MITSUBISHI ELECTRIC

INVERTER

FR-E800-HVC
Instruction Manual (Connection)
(200V / 400V CLASS)

Compact, high functionality inverters

FR-E820-0011(0.2K) to 0978(30K)-HVC
FR-E840-0018(0.75K) to 0510(30K)-HVC
FR-E820S-0011(0.2K) to 0082(2.2K)-HVC

CONTENTS

Safety Instructions

Thank you for choosing Mitsubishi Electric inverter.
This Instruction Manual provides detailed instructions for advanced settings of the FR-E800 series inverters.
Incorrect handling might cause an unexpected fault. Before using this product, read this Instruction Manual and the document enclosed with the product carefully to ensure proper use.
Do not attempt to install, operate, maintain or inspect this product until you have read through this Instruction Manual and supplementary documents carefully to use the equipment correctly. Do not use this product until you have a full knowledge of this product mechanism, safety information and instructions.
Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, qualified personnel means a person who meets all the following conditions:

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

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

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

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

◆Electric shock prevention

⚠WARNING

- Do not remove the front cover or the wiring cover while the power of this product is ON, and do not run this product with the front cover or the wiring cover removed as the exposed high voltage terminals or the charging part of the circuitry can be touched. Otherwise you may get an electric shock.
- Even if power is OFF, do not remove the front cover except for wiring or periodic inspection as the inside of this product is charged. Otherwise you may get an electric shock.
- Before wiring or inspection, check that the LED display of the operation panel is OFF. Any person who is involved in wiring or inspection shall wait for 10 minutes or longer after the power supply has been cut off, and check that there are no residual voltage using a digital multimeter or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
- This product must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 61140 class 1 and other applicable standards). A neutral-point earthed (grounded) power supply must be used for 400 V class of this product to be compliant with EN standard.
- Any person who is involved in wiring or inspection of this product shall be fully competent to do the work.
- This product body must be installed before wiring. Otherwise you may get an electric shock or be injured.
- Do not touch the setting dial or keys with wet hands. Doing so may cause an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Doing so may cause an electric shock.
- Do not change the cooling fan while power is ON as it is dangerous.
- Do not touch the printed circuit board or handle the cables with wet hands. Doing so may cause an electric shock.
- Never touch the motor terminals, etc. right after powering OFF as the DC voltage is applied to the motor for 1 second at powering OFF if the main circuit capacitor capacity is measured. Doing so may cause an electric shock.
- Before wiring or inspection for a PM motor, confirm that the PM motor is stopped as a PM motor is a synchronous motor with high-performance magnets embedded inside and high-voltage is generated at the motor terminals while the motor is running even after the power of this product is turned OFF. In an application, such as fan and blower, that the motor may be driven by the load, connect a low-voltage manual contactor at the output side of this product and keep it open during wiring and inspection of this product. Otherwise you may get an electric shock.

◆Fire prevention

⚠CAUTION

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

◆Injury prevention

⚠CAUTION

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

◆Additional instructions

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

⚠CAUTION

Transportation and installation

- To prevent injury, wear cut-resistant gloves when opening packaging with sharp tools.
- Use proper lifting techniques or a trolley when carrying products. Failure to do so may lead to injuries.
- Do not stand or place any heavy object on this product.
- Do not stack the boxes containing this product higher than the number recommended.
- When carrying this product, do not hold it by the front cover or the setting dial. It may fall or break.
- During installation, caution must be taken not to drop this product as doing so may cause injuries.
- The product must be installed on a surface that withstands the weight of the product.
- Do not install the product on a hot surface.
- Ensure the mounting orientation of this product is correct.
- Ensure this product is mounted securely with screws in its enclosure.
- Do not install or operate this product if it is damaged or has parts missing.
- Foreign conductive objects must be prevented from entering this product. That includes screws and metal fragments or other flammable substance such as oil.
- As this product is a precision instrument, do not drop or subject it to impact.
- The surrounding air temperature must be between -20°C and +50°C (non-freezing). Otherwise this product may be damaged.
- The ambient humidity must be 95% RH or less (non-condensing). Otherwise this product may be damaged.
- The temporary storage temperature (applicable to a short limited time such as a transportation time) must be between -40°C and +70°C. Otherwise this product may be damaged.
- This product must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt). Otherwise this product may be damaged.
- Do not use this product at an altitude above 3000 m. Vibration should not exceed 5.9 m/s^2 at 10 to 55 Hz in X, Y, and Z directions. Otherwise this product may be damaged. (Refer to page 32 for details.)
- If halogens (including fluorine, chlorine, bromine, and iodine) contained in fumigants for wood packages enter this product, the product may be damaged. Prevent the entry of fumigant residuals or use an alternative method such as heat disinfection. Note that sterilization or disinfection of wood packages should be performed before packing the product.

Wiring

- Do not install a power factor correction capacitor, surge absorber, or radio noise filter on the output side of this product. These devices may overheat or burn out.
- The output terminals (terminals U, V, and W) must be connected to a motor correctly. Otherwise the motor will rotate inversely.
- Even with the power OFF, high voltage is still applied to the terminals U, V and W while the PM motor is running. Ensure the PM motor has stopped before carrying out any wiring. Otherwise you may get an electric shock.
- Never connect a PM motor to a commercial power supply. Connecting a commercial power supply to the input terminals (U, V, W) of a PM motor will burn it out. The PM motor must be applied a power from the inverter with the output terminals (U, V, W).

