cables) in parallel with each other.</td>
<td></td>
</tr>
<tr>
<td>- Do not bundle them.</td>
<td></td>
</tr>
<tr>
<td>- Set the EMC filter ON/OFF connector of the converter unit to the ON position (Refer to page 78.)</td>
<td></td>
</tr>
<tr>
<td>- Inserting a line noise filter into the output suppresses the radiated noise from the cables.</td>
<td></td>
</tr>
<tr>
<td>- Use shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.</td>
<td></td>
</tr>
</tbody>
</table>

When signal cables are run in parallel with or bundled with power cables, magnetic and static induction noises may be propagated to the signal cables to cause malfunction of the devices and the following countermeasures must be taken:

- Install easily affected devices as far away as possible from the inverter or the converter unit.
- Run easily affected signal cables as far away as possible from the inverter or the converter unit, and its I/O cables.
- Do not run the signal cables and power cables (inverter or converter unit I/O cables) in parallel with each other and do not bundle them.
- Use shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.

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, its generated noises may flow back through the power supply cables to cause malfunction of the devices and the following countermeasures must be taken:

- Set the EMC filter ON/OFF connector of the converter unit to the ON position (Refer to page 78.)
- Install the line noise filter to the power cables (output cables) of the inverter.

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 and cause the device to malfunction. In that case, disconnecting the earthing (grounding) cable from the device may stop the malfunction of the device.

### Data line filter

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

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

**Impedance (ZCAT3035-1330)**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Impedance (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 100 MHz</td>
<td>100 to 500 MHz</td>
</tr>
</tbody>
</table>

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

PRECAUTIONS FOR USE OF THE INVERTER
Electro-magnetic interference (EMI) and leakage currents

EMI countermeasure example

- Install filter on inverter output side.
- Use a twisted pair shielded cable for sensor cable.
- Use 4-core cable for motor power cable and use one cable as earth (ground) cable.
- Do not earth (ground) shield but connect it to signal common cable.
- Control power supply: Do not earth (ground) control cable.
- Do not earth (ground) enclosure directly.
- Decrease carrier frequency.

NOTE

• For compliance with the EU EMC Directive, refer to page 117.
### Electro-magnetic interference (EMI) and leakage currents

#### 3.1.3 Converter unit (FR-CC2) built-in EMC filter

The converter unit (FR-CC2) is equipped with a built-in EMC filter (capacitive filter). These filters are effective in reducing air-propagated noise on the input side of the converter unit. To enable the EMC filter, fit the EMC filter ON/OFF connector to the ON position. Both of two EMC filter ON/OFF connectors are initially set to the OFF position (disabled). To enable the EMC filter, fit the both EMC filter ON/OFF connectors to the ON position.

**<How to enable or disable the filter>**

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

**NOTE**

- Fit the connector to either ON or OFF position.
- Enabling (turning ON) the EMC filter increases leakage current. (Refer to page 73.)

**WARNING**

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

3.2.1 Power supply harmonics

The inverter 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
- Countermeasures

<table>
<thead>
<tr>
<th>Item</th>
<th>Harmonics</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Typically 40th to 50th degrees or less (3 kHz or less).</td>
<td>High frequency (several 10 kHz to 1 GHz order).</td>
</tr>
<tr>
<td>Environment</td>
<td>Electric channel, power impedance</td>
<td>Space, distance, wiring path.</td>
</tr>
<tr>
<td>Generated circuit</td>
<td>Proportion to the load capacity.</td>
<td>Proportion to the load capacity.</td>
</tr>
<tr>
<td>Affected equipment immunity</td>
<td>Specified by standards per equipment.</td>
<td>Different depending on maker’s equipment specifications.</td>
</tr>
</tbody>
</table>

| Generated amount | Nearly proportional to the load capacity. | Changes with the current variation ratio. (Gets larger as switching speed increases.) |

- The harmonic current generated from the inverter to the input side differs according to various conditions such as the wiring 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.

- 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 excess current flows in the inverter to activate overcurrent protections, do not provide a capacitor and surge suppressor on the inverter output side when the motor is driven by the inverter. For power factor improvement, install a reactor on the inverter input side or in the DC circuit.
### 3.2.2 Harmonic Suppression Guidelines in Japan

Inverters have a converter section (rectifier circuit) and generate a harmonic current. Harmonic currents flow from the inverter to a power receiving point via a power transformer. The Harmonic Suppression Guidelines were established to protect other consumers from these outgoing harmonic currents. The three-phase 200 V input specifications 3.7 kW or lower were previously covered by "the Harmonic Suppression Guidelines for Household Appliances and General-purpose Products" and other models were covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage". However, the transistorized inverter has been excluded from the target products covered by "the Harmonic Suppression Guidelines for Household Appliances and General-purpose Products" in January 2004 and "the Harmonic Suppression 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>Harmonic order</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>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>0.40</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>

### Conversions Factors for FR-A800 series

<table>
<thead>
<tr>
<th>Capability</th>
<th>Conversion Coefficient C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 phase</td>
<td>1.9</td>
</tr>
<tr>
<td>1 phase</td>
<td>2.1</td>
</tr>
</tbody>
</table>

### Equivalent Capacity Limits

<table>
<thead>
<tr>
<th>Received 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>

### Harmonic Content (Values of the fundamental current is 100%)
Power supply harmonics

- Calculation of equivalent capacity \( P_0 \) of harmonic generating equipment
  "Equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated by the following equation: If the sum of equivalent capacities is higher than the limit (refer to page 80), harmonics must be calculated with the following procedure:

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

- Calculation of outgoing harmonic current
  Outgoing harmonic current = fundamental wave current (value converted from received power voltage) \( \times \) operation ratio \( \times \) harmonic content

- Operation ratio
  Operation ratio = actual load factor \( \times \) operation time ratio during 30 minutes

- Harmonic content
  Found in page 80.

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

- Determining if a countermeasure is required
  A countermeasure for harmonics is required if the following condition is satisfied: outgoing harmonic current > maximum value per 1 kW contract power \( \times \) contract power.

- Harmonic suppression techniques

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reactor installation (FR-HAL)</td>
<td>The converter unit (FR-CC2) is equipped with a DC reactor on its DC side, and outgoing harmonic current can be suppressed. By installing an AC reactor (FR-HAL) on the AC side of the inverter, the outgoing harmonic current suppression performance can be improved.</td>
</tr>
<tr>
<td>2</td>
<td>High power factor converter (FR-HC2)</td>
<td>This converter trims the current waveform to be a sine waveform by switching the rectifier circuit (converter module) with transistors. Doing so suppresses the generated harmonic amount significantly. Connect it to the DC area of an inverter. Use the high power factor converter (FR-HC2) with the accessories that come as standard.</td>
</tr>
<tr>
<td>3</td>
<td>Installation of power factor improving capacitor</td>
<td>When used with a reactor connected in series, the power factor improving connection capacitor can absorb harmonic currents.</td>
</tr>
<tr>
<td>4</td>
<td>Transformer multi-phase operation</td>
<td>Use two transformers with a phase angle difference of 30° ( \Delta ) and ( \Delta - \Delta ) combinations to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.</td>
</tr>
<tr>
<td>5</td>
<td>Passive filter (AC filter)</td>
<td>A capacitor and a reactor are used together to reduce impedances at specific frequencies. Harmonic currents are expected to be absorbed greatly by using this technique.</td>
</tr>
<tr>
<td>6</td>
<td>Active filter (Active filter)</td>
<td>This filter detects the current in a circuit generating a harmonic current and generates a harmonic current equivalent to the 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 Installation of a reactor

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

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

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

- 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 converter unit input side current as JEM 103A-AC-3 (beam 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 STF(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.

  **NOTE**

  - Do not open or close the contactor while the inverter is running (outputting).
Countermeasures against deterioration of the 400 V class motor insulation

3.5 Countermeasures against deterioration of the 400 V class motor insulation

In the PWM type inverter, a surge voltage attributable to wiring constants is generated at the motor terminals. Especially in a 400 V class motor, the surge voltage may deteriorate the insulation. When the 400 V class motor is driven by the inverter, consider the following countermeasures:

- **Countermeasures**
  It is recommended to take one of the following countermeasures:
  
  - Rectifying the motor insulation and limiting the PWM carrier frequency according to the wiring length
    
    For the 400 V class motor, use an insulation-enhanced motor. Specifically,
    
    - Order a “400 V class inverter-driven insulation-enhanced motor”.
    - For the dedicated motor such as the constant-torque motor and low-vibration motor, use an “inverter-driven dedicated motor”.
    