Test operation

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

⚠ WARNING

Usage

- Stay away from the equipment after using the retry function in this product as the equipment will restart suddenly after the output shutoff of this product.
- Access to the motor is allowed only after it is fully confirmed that the motor does not start running.
- Depending on the function settings of this product, the product does not stop its output even when the STOP/RESET key on the operation panel is pressed. To prepare for it, provide a separate circuit and switch (to turn OFF the power of this product, or apply a mechanical brake, etc.) for an emergency stop.
- Be sure to turn OFF the start (STF/STR) signal before clearing the fault as this product will restart the motor suddenly after a fault is cleared.
- Do not use a PM motor for an application that the motor may be driven by the load and run at a speed higher than the maximum motor speed.
- Use only a three-phase induction motor or PM motor as a load on this product. Connection of any other electrical equipment to the output of this product may damage the equipment.
- Performing pre-excitation (LX signal and X13 signal) under torque control may start the motor running at a low speed even when the start signal (STF or STR) is not input. This product with the start command ON may also rotate the motor at a low speed when the speed limit value is set to zero. Confirm that the motor running does not cause any safety problems before performing pre-excitation.
- Do not modify this product.
- Do not remove any part which is not instructed to be removed in the Instruction Manuals. Doing so may lead to a failure or damage of this product.

⚠ CAUTION

Usage

- When installing the MC on the output side of the inverter, turn it ON/OFF while both the inverter and motor are at a stop.
- The electronic thermal O/L relay function may not be enough for protection of a motor from overheating. It is recommended to install an external thermal relay or a PTC thermistor for overheat protection.
- Do not repeatedly start or stop this product with a magnetic contactor on its input side. Doing so may shorten the life of this product.
- Use a noise filter or other means to minimize electromagnetic interference with other electronic equipment used nearby this product.
- Appropriate precautions must be taken to suppress harmonics. Otherwise harmonics in power systems generated from this product may heat/damage a power factor correction capacitor or a generator.
- To drive a 400 V class motor with this product, use an insulation-enhanced motor, or take measures to suppress surge voltage. Otherwise surge voltage, which is attributed to the length and thickness of wire, may occur at the motor terminals, causing the motor insulation to deteriorate.
- When a motor is driven by the inverter, axial voltage is generated on the motor shaft, which may cause electrical corrosion of the bearing. Take measures such as decreasing the carrier frequency.
- As all parameters return to their initial values after the Parameter clear or All parameter clear is performed, the needed parameters for this product operation must be set again before the operation is started.
- This product can be easily set for high-speed operation. Therefore, consider all things related to the operation such as the performance of a motor and equipment in a system before the setting change.
- This product's brake function cannot be used as a mechanical brake. Use a separate device instead.
- When performing an inverter operation with frequent starts/stops, rise/fall in the temperature of the transistor element of the inverter will repeat due to a repeated flow of large current, shortening the life.
- Perform an inspection and test operation of this product if it has been stored for a long period of time.
- To avoid damage to this product due to static electricity, static electricity in your body must be discharged before you touch this product.
- Only one PM motor can be connected to a single unit of this product.
- A PM motor must be used under PM sensorless vector control. Do not use a synchronous motor, induction motor, or synchronous induction motor.
- Do not connect a PM motor to this product with it set to the induction motor control setting (initial setting). Do not connect an induction motor to this product with it set to the PM sensorless vector control setting. Doing so will cause failure.
- As a process of starting a PM motor, turn ON the power of this product first, and then close the contactor on the output side of this product.
- To maintain the security (confidentiality, integrity, and availability) of the inverter and the system against unauthorized access, DoS[*1] attacks, computer viruses, and other cyberattacks from external devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions. We shall have no responsibility or liability for any problems involving inverter trouble and system trouble by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.
- Depending on the network environment, the inverter may not operate as intended due to delays or disconnection in communication. Carefully consider what type of environment the inverter will be used in and any safety issues related to its use.
- When the emergency drive function is enabled, the operation is continued or the retry operation (automatic reset and restart) is repeated even if a fault occurs, which may damage or burn this product and the motor. Before restarting the normal operation after the operation using the emergency drive function, make sure that this product and the motor have no fault.

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

⚠CAUTION

Emergency stop

- 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 controlling this product.
- If the breaker installed on the input side of this product trips, check for wiring faults (such as short circuits) and damage to internal parts of this product. Identify and remove the cause of the trip before resetting the tripped breaker (or before applying the power to this product again).
- When any protective function is activated, take an appropriate corrective action before resetting this product to resume the operation.

Maintenance, inspection and parts replacement

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

Disposal

- This product must be treated as industrial waste.

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. For details on the PM motor, refer to the Instruction Manual of the PM motor.

Application of caution labels

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

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

- For the retry function

CAUTION

Retry Function Has Been Selected

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

- For automatic restart after instantaneous power failure

CAUTION

Automatic Restart after Instantaneous Power Failure Has Been Selected

Stay away from the motor and machine. They will start suddenly (after reset time has elapsed) when instantaneous power failure occurs.

Motor control labels

Make copies of the following labels and apply them to the inverter to avoid connecting motors not intended for a particular motor control setting.

Induction motor setting

The inverter is set for the induction motor control.
PM LED is ON during induction motor control.
Do not drive a PM motor.

PM motor control setting

The inverter is set for the PM motor control.
PM LED is ON during PM motor control.
Do not drive an induction motor.

MEMO

CHAPTER 1 Introduction

1 Introduction

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

◆ Abbreviations

Item	Description
PU	Operation panel
Inverter	Mitsubishi Electric FR-E800-HVC inverter for heating, ventilation, and air conditioning (HVAC) systems
Pr.	Parameter number (Number assigned to function)
PU operation	Operation using the PU (operation panel)
External operation	Operation using the control circuit signals
Combined operation	Combined operation using the PU (operation panel) and External operation
Mitsubishi Electric standard efficiency motor	SF-JR
Mitsubishi Electric constant-torque motor	SF-HRCA
Mitsubishi Electric high-performance energy-saving motor	SF-PR
Mitsubishi Electric geared motor	GM-[]
Mitsubishi Electric PM motor	EM-A

◆ Trademarks

- MODBUS is a registered trademark of SCHNEIDER ELECTRIC USA, INC.
- BACnet is a registered trademark of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- Other company and product names herein are the trademarks and registered trademarks of their respective owners.

◆ Notes on descriptions in this Instruction Manual

- Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to page 51.)

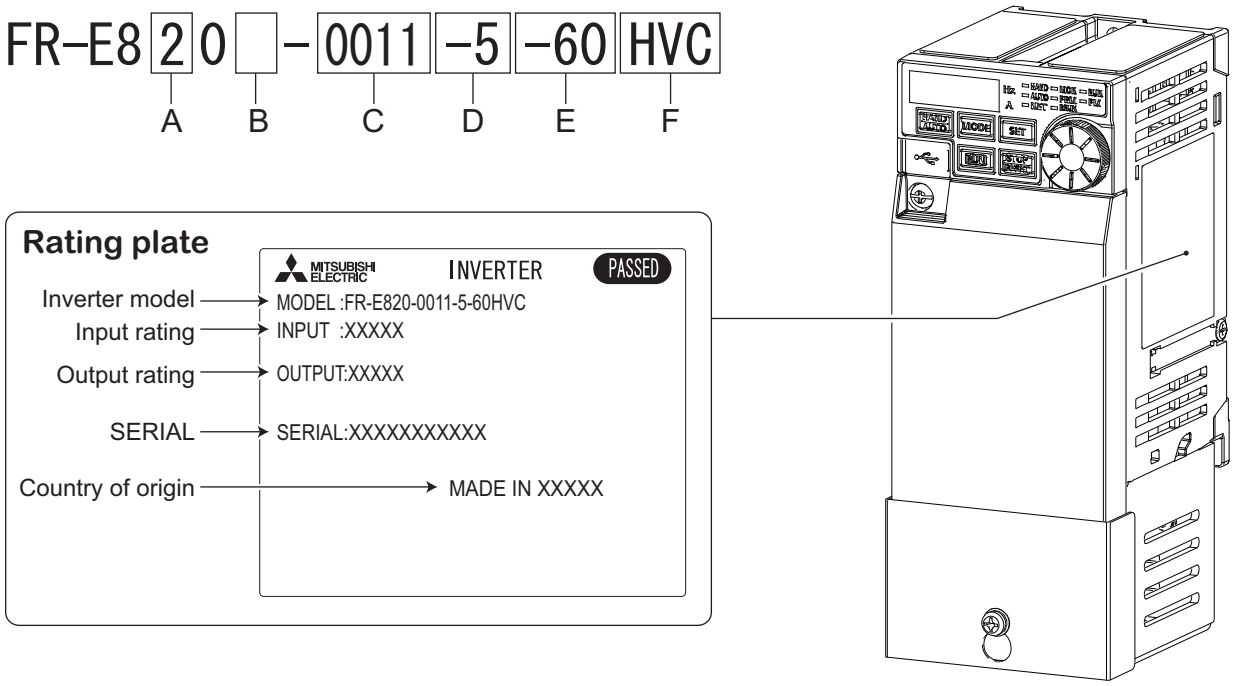
◆ Harmonic Suppression Guidelines

All the models of the inverters used by specific consumers are covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage". (For details, refer to page 69.)

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.

◆ Inverter model



- A: The voltage class is shown.

Symbol	Voltage class
2	200 V class
4	400 V class

- B: The number of phases of the power source is shown.

Symbol	Description
None	Three-phase input
S	Single-phase input

- C: The inverter rated current is shown.

Symbol	Description
0011 to 0978	Inverter rated current (A)

- D: The communication specification, monitoring specification, rated frequency, and control logic are shown.

Symbol	Communication specification	Monitoring specification	Rated frequency (initial setting)	Control logic (initial status)
-5	RS-485 communication (Mitsubishi inverter protocol, MODBUS RTU, BACnet MS/TP)	Voltage (terminal AM)	60 Hz	Sink logic

- E: Availability of circuit board coating / plated conductors is shown.

Symbol	Circuit board coating*1	Plated conductor
-60	With coating	Without plated conductors

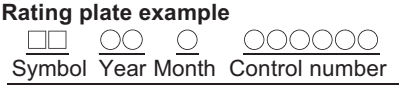
*1 Conforming to IEC 60721-3-3:1994 3C2

- F: The application is shown.