    - Set Pr.72 PWM frequency selection as indicated below according to the wiring length.

<table>
<thead>
<tr>
<th>Wiring length</th>
<th>Pr.72 PWM frequency selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 m or shorter</td>
<td>6 (6 kHz) or lower</td>
</tr>
<tr>
<td>Longer than 100 m</td>
<td>4 (4 kHz) or lower</td>
</tr>
</tbody>
</table>

- Suppressing the surge voltage on the inverter side
  
  - If the motor capacity is 280 kW or lower, connect the sine wave filter (MT-BSL/BSC) to the output side.

  **NOTE**
  
  - When using the optional sine wave filter (MT-BSL/BSC), set Pr.72 “25” (2.5 kHz).
  - For the details of the sine wave filter (MT-BSL/BSC), refer to the Instruction Manual of each option.
  - A sine wave filter (MT-BSL/BSC) can be used under V/F control. Do not use the filters under different control methods.
### Checklist before starting operation

The FR-A800 series inverter and FR-CC2 converter unit are highly reliable products, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the products.

Before starting operation, always recheck the following points.

<table>
<thead>
<tr>
<th>Checkpoint</th>
<th>Countermeasure</th>
<th>Refer to page</th>
<th>Check by user</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crimp terminals are insulated.</td>
<td>Use crimp terminals with insulation sleeves to wire the power supply and the motor.</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>The wiring between the power supply (U/L1, V/L2, W/L3) and the motor (U, V, W) is correct.</td>
<td>Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>No wire offcuts are left from the time of wiring.</td>
<td>Wire offcuts can cause an earth fault or malfunction. Always check before and after making the wiring to ensure that all wire offcuts are removed.</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>No wire offcuts are left from the time of wiring.</td>
<td>Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter and the converter unit clean.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The main circuit cable gauge is correctly selected.</td>
<td>Use an appropriate cable gauge to suppress the voltage drop to 2% or less.</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>The total wiring length is within the specified length.</td>
<td>Keep the total wiring length within the specified length.</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Countermeasures are taken against EMI.</td>
<td>The input/output (main circuit) of the inverter and the converter unit includes high frequency components, which may interfere with the communication devices (such as AM radios). Use the EMC filter (turn ON the EMC filter ON/OFF connector) to minimize interference.</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>On the inverter's output side, there is no power factor correction capacitor, surge suppressor, or radio noise filter installed.</td>
<td>Doing so will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices is connected, immediately remove it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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 inverter is low enough using a tester, etc.</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>The inverter's output side has no short circuit or ground fault occurring.</td>
<td>A short circuit or earth (ground) fault on the inverter's output side may damage the inverter module. Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits caused by peripheral circuit inadequacy or an earth (ground) fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter module. Fully check the to-earth (ground) insulation and phase-to-phase insulation of the inverter's output side before power-ON. Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance, etc.</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>The circuit is not configured to use the converter unit's input-side magnetic contactor to start/stop the inverter frequently.</td>
<td>Since repeated inrush currents at power ON will shorten the life of the inverter and the converter unit, frequent starts and stops of the magnetic contactor must be avoided. Turn OFF/OFF the inverter's start signals (STF, STR) to run/stop the inverter.</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>The voltage applied to the I/O signal input of the inverter and the converter unit is within the specifications.</td>
<td>Circuits of the inverter and the converter unit are externally powered by input voltage that is not subject to signal voltage input from being connected incorrectly to start circuit terminals 1G2 and 1G3.</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Checkpoint</td>
<td>Countermeasure</td>
<td>Risk level</td>
<td>Check by user</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>------------</td>
<td>---------------</td>
</tr>
<tr>
<td>The converter unit and the inverter are correctly connected.</td>
<td>Make sure that terminal P of the converter unit and terminal P of the inverter are correctly connected. Connecting the opposite polarity of terminals P+ and P will damage the inverter. Also, do not install an MCCB across terminals P+ and P- (across terminals P and P+ or across N and N+).</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>When using the electronic bypass operation, electrical and mechanical interlocks are provided between the electronic bypass contactors MC1 and MC2.</td>
<td>If switching to the commercial power supply operation while a failure such as an output short circuit has occurred between the magnetic contactor MC2 and the motor, the damage may further spread. If a failure has occurred between the MC2 and the motor, a protection circuit such as using the OH signal input must be provided.</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A magnetic contactor (MC) is installed on the converter unit's input side.</td>
<td>To disconnect the inverter and the converter unit from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.). To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure. To separate the inverter and converter unit from the power supply to ensure safe maintenance and inspection work. If using an MC for emergency stop operation, select an MC regarding the converter unit input side current as JEM 1038-AC-3 class rated current.</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>An EMI countermeasure is provided for the frequency setting signals.</td>
<td>If electromagnetic noise generated from the inverter and converter unit causes frequency setting signal fluctuations and the motor rotation speed to be unstable when changing the motor speed with analog signals, the following countermeasures are effective: Do not run the signal cables and power cables (inverter and converter unit I/O cables) in parallel and do not bundle them. Use shielded cables.</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

### Diagram

The diagram shows the connections between the inverter, converter unit, and power supply. It includes terminals P+, P-, N+, N-, R/L1, S/L2, T/L3, and IM. The diagram illustrates the correct connection of terminals and the interlock system.
### Checklist before starting operation

<table>
<thead>
<tr>
<th>Checkpoint</th>
<th>Countermeasure</th>
<th>Refer to page</th>
<th>Quick by user</th>
</tr>
</thead>
<tbody>
<tr>
<td>A countermeasure is provided for an overload operation.</td>
<td>When performing frequent starts/stops by the inverter, install a 20 Hz or more transient characteristic of the inverter will repeat due to a repeated flow of large current, shortening the lifetime from thermal fatigue. Since thermal fatigue is related to the amount of current, the Bi-Cell has increased the thermal characteristics of the transistor elements. The thermal characteristics may extend the service life but may also cause torque shortage, which leads to a start failure. Adding a margin to the current can alleviate such a condition. For an induction motor, use the inverter and the converter unit of a higher capacity (up to two ranks).</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>The specifications and rating match the system requirements.</td>
<td>Make sure that the specifications and rating match the system requirements.</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Countermeasures are taken against electrical corrosion on the inverter housing.</td>
<td>When a motor is driven by the inverter, axial voltage is generated on the motor shaft, which may cause electrical corrosion of the bearing in rare cases depending on the wiring, load, operating conditions of the motor or specific inverter settings (high carrier frequency and EMC filter ON). Contact your sales representative to take appropriate countermeasures for the motor. The following shows examples of countermeasures for the inverter. Check the carrier frequency.</td>
<td>• Decrease the carrier frequency. • Turn OFF the EMC filter. • Provide a common mode choke on the output side of the inverter.</td>
<td></td>
</tr>
</tbody>
</table>

1. Recommended common mode choke: FT-3KM F series FINEMET® common mode choke cores manufactured by Hitachi Metals, Ltd. FINEMET is a registered trademark of Hitachi Metals, Ltd.
3.7 Failsafe system which uses the inverter

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

◆ Interlock method which uses the inverter status output signals

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

<table>
<thead>
<tr>
<th>No.</th>
<th>Interlock method</th>
<th>Check method</th>
<th>Used signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Inverter protective function operation</td>
<td>Operation check of alarm contacts (Circuit error detection by negative logic)</td>
<td>Fault(ALM) signal</td>
</tr>
<tr>
<td>b</td>
<td>Inverter operating status</td>
<td>Operation ready signal check</td>
<td>Operation ready (RY) signal</td>
</tr>
<tr>
<td>c</td>
<td>Inverter running status</td>
<td>Logic check of start signal and running signal</td>
<td>Start (STF/STR) signal, Running (RUN) signal</td>
</tr>
<tr>
<td>d</td>
<td>Inverter running status</td>
<td>Logic check of start signal and output current</td>
<td>Start (STF/STR) signal, Output current detection (Y12) signal</td>
</tr>
</tbody>
</table>

(a) Checking by the output of the inverter fault signal
When the inverter’s protective function is activated and the inverter trips, the Fault signal is output. (The ALM signal is assigned to terminal A1B1C1 in the initial setting).
With this signal, check that the inverter operates properly.
In addition, negative logic can be set. (ON when the inverter is normal, OFF when the fault occurs.)

(b) Checking the inverter operating status by the inverter operation ready completion signal
The Operation ready (RY) signal is output when the inverter power is ON and the inverter becomes operative.
Check if the RY signal is output after powering ON the inverter.