Symbol	Application
HVC	HVAC model

◆ How to read the SERIAL number

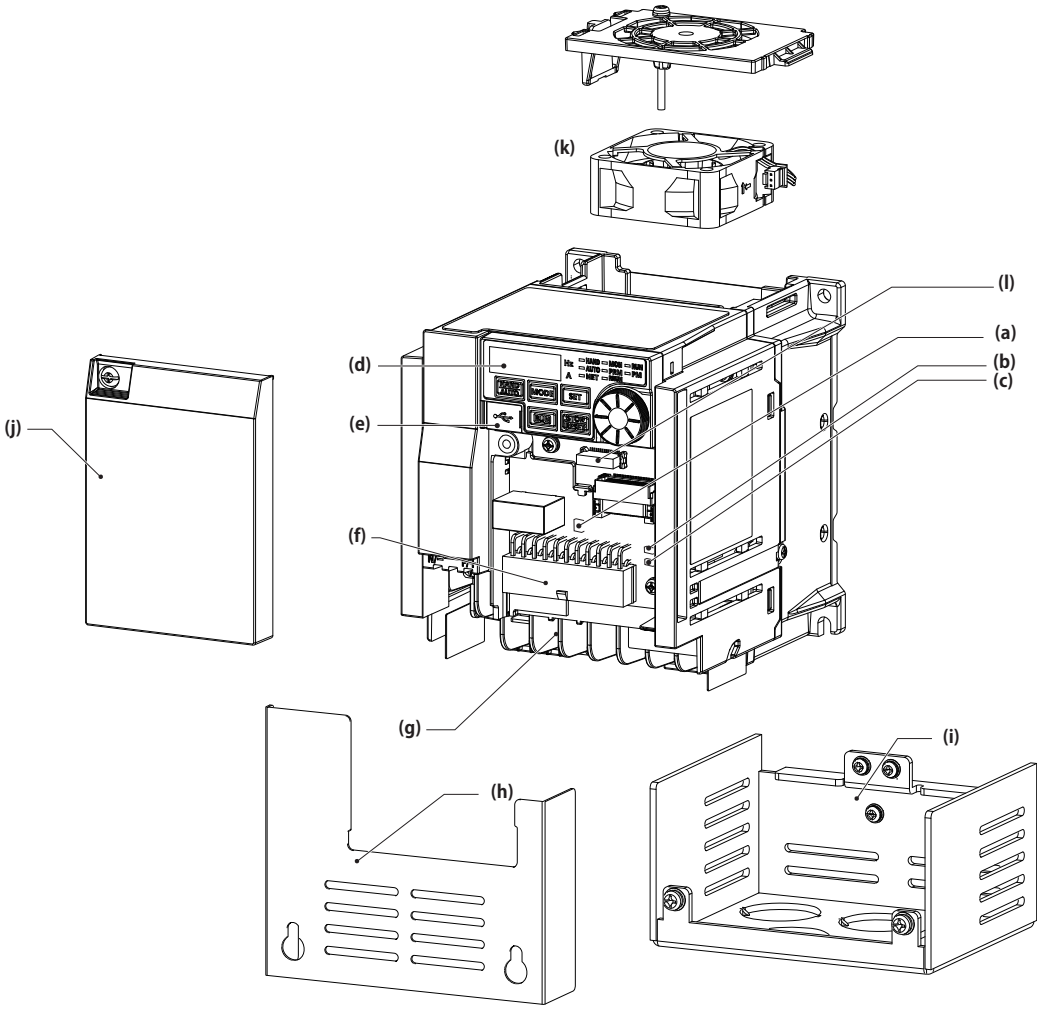
Rating plate example



The SERIAL consists of two symbols, three characters indicating the production year and month, and six characters indicating the control number.
The last two digits of the production year are indicated as the Year, and the Month is indicated by 1 to 9, X (October), Y (November), or Z (December).

1.2 Component names

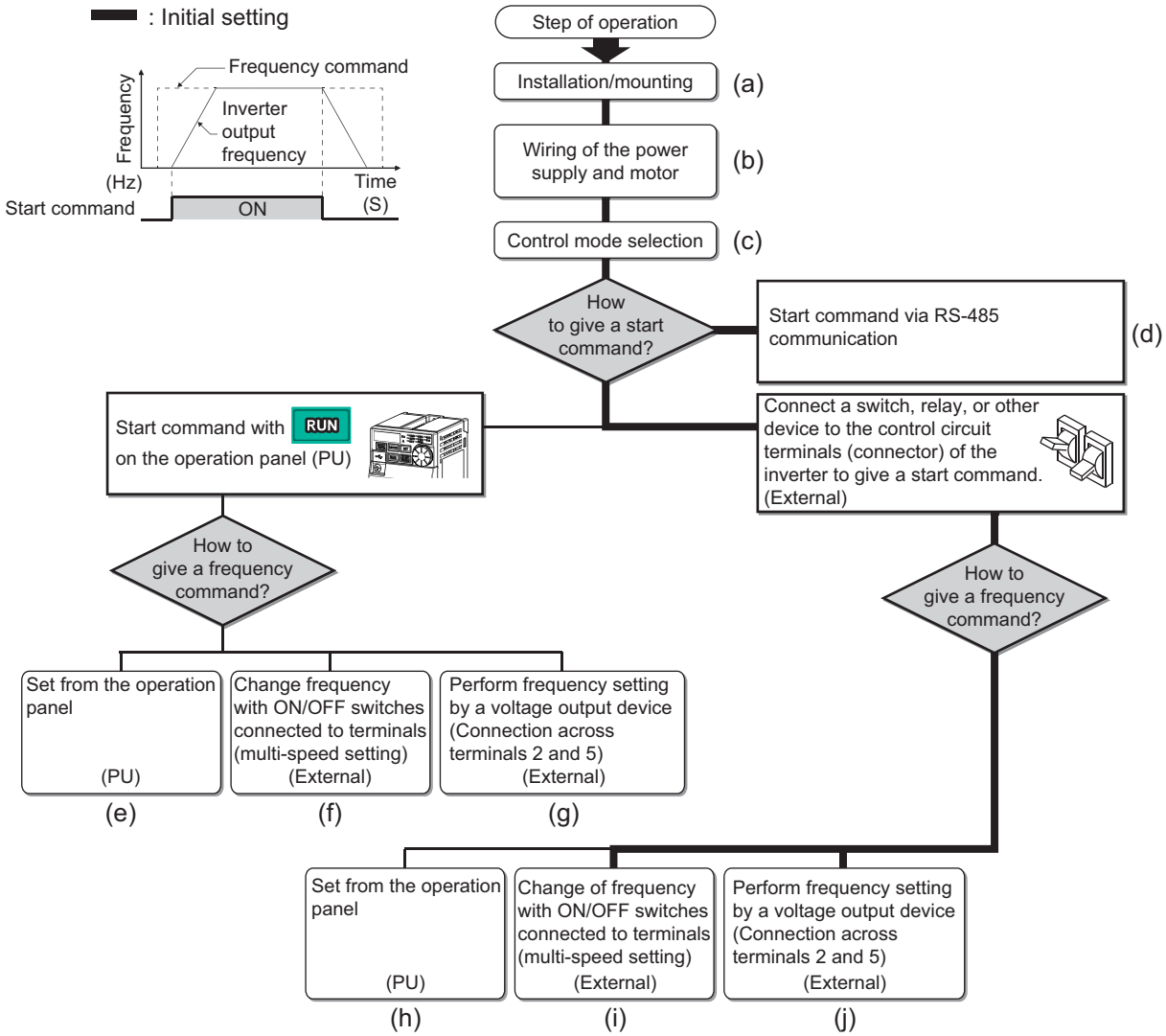
Component names are as follows.



Symbol	Name	Description	Refer to page
(a)	Control logic switch	Select the sink logic (SINK) or the source logic (SOURCE).	51
(b)	Voltage/current input switch	Select voltage or current for the input via terminal 2.	*1
(c)	Terminating resistor switch	Select whether or not to use the terminating resistor for RS-485 communication.	57
(d)	Operation panel	Operates and monitors the inverter. The operation panel cannot be removed from the inverter.	*1
(e)	USB mini B connector	Connector for a personal computer.	59
(f)	Control circuit terminals (connector)	Connects cables for the control circuit.	50
(g)	Main circuit terminal block	Connects cables for the main circuit.	41
(h)	Wiring cover 1	Remove it for wiring.	24
(i)	Wiring cover 2	When conduits are installed in the knockout holes of this cover, wiring can be passed through the conduits.	24
(j)	Front cover	Remove it for wiring.	24
(k)	Cooling fan	Cools the inverter (FR-E820-0082(2.2K) or higher, FR-E840-0047(2.2K) or higher, and FR-E820S-0082(2.2K) or higher). The fan cover is fixed with the fixing screw(s). When replacing the cooling fan, remove the fixing screw(s). After replacement, fix the fan cover with the screw(s).	*2
(l)	Plug-in option connector	Not used.	—

*1 Refer to the FR-E800 Instruction Manual (Function).
*2 Refer to the FR-E800 Instruction Manual (Maintenance).

1.3 Operation steps



Symbol	Overview	Refer to page
(a)	Install the inverter.	32
(b)	Perform wiring for the power supply and the motor.	41
(c)	Select the control method (V/F control, Advanced magnetic flux vector control, Real sensorless vector control, Vector control, and PM sensorless vector control).	Instruction Manual (Function)
(d)	Give the start command via communication.	Instruction Manual (Communication)
(e)	Give both the start and frequency commands from the PU. (PU operation mode)	Instruction Manual (Function)
(f)	Give the start command from the PU and the frequency command via terminals RH, RM, and RL. (External/PU combined operation mode 2)	Instruction Manual (Function)
(g)	Give the start command from the PU and the frequency command by voltage input via terminal 2. (External/PU combined operation mode 2)	Instruction Manual (Function)
(h)	Give the start command via terminal STF or STR and the frequency command from the PU. (External/PU combined operation mode 1)	Instruction Manual (Function)
(i)	Give the start command via terminal STF or STR and the frequency command via terminals RH, RM, and RL. (External operation mode)	Instruction Manual (Function)
(j)	Give the start command via terminal STF or STR and the frequency command by voltage input via terminal 2. (External operation mode)	Instruction Manual (Function)

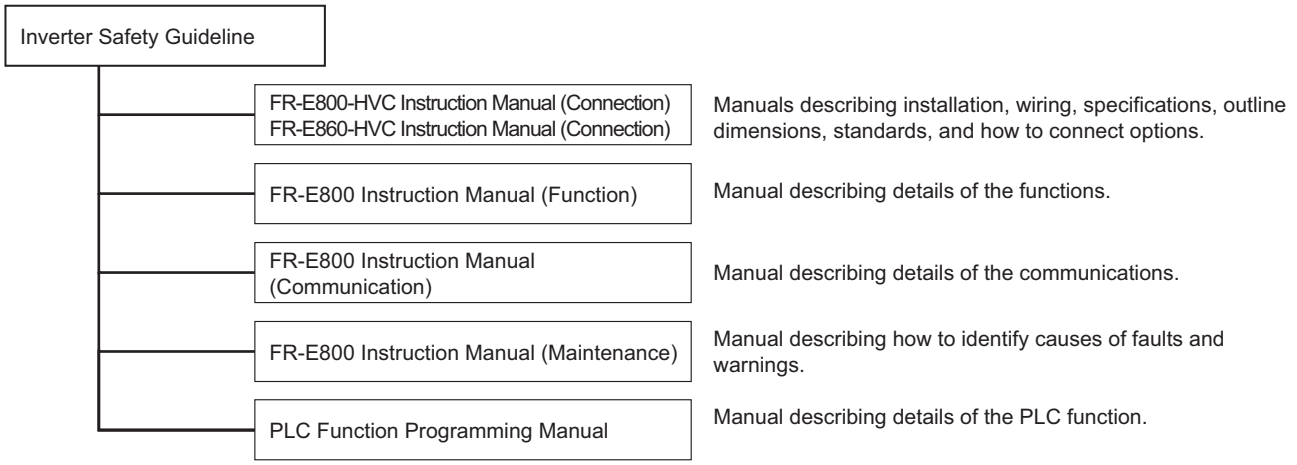
1.4 Related manuals

When using this inverter for the first time, prepare the following manuals as required and use the inverter safely.
https://www.mitsubishielectric.com/fa/products/drv/inv/support/e800/e800hvc.html

Point

- e-Manual refers to the Mitsubishi Electric FA electronic book manuals that can be browsed using a dedicated tool.
- e-Manual has the following features:
  Required information can be cross-searched in multiple manuals.
  Pages that users often browse can be bookmarked.

Manuals related to the FR-E800-HVC inverter are shown in the following table.



Name	Manual number
FR-E800-HVC Inverter Safety Guideline	IB-0600944ENG
FR-E800 Instruction Manual (Function)	IB-0600868ENG
FR-E800 Instruction Manual (Communication)	IB-0600871ENG
FR-E800 Instruction Manual (Maintenance)	IB-0600874ENG
PLC Function Programming Manual	IB-0600492ENG