(c) Checking the inverter operating status by the start signal input to the inverter and inverter running signal
The Inverter running (RUN) signal is output when the inverter is running. (The RUN signal is assigned to terminal RUN in the initial setting.)
Check if the Y12 signal is being output while inputting a start signal to the inverter. (The STF signal is a forward rotation signal, and the STR signal is a reverse rotation signal.) Even after the start signal is turned OFF, the RUN signal is kept output until the inverter makes the motor to decelerate and to stop. For the logic check, configure a sequence considering the inverter’s deceleration time.
Failsafe system which uses the inverter

Checking the motor operating status by the start signal input to the inverter and inverter output current detection signal
The Output current detection (Y12) signal is output when the inverter operates and current flows into the motor. Check if the Y12 signal is being output while inputting a start signal to the inverter. (The STF signal is a forward rotation signal, and the STR signal is a reverse rotation signal.) The Y12 signal is initially set to be output at 150% inverter rated current. Adjust the level to around 20% using no-load current of the motor as reference with Pr.150 Output current detection level.

Like the inverter running (RUN) signal, even after the start signal is turned OFF, the Y12 signal is kept output until the inverter stops the output to a decelerating motor. For the logic check, configure a sequence considering the inverter's deceleration time.

<table>
<thead>
<tr>
<th>Output signal</th>
<th>Pr.190 to Pr.196 setting</th>
<th>Positive logic</th>
<th>Negative logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>STF</td>
<td>y</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>STR</td>
<td>y</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Y12</td>
<td>y</td>
<td>100</td>
<td>150</td>
</tr>
</tbody>
</table>

When using various signals, assign the functions to Pr.190 and Pr.196 (output terminal function selection) referring to the table on the left.

Backup method outside the inverter
Even if the interlock is provided by the inverter status signal, enough failsafe is not ensured depending on the failure status of the inverter itself. For example, if an inverter CPU fails in a system interlocked with the inverter's fault, start, and RUN signals, no fault signal will be output and the RUN signal will be kept ON because the inverter CPU is down. Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as performing a check as below according to the level of importance of the system.

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

(b) Command speed and actual operation check
Check for a gap between the actual speed and commanded speed by comparing the inverter's speed command and the speed detected by the speed detector.
This chapter explains the "PROTECTIVE FUNCTIONS" that operates in this product.
Always read the instructions before using the equipment.

4.1 Inverter fault and indications ................................................. 92
4.2 Reset method for the protective functions ............................ 92
4.3 Check and clear of the fault history ....................................... 93
4.4 List of fault displays ............................................................ 95
4.1 Inverter fault and indications

- When a fault occurs in the inverter, a protective function is automatically activated to shut off the inverter output and show an indication on the operation panel of the inverter.
- When any fault occurs, take an appropriate corrective action, then reset the inverter, and resume the operation. Restarting the operation without a reset may break or damage the inverter.
- When a protective function is activated, note the following points.

  - Inverter fault or alarm indications are categorized as below.
    - Fault output signal
      - A message regarding an operational fault and setting from the operation panel (FR-DU08) and parameter unit (FR-PU07) is displayed. The inverter does not trip.
    - Fault or alarm indication
      - A protective function is activated, the operation panel displays a fault indication.
    - Operation reset method
      - Reset the inverter by performing any of the following operations. Note that the accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the inverter. The inverter recovers about 1 s after the reset is released.

      - On the operation panel, press to reset the inverter. (This may only be performed when a fault occurs.)
      - Switch power OFF once, then switch it ON again.
      - Turn ON the Inverter reset (RES) signal for 0.1 s or more. (If the RES signal is kept ON, "Err" appears (blinks) to indicate that the inverter is in a reset status.)

          | Displayed Item | Description |
          |----------------|-------------|
          | Error message | A message regarding an operational fault and setting from the operation panel (FR-DU08) and parameter unit (FR-PU07) is displayed. The inverter does not trip. |
          | Warning       | The inverter does not trip when a warning is displayed, failure to take appropriate measures will lead to a fault. |
          | Alarm         | A protection function is activated to trip the inverter and output the Fault (ALM) signal. |
          | Fault         | A protective function is activated to trip the inverter and output the Fault (ALM) signal. |

4.2 Reset method for the protective functions

Reset the inverter by performing any of the following operations. Note that the accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the inverter. The inverter recovers about 1 s after the reset is released.

- On the operation panel, press to reset the inverter. (This may only be performed when a fault occurs.)
- Switch power OFF once, then switch it ON again.
- Turn ON the Inverter reset (RES) signal for 0.1 s or more. (If the RES signal is kept ON, "Err" appears (blinks) to indicate that the inverter is in a reset status.)

  - OFF status of the start signal must be confirmed before resetting the inverter fault. Reactivating or inverter fault with the start signal ON restarts the motor suddenly.
4.3 Check and clear of the fault history

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

**Check for the fault history**

- When an overcurrent trip occurs by an instantaneous overcurrent, the monitored current value saved in the fault history may be lower than the actual current that has flowed.
- The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.

<table>
<thead>
<tr>
<th>Fault history mode</th>
<th>Monitor mode</th>
<th>Parameter setting mode</th>
<th>Function mode</th>
</tr>
</thead>
</table>

**[Operation for displaying fault history]**

The last eight fault records can be displayed.

On the display of the last fault record (fault record 1), a decimal point LED is ON.

- Press the setting dial.
- Press the setting dial.
- Press the setting dial.
- Press the setting dial.

**Latest fault**

- Output frequency
- Output voltage
- Time
- Day
- Month
- Year

**Second latest fault**

- Output frequency
- Output voltage
- Time
- Day
- Month
- Year

**Eighth latest fault**

- Output frequency
- Output voltage
- Time
- Day
- Month
- Year

- When an unmeasured trip causes by an instantaneous overcurrent, the monitored current value saved in the fault history may be lower than the actual current that has flowed.
- The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.
## Clearing the fault history

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

### Operation

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Turning ON the power of the inverter. The monitor display appears.</td>
</tr>
<tr>
<td>2.</td>
<td>Selecting the parameter setting mode. Press [SET] to choose the parameter setting mode. (The parameter number read previously appears.)</td>
</tr>
<tr>
<td>4.</td>
<td>Fault history clear. Turn [ ] to change the set value to “1”. Press [SET] to select clear. “1” and Err.CL are displayed alternately after the fault history is cleared.</td>
</tr>
<tr>
<td></td>
<td>Turn [ ] to read another parameter.</td>
</tr>
<tr>
<td></td>
<td>Press [SET] to show the setting again.</td>
</tr>
<tr>
<td></td>
<td>Press [SET] twice to show the next parameter.</td>
</tr>
</tbody>
</table>
### 4.4 List of fault displays

For details, refer to the FR-A800 Instruction Manual (Detailed).

<table>
<thead>
<tr>
<th>Operation panel indication</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOL</strong></td>
<td>GCOL</td>
<td>Operation panel lock</td>
</tr>
<tr>
<td><strong>LOC</strong></td>
<td>GCOD</td>
<td>Parameter locked</td>
</tr>
<tr>
<td><strong>E.11</strong></td>
<td>E11</td>
<td>Communication or sensor fault</td>
</tr>
</tbody>
</table>
### List of fault displays

<table>
<thead>
<tr>
<th>Operation parameter</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Normal</td>
</tr>
<tr>
<td>E.0</td>
<td>No fault recorded</td>
</tr>
<tr>
<td>E.2</td>
<td>EV 24V external power supply operation</td>
</tr>
<tr>
<td>P2f</td>
<td>RD Backup in progress</td>
</tr>
<tr>
<td>R (P2f)</td>
<td>WR Restoration in progress</td>
</tr>
</tbody>
</table>

* If faults other than the above appear, contact your sales representative.*
5 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

This chapter explains the "PRECAUTIONS FOR MAINTENANCE AND INSPECTION" for this product.
Always read the instructions before using the equipment.

5.1 Inspection item ................................................................. 98
5.2 Measurement of main circuit voltages, currents and powers ......................................................... 105
Inspection item

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

● Precautions for maintenance and inspection

When accessing the inverter for inspection, wait for at least 10 minutes after the power supply has been switched OFF, and then make sure that the voltage across the main circuit terminals P+ and N- of the inverter is not more than 30 VDC using a tester, etc.

5.1 Inspection item

5.1.1 Daily inspection

Briefly, check for the following faults during operation.

- Motor operation fault
- Improper installation environment
- Cooling system fault
- Abnormal vibration, abnormal noise
- Abnormal overheat, discoloration

5.1.2 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.

Consult us for periodic inspection.

- Check and clean the cooling system. Clean the air filter, etc.
- Check the tightening and retighten. The screws and bolts may become loose due to vibration, temperature changes, etc. Check and tighten them. Tighten them according to the specified tightening torque. (Refer to page 38.)
- Check the conductors and insulating materials for corrosion and damage.
- Measure the insulation resistance.
- Check and change the cooling fan and relay.

NOTE

- When using the safety stop function, periodic inspection is required to confirm that the safety function of the safety system operates correctly.
- For more details, refer to the Safety Stop Function Instruction Manual (BCN-A0328-001).
### 5.1.3 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></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the surrounding air temperature, humidity, dirt, corrosive gas, oil mist, etc.</td>
<td>Daily</td>
<td>Inspect the environment.</td>
<td>User</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for unusual vibration and noise.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td><strong>Main circuit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the voltage at the main circuit terminals and earth (ground) terminals.</td>
<td>Daily</td>
<td>Inspect the voltage.</td>
<td>User</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for foreign objects on the main circuit.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for electrical short circuit and overheat.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td><strong>Operation check</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check that the output voltages are balanced while operating the inverter alone.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check that no fault is found in protective and display circuits in a sequence protective operation test.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td><strong>Cooling system</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for unusual vibration and noise.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for loose screws and bolts.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for stain.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check that messages are correct.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
<tr>
<td><strong>Load motor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for vibration and abnormal increase in operation noise.</td>
<td>Daily</td>
<td>Inspect the equipment.</td>
<td>User</td>
</tr>
</tbody>
</table>

**NOTE:**
- Continuous use of a leaked, deformed, or imperfectly smoothing aluminum electrolytic capacitor (as shown in the table above) may lead to a burst, breakdown or fire. Replace such capacitor without delay.
- Due to the nature of periodic inspection cycle, it does not change according to the installation environment.
- Consult us for periodic inspection.

---

**PRECAUTIONS FOR MAINTENANCE AND INSPECTION**

- All components of the load protection power unit inside the inverter may fail. The input components, however, are shock absorbable, surge and electrode and is not handled by humans. These affect such component.
- Do not perform a cold start during a voltage fault. Never perform a cold start during a voltage fault. This may cause an interruption of the power supplied to the inverter.
- One to five years of periodic inspection cycle is recommended. However, it differs according to the installation environment.
- Consult us for periodic inspection.
5.1.4 Checking the inverter and converter semiconductor devices

**Preparation**
- Disconnect the external power supply cables (R/L1, S/L2, T/L3) and motor cables (U, V, W). (The inverter and the converter unit (FR-CC2) can be measured with those cables connected.)
- Prepare a continuity tester. (For the resistance measurement, use the 100 Ω range.)

**Checking method**
Change the polarity of the tester alternately at a semiconductor device (transistor) on an electrical path between two terminals among the inverter main circuit terminals R/L1, S/L2, T/L3, U, V, W, P/+, and N/-. To check the electric continuity.

**NOTE**
- Before measurement, check that the smoothing capacitor is discharged.
- At the time of electric discontinuity, the measured value is almost ∞. When there is an instantaneous electric continuity, due to the smoothing capacitor, the tester may not indicate ∞. At the time of electric continuity, the measured value is several Ω to several tens of Ω. When all measured values are almost the same (although values may not be constant depending on the tester type), it shows that there are no electrical paths with problems.

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

<table>
<thead>
<tr>
<th>Semiconductor device</th>
<th>Continuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1, TR1, TR2, TR3</td>
<td>Yes</td>
</tr>
<tr>
<td>D2, TR4, TR5, TR6</td>
<td>Yes</td>
</tr>
<tr>
<td>D3</td>
<td>Yes</td>
</tr>
<tr>
<td>D4</td>
<td>Yes</td>
</tr>
</tbody>
</table>

(assuming that an analog meter is used)
5.1.5 Cleaning

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

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

5.1.6 Replacement of parts

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

The standard replacement interval of the inverter parts is as follows.

<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>On-board smoothing capacitor</td>
<td>10 years</td>
<td>Replace the board (as required)</td>
</tr>
<tr>
<td>Relays</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Main circuit fuse</td>
<td>10 years</td>
<td>Replace (as required)</td>
</tr>
</tbody>
</table>

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

◆Inverter parts life display

The inverter diagnoses the control circuit capacitor and the cooling fan 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 20%</td>
</tr>
<tr>
<td>Cooling fan</td>
<td>Estimated speed</td>
</tr>
</tbody>
</table>

**NOTE**
- Refer to the FR-A800 Instruction Manual (Detailed) to perform the life check of the inverter parts.
Inspection item

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) Before installing the new fan, check the orientation of the fan to be sure that the "AIR FLOW" arrow printed on the side of the fan points upward.
  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 inverter life to be shorter.
- Prevent the cable from being caught when installing a fan.
- Switch the power OFF before replacing fans. Since the inverter circuits are charged with voltage even after power OFF, replace fans only when the inverter cover is on the inverter to prevent an electric shock accident.
**Smoothing capacitors**

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

Inspecting the product visually:

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

**NOTE**

- The inverter diagnoses the control circuit capacitor by itself and can judge its life. (Refer to the FR-A800 Instruction Manual (Detailed)).

**Relay output terminals**

- The contacts of relays deteriorate over time. To prevent faults from occurring, relays must be replaced when they have reached the maximum of switching operations (switching life).
- The control terminal block must be replaced in case of failure of either relay connected to the relay output terminals A1, B1, and C1, or A2, B2, and C2. (After replacing the control terminal block, connect the jumper connector to the correct position in accordance with the control logic of input signals. Refer to page 46.)

**Main circuit fuse**

A fuse is used inside the inverter. Replacement intervals of fuses vary with surrounding temperatures and operating conditions. Replace them roughly every 10 years when used in normal air-conditioned environments.
5.1.7 Removal and reinstallation of the control circuit terminal block

The FR-A800 series inverter has a removable control circuit terminal block, which can be replaced with a new one or a control terminal option.

○ Removal and reinstallation

1) Loosen the two mounting screws at both sides of the control circuit terminal block. (These screws cannot be removed.) Slide down the control circuit terminal block to remove it.

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

○ Removal and reinstallation precautions

Precautions to be taken when removing or reinstalling the control circuit terminal block are shown below. Observe the following precautions and handle the inverter properly to avoid malfunctions or failures.

- To remove or reinstall the control circuit terminal block, keep it upright so that it is parallel with the inverter.
- To reinstall the control circuit terminal block, slide it upward so that the tongues on the inverter slot into the grooves on the terminal block.
- Check that the terminal block is parallel to the inverter and the pins on the inverter control circuit connector are not bent.

After checking proper connection, fix the terminal block in place with two screws.

- Do not tilt the terminal block while tightening the screws or removing it from the inverter. (Otherwise, stress applied to the control circuit terminal block or the control circuit connector may damage the pins.)
- After replacing the control terminal block, connect the jumper connector to the correct position in accordance with the control logic of input signals. (Refer to page 46.)
Measurement of main circuit voltages, currents and powers

5.2 Measurement of main circuit voltages, currents and powers

Since the voltages and currents on the inverter power supply and output sides include harmonics, measurement data depends on the instruments used and circuits measured.

When instruments for commercial frequency are used for measurement, measure the following circuits with the instruments given on the next page.

**NOTE**

- When installing meters etc. on the inverter output side

When the wiring length between the inverter and the motor is large, the meters and CTs may generate heat due to line-to-line leakage current. Therefore, choose equipment which has enough capacity for the current rating.