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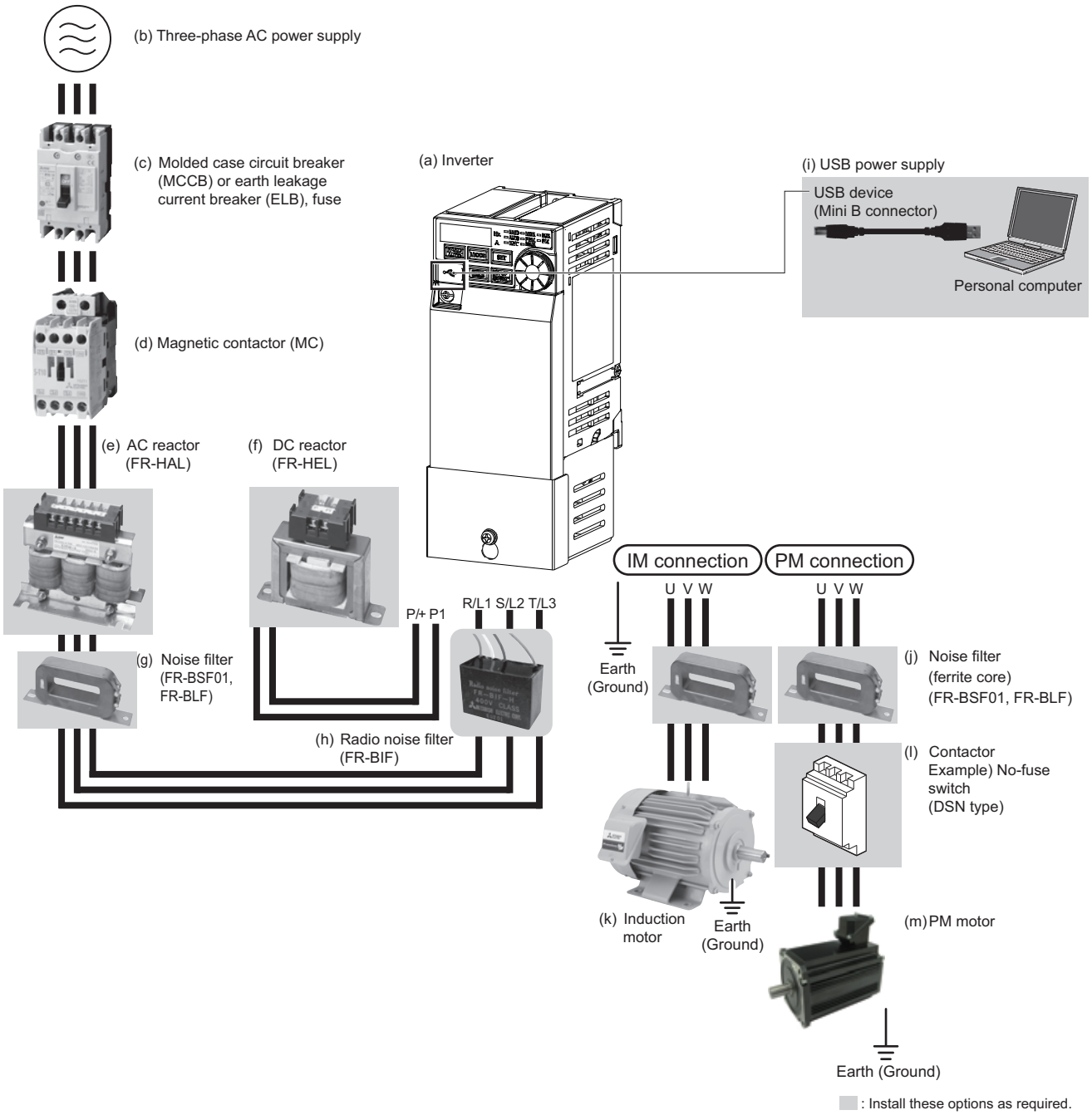
CHAPTER 2 Installation and Wiring

2 Installation and Wiring

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

2.1 Peripheral devices

2.1.1 Inverter and peripheral devices



Symbol	Name	Overview	Refer to page
(a)	Inverter (FR-E800-HVC)	The life of the inverter is influenced by the surrounding air temperature. The surrounding air temperature should be as low as possible within the permissible range. This must be noted especially when the inverter is installed in an enclosure. Incorrect wiring may lead to damage of the inverter. The control signal lines must be kept fully away from the main circuit lines to protect them from noise.	32, 39
(b)	Three-phase AC power supply	Must be within the permissible power supply specifications of the inverter.	84
(c)	Molded case circuit breaker (MCCB), earth leakage circuit breaker (ELB), or fuse	Must be selected carefully since an inrush current flows in the inverter at power ON.	22
(d)	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.	74
(e)	AC reactor (FR-HAL)	Install this to suppress harmonics and to improve the power factor. An AC reactor (FR-HAL) (option) is required when installing the inverter near a large power supply system (500 kVA or more). Under such condition, the inverter may be damaged if you do not use a reactor. Select a reactor according to the applied motor capacity. (When using a motor with capacity lower than 0.4 kW, select the reactor for a 0.4kW motor. For the single-phase 200 V power input models, select the reactor whose capacity is one rank higher than the motor capacity.)	60, 73
(f)	DC reactor (FR-HEL)	Install this to suppress harmonics and to improve the power factor. Select a reactor according to the applied motor capacity. * For the single-phase 200 V power input models, select the reactor whose capacity is one rank higher than the motor capacity. When using a DC reactor, remove the jumper across terminals P/+ and P1 before connecting a DC reactor to the inverter.	61
(g)	Noise filter (ferrite core) (FR-BSF01, FR-BLF)	Install this to reduce the electromagnetic noise generated from the inverter.	66
(h)	Radio noise filter (FR-BIF)	Install this to reduce the radio noise.	—
(i)	USB connection	Connect between the inverter and a personal computer with a USB (ver. 1.1) cable.	59
(j)	Noise filter (ferrite core) (FR-BSF01, FR-BLF)	Install this to reduce the electromagnetic noise generated from the inverter. The noise filter is effective in the range from about 0.5 to 5 MHz. A wire should be wound four turns at maximum.	66
(k)	Induction motor	Connect a squirrel-cage induction motor.	—
(l)	Contactor Example) No-fuse switch (DSN type)	Connect this for an application where a PM motor is driven by the load even while the inverter power is OFF. Do not open or close the contactor while the inverter is running (outputting).	—
(m)	PM motor	An IPM motor cannot be driven by the commercial power supply.	—

NOTE

- To prevent an electric shock, always earth (ground) the motor and inverter.
- Do not install a power factor correction capacitor, surge suppressor, or capacitor type filter on the inverter's output side. Doing so will cause the inverter shut off or damage the capacitor or surge suppressor. If any of the above devices is connected, immediately remove it. When installing a molded case circuit breaker on the output side of the inverter, contact the manufacturer of the molded case circuit breaker.
- Electromagnetic wave interference:
  The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. Connect the optional radio noise filter FR-BIF (for use in the input side only), line noise filter FR-BSF01/FR-BLF, Filterpack, or EMC filter to minimize interference.
- For details of options and peripheral devices, refer to the respective Instruction Manual.
- A PM motor cannot be driven by the commercial power supply.
- A PM motor is a motor with permanent magnets embedded inside. High voltage is generated at the motor terminals while the motor is running. Before closing the contactor at the output side, make sure that the inverter power is ON and the motor is stopped.