To measure and display the output voltage and output current of the inverter, it is recommended that the terminal AM and FM/CA output functions of the inverter are used.
### Measurement of main circuit voltages, currents and powers

#### 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>Converter unit (FR-CC2)</td>
<td>Power supply voltage across R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1</td>
<td>Digital power meter (for inverter)</td>
<td>P1 = W11 + W12 + W13 (3-wattmeter method)</td>
</tr>
<tr>
<td>Power supply side current</td>
<td>I1 R/L1, S/L2, T/L3 line current</td>
<td>Digital multimeter or other instrument</td>
<td></td>
</tr>
<tr>
<td>Power supply side power</td>
<td>P1 across R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1</td>
<td>P1 = W11 + W12 + W13 (3-wattmeter method)</td>
<td></td>
</tr>
<tr>
<td>Converter output voltage</td>
<td>V2 across U and V, V and W, and W and U</td>
<td>Digital power meter (designed for inverter)</td>
<td>Difference between the phases is within 1% of the maximum output voltage.</td>
</tr>
<tr>
<td>Output side current</td>
<td>I2 U, V and W line current</td>
<td>Digital power meter (designed for inverter)</td>
<td>Difference between the phases is 10% or lower of the inverter rated current.</td>
</tr>
<tr>
<td>Output side power</td>
<td>P2 across U, V, W and across U and V, V and W</td>
<td>P2 = W21 + W22 (2-wattmeter method or 3-wattmeter method)</td>
<td></td>
</tr>
<tr>
<td>Output side power factor</td>
<td>Pf2</td>
<td>Calculate in similar manner to power supply side power factor.</td>
<td></td>
</tr>
<tr>
<td>Frequency setting signal</td>
<td>Across 2, 4(+) and 5</td>
<td>Digital multimeter or other instrument</td>
<td>0 to 10 VDC, 4 to 20 mA</td>
</tr>
<tr>
<td>Frequency setting power supply</td>
<td>Across 10(+) and 5</td>
<td>Frequency meter</td>
<td>5.2 VDC</td>
</tr>
<tr>
<td>Start signal</td>
<td>Across STF, STR, RH, RM, RL, JOG, RT, AU, STOP, CS, RES, MRS(+) and SD (for sink logic)</td>
<td>When open 20 to 30 VDC, ON voltage: 1 V or less</td>
<td></td>
</tr>
<tr>
<td>Fault signal</td>
<td>Across A1 and C1</td>
<td>Digital multimeter or other instrument</td>
<td></td>
</tr>
</tbody>
</table>
5.2.1 Measurement of powers
Use a digital power meter (for inverter) for the input side of the converter unit (FR-CC2) and the output side of the inverter.

5.2.2 Measurement of voltages

- Converter unit (FR-CC2) input side
  Use digital power meters (for inverters) for the input side voltage.

- Inverter output side
  When using a measuring instrument, use a digital power meter for inverters as the inverter outputs PWM-controlled square wave voltage.

  The value displayed on the operation panel is the inverter-controlled voltage itself. Hence, that value is accurate and it is recommended to monitor values using the operation panel.

5.2.3 Measurement of currents
Use a digital power meter (for inverter) for the input side of the converter unit (FR-CC2) and the output side of the inverter. Since the converter unit input current tends to be unbalanced, measurement of three phases is recommended. The correct value cannot be obtained by measuring only one or two phases. On the other hand, the unbalanced ratio of each phase of the output current should be within 10%.

  The inverter output current can be monitored on the operation panel. The value displayed on the operation panel is accurate even if the output frequency varies. Hence, it is recommended to monitor values on the operation panel.

5.2.4 Example of measuring converter unit (FR-CC2) input power factor

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

\[
\text{Total power factor of the converter unit} = \frac{\text{Effective power}}{\text{Apparent power}} = \frac{\text{Three-phase input power found by the 3-wattmeter method}}{V \times I} \quad (V \text{ power supply voltage}, I \text{ input current effective value})
\]

5.2.5 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 voltmeter such as a digital multimeter. Although the voltage varies according to the power supply voltage, approximately 340 to 600 V is output when no load is connected and voltage decreases during driving load operation. When energy is regenerated from the motor during deceleration, for example, the converter output voltage rises to nearly 800 to 900 V maximum.
5.2.6 Measurement of inverter output frequency

In the initial setting of the FM type inverter, a pulse train proportional to the output frequency is output across the pulse train output terminals FM and SD of the inverter. This pulse train output can be counted by a frequency counter, or a digital multimeter can be used to read the mean value of the pulse train output voltage. When a meter is used to measure the output frequency, approximately 5 VDC is indicated at the maximum frequency.

For detailed specifications of the pulse train output terminal FM, refer to the FR-A800 Instruction Manual (Detailed).

In the initial setting of the CA type inverter, a pulse train proportional to the output frequency is output across the analog current output terminals CA and 5 of the inverter. Measure the current using a digital multimeter.

For detailed specifications of the analog current output terminal CA, refer to the FR-A800 Instruction Manual (Detailed).

5.2.7 Insulation resistance test using megger

- For the inverter and the converter unit (FR-CC2), 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 inverter and the converter unit so that the test voltage is not applied to the inverter and 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.

5.2.8 Pressure test

Do not conduct a pressure test. Deterioration may occur.
6 SPECIFICATIONS

This chapter explains the “SPECIFICATIONS” of this product.
Always read the instructions before using the equipment.

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6.3 Outline dimension drawings....................................................113
Inverter rating

6.1 Inverter rating

### 400 V class

<table>
<thead>
<tr>
<th>Inverter</th>
<th>315K</th>
<th>355K</th>
<th>400K</th>
<th>450K</th>
<th>500K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable motor capacity (kW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated capacity (kVA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated current (A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload current rating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regenerative braking torque</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Specifications

- **Inverter rating**
  - **400 V class**
    - **Inverter**
      - **Model**: FR-A442-[ ]-R2R
      - **Applicable motor capacity (kW)**
        - SLD 400 450 500 560 630
        - LD 355 400 450 500 560
        - SND 355 400 450 500 560
        - ND (initial setting) 315 355 400 450 500
        - HD 280 315 355 400 450
      - **Rated capacity (kVA)**
        - SLD 587 660 733 834 924
        - LD 521 587 660 733 834
        - SND 521 587 660 733 834
        - ND (initial setting) 465 521 587 660 733
        - HD 417 465 521 587 660
      - **Rated current (A)**
        - SLD 770 866 962 1094 1212
        - LD 683 770 866 962 1094
        - SND 683 770 866 962 1094
        - ND (initial setting) 610 683 770 866 962
        - HD 547 610 683 770 866
      - **Overload current rating**
        - SLD 110% 60 s, 120% 3 s (inverse-time characteristics) at surrounding air temperature of 40°C
        - LD 120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature of 50°C
        - SND 150% 60 s (inverse-time characteristics) at surrounding air temperature of 50°C
        - ND (initial setting) 150% 60 s, 200% 3 s (inverse-time characteristics) at surrounding air temperature of 50°C
        - HD 200% 60 s, 250% 3 s (inverse-time characteristics) at surrounding air temperature of 50°C
      - **Rated voltage**
        - Three-phase 380 to 500 V
      - **Regenerative braking torque**
        - (When the converter unit (FR-CCU2) is used)
      - **Overload brake torque**
        - 150% 60 s, 200% 3 s (inverse-time characteristics)
      - **Rated voltage**
        - Three-phase 380 to 500 V
      - **DC power supply voltage**
        - 430 to 780 VDC
      - **Control power supply auxiliary input**
        - Single phase 380 to 500 V 50 Hz/60 Hz
      - **Permissible control power supply auxiliary input fluctuation**
        - Frequency: ±5%, voltage: ±10%
      - **Protective structure (IEC 60529)**
        - Open type (IP00)
      - **Cooling system**
        - Forced air cooling
      - **Approx. mass (kg)**
        - 163 163 243 243 243
## 6.2 Common specifications

<table>
<thead>
<tr>
<th>Operational functions</th>
<th>Output frequency range</th>
<th>Output current range</th>
<th>Output voltage range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional selection</td>
<td>Pr.190 to Pr.196 (output terminal function selection)</td>
<td>Pr.54 FM/CA terminal function selection</td>
<td>Pr.54 FM/CA terminal function selection</td>
</tr>
<tr>
<td>Fault output</td>
<td>Pr.158 AM terminal function selection</td>
<td>Terminal 1: -10 to +10 V, -5 to 5 V are available.</td>
<td>Terminal 2 and 4: 0 to 10 V, 0 to 5 V, 4 to 20 mA (0 to 20 mA) are available.</td>
</tr>
<tr>
<td>Pulse train output</td>
<td>100k pulses/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse train input</td>
<td>100k pulses/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input signals</td>
<td>Pr.54 FM/CA terminal function selection (when used with option FR-A8AX)</td>
<td>Terminal 1: -10 to +10 V, -5 to 5 V are available.</td>
<td>Terminal 2 and 4: 0 to 10 V, 0 to 5 V, 4 to 20 mA (0 to 20 mA) are available.</td>
</tr>
<tr>
<td>Digital input</td>
<td>0.01 Hz</td>
<td>±10 V/12 bits for terminal 1</td>
<td>±10 V/12 bits for terminal 1</td>
</tr>
<tr>
<td>Analog input</td>
<td>0.2% of the max. output frequency (25°C ±10°C)</td>
<td>±10 V/12 bits for terminal 1</td>
<td>±10 V/12 bits for terminal 1</td>
</tr>
</tbody>
</table>

### Output signals

- Relay output (two terminals)
- Open collector output (five terminals)
- Start signal
- Forward and reverse rotation or start signal automatic self-holding input (3-wire input)
  - Setting
  - Setting
  - Setting
  - Setting

### Control method

- Pulse train output
- Pulse train input

### Operational functions

- Inverter running
- Up to frequency
- Overload warning
- Output frequency detection
- Fault stop/coasting
- Power-failure deceleration stop function
- PLC function
- Life diagnosis
- Maintenance timer
- Current average

### Frequency setting

- Operational functions
- Frequency setting
- Accuracy
- Frequency resolution

### Input signals

- Input signals (twelve terminals)

### Digital input

- Digital input
- 0.01 Hz

### Analog input

- Analog input
- 0.2% of the max. output frequency (25°C ±10°C)

### Frequency setting

- Frequency setting
- Accuracy
- Frequency resolution

### Operational functions

- Operational functions
- Frequency setting
- Accuracy
- Frequency resolution

### Input signals

- Input signals (twelve terminals)

### Digital input

- Digital input
- 0.01 Hz

### Analog input

- Analog input
- 0.2% of the max. output frequency (25°C ±10°C)
### Common specifications

#### Protective function

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overcurrent trip during acceleration</td>
<td>Overcurrent trip during constant speed</td>
</tr>
<tr>
<td>Overcurrent trip during deceleration or stop</td>
<td>Regenerative overvoltage trip during acceleration</td>
</tr>
<tr>
<td>Regenerative overvoltage trip during constant speed</td>
<td>Regenerative overvoltage trip during deceleration or stop</td>
</tr>
<tr>
<td>Inverter overload trip (electronic thermal relay function)</td>
<td>Motor overload trip (electronic thermal relay function)</td>
</tr>
<tr>
<td>Heat sink overheat</td>
<td>Stall prevention stop</td>
</tr>
<tr>
<td>Upper limit fault detection</td>
<td>Lower limit fault detection</td>
</tr>
<tr>
<td>Output side earth (ground) fault overcurrent</td>
<td>Output phase loss</td>
</tr>
<tr>
<td>External thermal relay operation</td>
<td>PTC thermistor operation</td>
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<tr>
<td>Option fault</td>
<td>Communication option fault</td>
</tr>
<tr>
<td>Parameter storage device fault (control circuit board)</td>
<td>PU disconnection</td>
</tr>
<tr>
<td>Retry count excess</td>
<td>Parameter storage device fault (main circuit board)</td>
</tr>
<tr>
<td>CPU fault</td>
<td>Operation panel power supply short circuit/RS-485 terminals power supply short circuit</td>
</tr>
<tr>
<td>Abnormal output current detection</td>
<td>Communication fault (inverter)</td>
</tr>
<tr>
<td>Analog input fault</td>
<td>Safety circuit fault</td>
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<tr>
<td>Overspeed occurrence</td>
<td>Speed deviation excess detection</td>
</tr>
<tr>
<td>Signal line detection</td>
<td>Signal line detection</td>
</tr>
<tr>
<td>Y-axis deviation measurement detection</td>
<td>Signal line detection</td>
</tr>
<tr>
<td>Encoder phase fault</td>
<td>4 mA input fault</td>
</tr>
<tr>
<td>PID signal fault</td>
<td>Option fault</td>
</tr>
<tr>
<td>Opposite rotation deceleration fault</td>
<td>Internal circuit fault</td>
</tr>
<tr>
<td>Encoder pulse number setting error</td>
<td>Overload trip</td>
</tr>
<tr>
<td>Ethernet communication fault</td>
<td>Load fault warning</td>
</tr>
</tbody>
</table>

#### Warning function

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan alarm</td>
<td>Stall prevention (overcurrent)</td>
</tr>
<tr>
<td>Stall prevention (overvoltage)</td>
<td>Electronic thermal relay function pre-alarm</td>
</tr>
<tr>
<td>PU stop</td>
<td>Speed limit indication (output during speed limit)</td>
</tr>
<tr>
<td>Parameter copy</td>
<td>Safety stop</td>
</tr>
<tr>
<td>Maintenance timer 1 to 3</td>
<td>USB host error</td>
</tr>
<tr>
<td>Operation panel lock</td>
<td>Password locked</td>
</tr>
<tr>
<td>Parameter write error</td>
<td>Copy operation error</td>
</tr>
<tr>
<td>24 V external power supply operation</td>
<td>Ethernet communication fault</td>
</tr>
</tbody>
</table>

#### Environment

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surrounding air temperature</td>
<td>-10°C to +50°C (non-freezing) (LD, SND, ND, HD ratings)</td>
</tr>
<tr>
<td></td>
<td>-10°C to +40°C (non-freezing) (SLD rating)</td>
</tr>
<tr>
<td>Surrounding air humidity</td>
<td>95% RH or less (non-condensing) (With circuit board coating (conforming to IEC 60721-3-3 3C2/3S2))</td>
</tr>
<tr>
<td></td>
<td>90% RH or less (non-condensing) (Without circuit board coating)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20°C to +65°C</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt, etc.)</td>
</tr>
<tr>
<td>Altitude/vibration</td>
<td>Maximum 2500 m above sea level, 2.9 m/s² or less at 10 to 55 Hz (directions of X, Y, Z axes)</td>
</tr>
</tbody>
</table>

---

* Available for a time when a certain condition is met.
* In the initial setting, it is limited to 150% by the torque limit level.
* Temperature applicable for a short time, e.g. in transit.
* For the installation at an altitude above 1000 m, derate the rated current 3% per 500 m.
* This protective function is not available in the initial status.
* Available for the Ethernet models only.
6.3 Outline dimension drawings

6.3.1 Inverter outline dimension drawings

FR-A842-07700(315K), FR-A842-08660(355K)-R2R
FR-A842-09620(400K), FR-A842-10940(450K), FR-A842-12120(500K)-R2R

[Unit: mm]
Outline dimension drawings

Operation panel (FR-DU08)

**27.8 mm**

**FR-DU08**

**Operation panel connection connector (FR-ADP) (option)**

**66 mm**

**72.5 mm**

**78.5 mm**

**3 mm**

**3 mm**

**3 mm**

**72 mm**

**16 mm**

**17 mm**

**3.2**

* Denotes the space required to connect an optional parameter unit connection cable (FR-CB2[ ]). When using another cable, leave the space required for the cable specification.
APPENDIX provides the reference information for use of this product. Refer to APPENDIX as required.

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Appendix 2 Instructions for compliance with the EU Directives ..117
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Appendix 5 Restricted Use of Hazardous Substances in
  Electronic and Electrical Products .................................123
Appendix 6 Referenced Standard (Requirement of Chinese
  standardized law) .....................................................123
## Appendix 1  Comparison with FR-A840-R2R

<table>
<thead>
<tr>
<th>Item</th>
<th>FR-A840-R2R</th>
<th>FR-A842-R2R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr.30 Regenerative function selection</td>
<td>Setting range: 0 to 2, 10, 11, 20, 21, 100 to 102, 110, 111, 120, 121, Initial value: “0”</td>
<td>Setting range: 2, 10, 11, 102, 110, 111, Initial value: “10”</td>
</tr>
<tr>
<td>Pr.70 Special regenerative brake duty</td>
<td>With the parameter</td>
<td>Without the parameter</td>
</tr>
<tr>
<td>Monitor function (Pr.52, Pr.54, Pr.158, Pr.174 to Pr.176, Pr.182 to Pr.184)</td>
<td>Regenerative brake duty</td>
<td>Regenerative brake duty</td>
</tr>
<tr>
<td>PR.174 Input terminal function selection (Pr.174 to Pr.183)</td>
<td>DC feeding operation permission (X70), DC feeding cancel (X71), DC feeding pre-alarm (RBP), DC current feedback (Y85), Main circuit capacitor life (Y87), Inrush current limit circuit life (Y89) Available</td>
<td>DC feeding operation permission (X70), DC feeding cancel (X71), DC feeding pre-alarm (RBP), DC current feedback (Y85), Main circuit capacitor life (Y87), Inrush current limit circuit life (Y89) Available</td>
</tr>
<tr>
<td>PR.177 Input terminal function selection</td>
<td>Initial value: “0” (NOT)</td>
<td>Initial value: “10” (NOT)</td>
</tr>
<tr>
<td>Output terminal function assignment selection (Pr.184 to Pr.230, Pr.313 to Pr.332)</td>
<td>Instantaneous power failure/undervoltage (IPF), During deceleration at occurrence of power failure retained until release (Y46), Regenerative brake pre-alarm (RBP), DC current feedback (Y85), Main circuit capacitor life (Y87), Inrush current limit circuit life (Y89) Available</td>
<td>Instantaneous power failure/undervoltage (IPF), During deceleration at occurrence of power failure retained until release (Y46), Regenerative brake pre-alarm (RBP), DC current feedback (Y85), Main circuit capacitor life (Y87), Inrush current limit circuit life (Y89) Available</td>
</tr>
<tr>
<td>Pr.188 IPF terminal function selection</td>
<td>Initial value: “2” (FF)</td>
<td>Initial value: “9999” (No function)</td>
</tr>
<tr>
<td>Input current limit circuit life display, Main circuit capacitor life display (Pr.224, Pr.256, Pr.258, Pr.259)</td>
<td>With the parameter</td>
<td>Without the parameter</td>
</tr>
<tr>
<td>PR.192 Input phase loss protection selection</td>
<td>Initial value: “0” (NC contact specification)</td>
<td>Initial value: “1” (NC contact specification)</td>
</tr>
<tr>
<td>Warning, protective functions</td>
<td>Regenerative brake pre-alarm (E.BE), Instantaneous power failure (E.IPF), Undervoltage (E.UVT), Input phase loss (E.ILF), Brake transistor alarm detection (E.BE), Inrush current limit circuit fault (E.IOH) Not available</td>
<td>Regenerative brake pre-alarm (E.BE), Instantaneous power failure (E.IPF), Undervoltage (E.UVT), Input phase loss (E.ILF), Brake transistor alarm detection (E.BE), Inrush current limit circuit fault (E.IOH) Not available</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