2.1.2 Peripheral devices

Check the model of the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the following table for right selection.

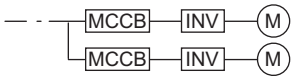
◆ Molded case circuit breaker / earth leakage circuit breaker

- This is a matrix showing the rated current of the molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB) (NF or NV type) according to the selected inverter and rating.

Voltage	Inverter model	Without AC/DC power factor improving reactor	With AC/DC power factor improving reactor
Three-phase 200 V class	FR-E820-0011(0.2K)	5 A	5 A
	FR-E820-0017(0.4K)	5 A	5 A
	FR-E820-0030(0.75K)	10 A	5 A
	FR-E820-0051(1.1K)	15 A	10 A
	FR-E820-0082(2.2K)	20 A	15 A
	FR-E820-0102(3.0K)	30 A	20 A
	FR-E820-0167(5.5K)	40 A	30 A
	FR-E820-0255(7.5K)	60 A	50 A
	FR-E820-0340(11K)	75 A	60 A
	FR-E820-0476(15K)	125 A	100 A
	FR-E820-0587(18.5K)	150 A	125 A
	FR-E820-0748(22K)	175 A	125 A
	FR-E820-0978(30K)	225 A	175 A
Three-phase 400 V class	FR-E840-0018(0.75K)	5 A	5 A
	FR-E840-0030(1.5K)	10 A	10 A
	FR-E840-0047(2.2K)	10 A	10 A
	FR-E840-0059(3.0K)	20 A	15 A
	FR-E840-0094(5.5K)	30 A	20 A
	FR-E840-0149(7.5K)	40 A	30 A
	FR-E840-0196(11K)	50 A	40 A
	FR-E840-0298(15K)	75 A	50 A
	FR-E840-0349(18.5K)	100 A	60 A
	FR-E840-0383(22K)	100 A	75 A
	FR-E840-0510(30K)	125 A	100 A
Single-phase 200 V class	FR-E820S-0011(0.2K)	5 A	5 A
	FR-E820S-0017(0.4K)	10 A	10 A
	FR-E820S-0030(0.75K)	15 A	10 A
	FR-E820S-0051(1.1K)	20 A	20 A
	FR-E820S-0082(2.2K)	40 A	30 A

NOTE

- Select an MCCB according to the power supply capacity.
- Install one MCCB per inverter.



- For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the document enclosed with the product and select appropriate fuses.
- When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter model, and select cables and reactors according to the motor output.
- When the breaker installed on the inverter input side is shut off, check for the wiring fault (short circuit), damage to internal parts of the inverter etc. The cause of the output shutoff must be identified and removed before turning ON the power of the breaker.

◆ Magnetic contactor at the inverter's input line

- This is a matrix showing the model name of the Mitsubishi magnetic contactor to be installed at the inverter's input line according to the selected inverter and rating.

Voltage	Inverter model	Without AC/DC power factor improving reactor	With AC/DC power factor improving reactor
Three-phase 200 V class	FR-E820-0011(0.2K)	S-T10	S-T10
	FR-E820-0017(0.4K)	S-T10	S-T10
	FR-E820-0030(0.75K)	S-T10	S-T10
	FR-E820-0051(1.1K)	S-T10	S-T10
	FR-E820-0082(2.2K)	S-T10	S-T10
	FR-E820-0102(3.0K)	S-T10	S-T10
	FR-E820-0167(5.5K)	S-T21	S-T10
	FR-E820-0255(7.5K)	S-T35	S-T21
	FR-E820-0340(11K)	S-T35	S-T35
	FR-E820-0476(15K)	S-T50	S-T50
	FR-E820-0587(18.5K)	S-T50	S-T50
	FR-E820-0748(22K)	S-T65	S-T65
	FR-E820-0978(30K)	S-T100	S-T100
Three-phase 400 V class	FR-E840-0018(0.75K)	S-T10	S-T10
	FR-E840-0030(1.5K)	S-T10	S-T10
	FR-E840-0047(2.2K)	S-T10	S-T10
	FR-E840-0059(3.0K)	S-T10	S-T10
	FR-E840-0094(5.5K)	S-T21	S-T12
	FR-E840-0149(7.5K)	S-T21	S-T21
	FR-E840-0196(11K)	S-T35	S-T21
	FR-E840-0298(15K)	S-T35	S-T35
	FR-E840-0349(18.5K)	S-T35	S-T35
	FR-E840-0383(22K)	S-T35	S-T35
	FR-E840-0510(30K)	S-T50	S-T50
Single-phase 200 V class	FR-E820S-0011(0.2K)	S-T10	S-T10
	FR-E820S-0017(0.4K)	S-T10	S-T10
	FR-E820S-0030(0.75K)	S-T10	S-T10
	FR-E820S-0051(1.1K)	S-T10	S-T10
	FR-E820S-0082(2.2K)	S-T21	S-T10