  Company name: Mitsubishi Electric Europe B.V.
  Address: Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany

◆EMC Directive

We declare that this inverter conforms with the EMC Directive and affix the CE marking on the inverter.

- EMC Directive 2014/30/EU
- This inverter is not intended to be used on a low-voltage public network which supplies domestic premises. When using the inverter in a residential area, take appropriate measures and ensure the conformity of the inverter used in the residential area.
- The installer shall provide a guide for installation and use, including recommended mitigation devices.

Note:
First environment
Environment including buildings/facilities which are directly connected to a low voltage main supply which also supplies residential buildings. Directly connected means that there is no intermediate transformer between these buildings.

Second environment
Environment including all buildings/facilities which are not directly connected to a low voltage main supply which also supplies residential buildings.

◆Note
Set the EMC filter valid and install the inverter and perform wiring according to the following instructions:
- The FR-CC2 converter unit used with this inverter is equipped with a built-in EMC filter (Class C3). Enable the EMC filter. (For details, refer to page 78.)
- 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-113) according to the instruction.
- To make full use of the built-in EMC filter, motor cable lengths should not exceed 20 m.
- Confirm that the inverter and the converter unit conforms with the EMC Directive as the industrial drives application for final installation.
Low Voltage Directive

We have self-confirmed our inverters as products compliant to the Low Voltage Directive and affix the CE marking on the inverters.

- Conforming standard: EN 61800-5-1:2007

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 terminal independently. (Do not connect two or more cables to one terminal.)
- Use the cable sizes on page 38 under the following conditions.
- Surrounding air temperature 40°C maximum

If conditions are different from above, select appropriate wire according to EN 60204-1 or IEC 60364-5-52.

- Use a tin-plated (polished) earth terminal to connect the earth (ground) cable. When tightening the screw, be careful not to damage the threads.
- Use as a product compliant with the Low Voltage Directive, use PVC cable whose size is indicated on page 38.
- Use the molded case-circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
- DC current may flow from the inverter to a protective earth (ground) conductor. When using a residual current device (RCD) or residual current monitor (RCoM), connect a type B RCD or RCM to the power supply side.
- Use the inverter under the conditions of overvoltage category II (suitable with the earthed-neutral system power supply, 400 V class only) and pollution degree 2 or lower specified in IEC 60664.
- To use the inverter 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 27 are safely isolated from the main circuit.
- Environment (For the detail, refer to page 28.)

- Branch circuit protection

Class T, Class J, Class CC, or Class L fuses must be provided. (Use a product which conforms to the EN or IEC Standard.)

- Short circuit ratings

Suitable For Use in A-Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 V Maximum.
**Motor overload protection**

When using the electronic thermal relay function as motor overload protection, set the rated motor current in \( Pr.9 \) Electronic thermal O/L relay.

### NOTE
- The internal accumulated heat value of the electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power OFF.
- Install an external thermal relay (OCR) between the inverter and motors to operate several motors, a multi-pole motor or a dedicated motor with one inverter. Note that the current indicated on the motor rating plate is affected by the line-to-line leakage current (Refer to page 72) when selecting the setting for an external thermal relay.
- The cooling effect of the motor drops during low-speed operation. Use a thermal protector or a motor with built-in thermistor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In such cases, use an external thermal relay.
- A dedicated motor cannot be protected by an electronic thermal O/L relay. Use an external thermal relay.
- Motor over temperature sensing is not provided by the drive.
- Electronic thermal memory retention function is not provided by the drive.
Appendix 3  Instructions for UL and cUL

(Standard to comply with: UL 508C, CSA C22.2 No.274-13)

◆ General Precaution

CAUTION - Risk of Electric Shock -
The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P/+ and N/- with a meter etc., to avoid a hazard of electrical shock.
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, mettre l’appareil hors tension et attendez plus de 10 minutes.

◆ Installation

The FR-A802 inverters with 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 inverter will satisfy the specifications. (Refer to page 20.)

◆ Branch circuit protection

For installation in the United States, Class T, Class J, Class CC, or Class L fuses must be provided, in accordance with the National Electrical Code and any applicable local codes.
For installation in Canada, Class T, Class J, Class CC, or Class L fuses must be provided, in accordance with the Canadian Electrical Code and any applicable local codes.

◆ Wiring to the power supply and the motor

Refer to the National Electrical Code (Article 310) regarding the allowable current of the cable. Select the cable size for 125% of the rated current according to the National Electrical Code (Article 430).
For wiring the input (R/L1, S/L2, T/L3) terminals of the converter unit and output (U, V, W) terminals of the inverter, use the UL listed copper, stranded wires (rated at 75°C) and round crimp terminals. Crimp the terminals with the crimping tool recommended by the terminal maker.

◆ Short circuit ratings

Suitable for use in a circuit capable of delivering not more than 100 A rms symmetrical amperes, 500 V maximum.
When using the electronic thermal relay function as motor overload protection, set the rated motor current in Pr.9 Electronic thermal O/L relay.

NOTE
• The internal accumulated heat value of the electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.
• Install an external thermal relay (OCR) between the inverter and motors to operate several motors, a multi-pole motor or a dedicated motor with one inverter. Note that the current indicated on the motor rating plate is affected by the line-to-line leakage current (Refer to page 72) when selecting the setting for an external thermal relay.
• The cooling effect of the motor drops during low-speed operation. Use a thermal protector or a motor with built-in thermistor.
• When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In such case, use an external thermal relay.
• A dedicated motor cannot be protected by an electronic thermal O/L relay. Use an external thermal relay.
• Motor over temperature sensing is not provided by the drive.

Operation characteristics of electronic thermal relay function

This function detects the overload (overheat) of the motor and trips the inverter by stopping the operation of the transistor at the inverter output side. (The operation characteristic is shown on the left.)

1. Mitsubishi Electric constant-torque motor
   (1) Set one of "1", "13" to "16" in Pr.71. (This setting will enable the 100% constant-torque characteristic in the low-speed range.)
   (2) Set the rated current of the motor in Pr.9.

   ∗1 When a value 50% of the inverter rated output current (current value) is set in Pr.9

   ∗2 The % value denotes the percentage to the inverter rated current. It is not the percentage to the rated motor current.

   ∗3 When you set the electronic thermal relay function dedicated to the Mitsubishi Electric constant-torque motor, this characteristic curve applies to operation at 6 Hz or higher.

   ∗4 Transistor protection is activated depending on the temperature of the heat sink. The protection may be activated even with less than 150% depending on the operating conditions.

<table>
<thead>
<tr>
<th>Inverter output power (% of inverter rating)</th>
<th>Operation time (s)</th>
<th>Operation time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% 50% 105% 50 100 150 60 120 180 240 50 60 70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Range for the transistor protection

Second display in this region

Minute display in this region

Operation region

Region on the right of characteristic curve

Non-operation region

Region on the left of characteristic curve

◆Motor overload protection

This function detects the overload (overheat) of the motor and trips the inverter by stopping the operation of the transistor at the inverter output side. (The operation characteristic is shown on the left.)

1. Mitsubishi Electric constant-torque motor

   (1) Set one of "1", "13" to "16" in Pr.71. (This setting will enable the 100% constant-torque characteristic in the low-speed range.)

   (2) Set the rated current of the motor in Pr.9.

   ∗1 When a value 50% of the inverter rated output current (current value) is set in Pr.9

   ∗2 The % value denotes the percentage to the inverter rated current. It is not the percentage to the rated motor current.

   ∗3 When you set the electronic thermal relay function dedicated to the Mitsubishi Electric constant-torque motor, this characteristic curve applies to operation at 6 Hz or higher.

   ∗4 Transistor protection is activated depending on the temperature of the heat sink. The protection may be activated even with less than 150% depending on the operating conditions.
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 purpose 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-TU), 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 Komandnaya 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。

<table>
<thead>
<tr>
<th>部件名称及说明</th>
<th>有害物质</th>
<th>限制值（容许）</th>
<th>约定限制值（容许）</th>
<th>含量</th>
<th>全球限量</th>
<th>含量二倍限量</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>

上表依据 SJ/T11364 的规定编制。
×：表示该有害物质在该部件的至少一种均质材料中含量超出 GB/T26572 规定的限量要求以下。
○：表示该有害物质在该部件的至少一种均质材料中含量为 GB/T26572 规定的限量要求以下。

Appendix 6 Referenced Standard (Requirement of Chinese standardized law)

This Product is designed and manufactured accordance with following Chinese standards.

Machinery safety: GB/T 16855.1
GB/T 12668.502
GB 28526
GB/T 12668.3
Electrical safety: GB/T 12668.001
EMC: GB/T 12668.3
WARRANTY

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

1. Warranty period and coverage

We will repair any failure or defect (hereinafter referred to as "Failure") in our Product (hereinafter referred to as the "Product") when a single (1) hundred twenty-four (124) days have passed after the date of purchase, as long as we are responsible for the failure. However, we will not be responsible for the actual cost of repairing the unit by another repairer or by a repairer designated by the user. We are not responsible for any unexpected result caused by a failure which may be required after the defective unit is repaired or replaced.

The term of warranty for Product is twelve months after the purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture when the date is not shown in the instruction manual or the caution label affixed to the Product.

(1) Warranty period for Product is twelve months after your purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture when the date is not shown in the instruction manual or the caution label affixed to the Product.

We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

• a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
• any other failures which we are not responsible for or which you acknowledge we are not responsible for

• a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem

• a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
• any other failures which we are not responsible for or which you acknowledge we are not responsible for

We will repair any failure or defect (hereinafter referred to as "Failure") in our FA equipment (hereinafter referred to as the "Product") arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider.

2. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

3. Service in overseas

(2) Our product is designed and manufactured as a general purpose product for use at general industries.

4. Change of Product specifications

(1) Any other failures which we are not responsible for or which you acknowledge we are not responsible for

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

5. Change of Product specifications

(1) If the use of our product is applications should be those that may not result in a serious damage even if any failure or malfunction occurs in a product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.

(2) Our product is designed and manufactured as a general purpose product for use at general industries.

If the application is substantially influential to public interest for such as atomic power plants and other power plants of electric power companies, and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used.

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule. It can also be carried out by us or our service company upon your request and at the actual cost of repair. We are not responsible for the cost of repair.

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions and are not faulty in the instruction manual and user manual for the Product and the instruction label affixed to the Product.

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule. It can also be carried out by us or our service company upon your request and at the actual cost of repair. We are not responsible for the cost of repair.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

(2) Please note that the Product (including its spare parts) can not be ordered after its stop of production.

(1) For the use of our product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in a product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

(1) For the use of our product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in a product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.

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

1. Warranty period and coverage

We will repair any failure or defect (hereinafter referred to as "Failure") in our FA equipment (hereinafter referred to as the "Product") when a single (1) hundred twenty-four (124) days have passed after the date of purchase, as long as we are responsible for the failure. However, we will not be responsible for the actual cost of repairing the unit by another repairer or by a repairer designated by the user. We are not responsible for any unexpected result caused by a failure which may be required after the defective unit is repaired or replaced.

The term of warranty for Product is twelve months after the purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture when the date is not shown in the instruction manual or the caution label affixed to the Product.

(1) Warranty period for Product is twelve months after your purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture when the date is not shown in the instruction manual or the caution label affixed to the Product.

We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

• a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
• any other failures which we are not responsible for or which you acknowledge we are not responsible for

• a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem

• a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
• any other failures which we are not responsible for or which you acknowledge we are not responsible for

We will repair any failure or defect (hereinafter referred to as "Failure") in our FA equipment (hereinafter referred to as the "Product") arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider.

2. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

3. Service in overseas

(2) Our product is designed and manufactured as a general purpose product for use at general industries.

4. Change of Product specifications

(1) Any other failures which we are not responsible for or which you acknowledge we are not responsible for

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

5. Change of Product specifications

(1) If the use of our product is applications should be those that may not result in a serious damage even if any failure or malfunction occurs in a product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.

(2) Our product is designed and manufactured as a general purpose product for use at general industries.

If the application is substantially influential to public interest for such as atomic power plants and other power plants of electric power companies, and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used.

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule. It can also be carried out by us or our service company upon your request and at the actual cost of repair. We are not responsible for the cost of repair.

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions and are not faulty in the instruction manual and user manual for the Product and the instruction label affixed to the Product.

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule. It can also be carried out by us or our service company upon your request and at the actual cost of repair. We are not responsible for the cost of repair.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

(2) Please note that the Product (including its spare parts) can not be ordered after its stop of production.

(1) For the use of our product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in a product, and a backup or fail-safe function should operate on an external system to product when any failure or malfunction occurs.

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

1. Warranty period and coverage

We will repair any failure or defect (hereinafter referred to as "Failure") in our FA equipment (hereinafter referred to as the "Product") when a single (1) hundred twenty-four (124) days have passed after the date of purchase, as long as we are responsible for the failure. However, we will not be responsible for the actual cost of repairing the unit by another repairer or by a repairer designated by the user. We are not responsible for any unexpected result caused by a failure which may be required after the defective unit is repaired or replaced.

The term of warranty for Product is twelve months after the purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture when the date is not shown in the instruction manual or the caution label affixed to the Product.

(1) Warranty period for Product is twelve months after your purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture when the date is not shown in the instruction manual or the caution label affixed to the Product.

We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.
About the enclosed CD-ROM
• The enclosed CD-ROM contains PDF copies of the manuals related to this product.

Before using the enclosed CD-ROM
• The copyright and other rights of the enclosed CD-ROM all belong to Mitsubishi Electric Corporation.
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  Intel and Pentium are trademarks of Intel Corporation in the United States and/or other countries.
  Any trade names and product names of companies herein are all trademarks or registered trademarks of those respective companies.
• Warranty
  We do not provide a warranty against defects in the enclosed CD-ROM and related documents.

NOTE
This is a personal computer dedicated CD-ROM. Do not attempt to play it on ordinary audio devices. The loud volume may damage hearing and speakers.

System requirements for the enclosed CD-ROM
• The following system is required to read instruction manuals contained in the enclosed CD-ROM.

Operating method of the enclosed CD-ROM
• How to read instruction manuals
  Step 1. Start the personal computer and place the enclosed CD-ROM in the CD-ROM drive.
  Step 2. The main window will automatically open in the web browser.
  Step 3. Choose your language from a language menu.
  Step 4. Click the manual you want to read in the “INSTRUCTION MANUAL” list.
  Step 5. The PDF manual will open.

• Manual opening of the enclosed CD-ROM
  Step 1. Start the personal computer and place the enclosed CD-ROM in the CD-ROM drive.
  Step 2. Open the “index.html” file.
  Step 3. The main window will open in the web browser. Follow the previous steps from Step 3 to Step 5.

• PDF data of the instruction manual are stored in “MANUAL” folder on the enclosed CD-ROM.

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<th>Item</th>
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<td>CPU</td>
<td>Pentium® or better processor</td>
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<td>Memory</td>
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<td>Monitor</td>
<td>800 × 600 dots or more</td>
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<td>Application</td>
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<td>Internet Explorer® 6.0 or more</td>
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INVERTER
A800 Plus
FR-A802-R2R (SEPARATED CONVERTER TYPE)
INSTRUCTION MANUAL (HARDWARE)

Roll to Roll Function
FR-A842-07700(315K) to 12120(500K)-R2R