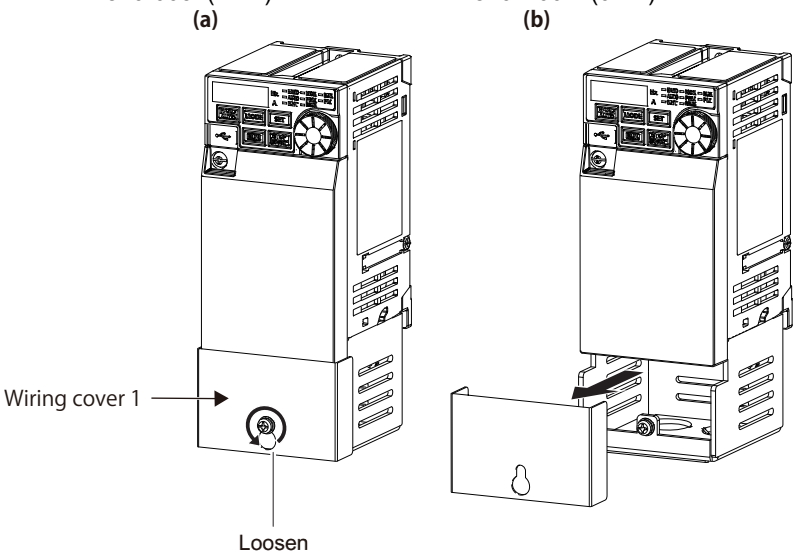
NOTE

- The matrix shows the magnetic contactor selected according to the standards of Japan Electrical Manufacturers' Association (JEM standards) for AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the MC is used for emergency stops during motor driving, the electrical durability is 25 times. If using the MC for emergency stop during motor driving, select the MC for the inverter input current according to the rated current against JEM 1038 standards for AC-3 class. When installing an MC on the inverter output side to switch to the commercial-power supply operation while running a general-purpose motor, select the MC for the rated motor current according to the rated current against JEM 1038 standards for AC-3 class.
- When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter model, and select cables and reactors according to the motor output.
- When the breaker installed on the inverter input side is shut off, check for the wiring fault (short circuit), damage to internal parts of the inverter etc. The cause of the output shutoff must be identified and removed before turning ON the power of the breaker.

2.2 Removal and reinstallation of the front cover

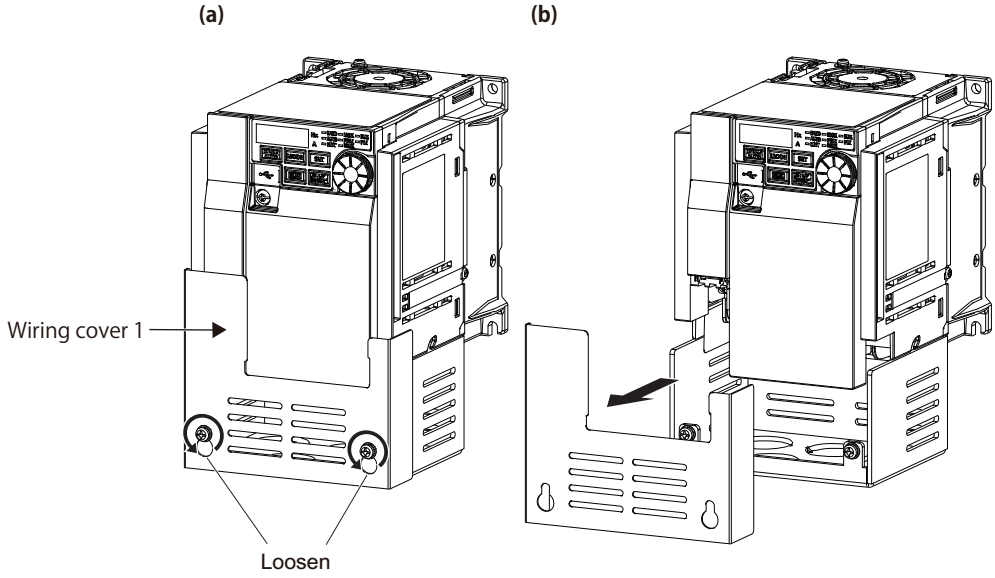
◆ Removal of the wiring cover 1

- FR-E820-0051(1.1K) or lower and FR-E820S-0017(0.4K) or lower



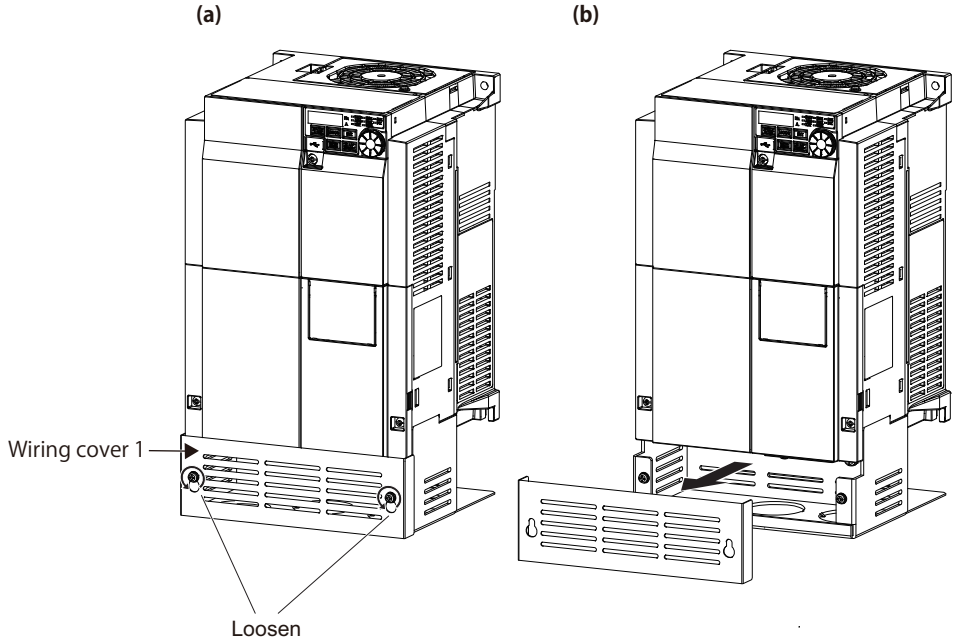
(a) Loosen the mounting screws of the wiring cover 1.
(b) Slide the cover up and pull it out.

- FR-E820-0082(2.2K) to 0167(5.5K), FR-E840-0196(11K) or lower, and FR-E820S-0030(0.75K) or higher



(a) Loosen the mounting screws of the wiring cover 1.
(b) Slide the cover up and pull it out.

- FR-E820-0255(7.5K) or higher and FR-E840-0298(15K) or higher

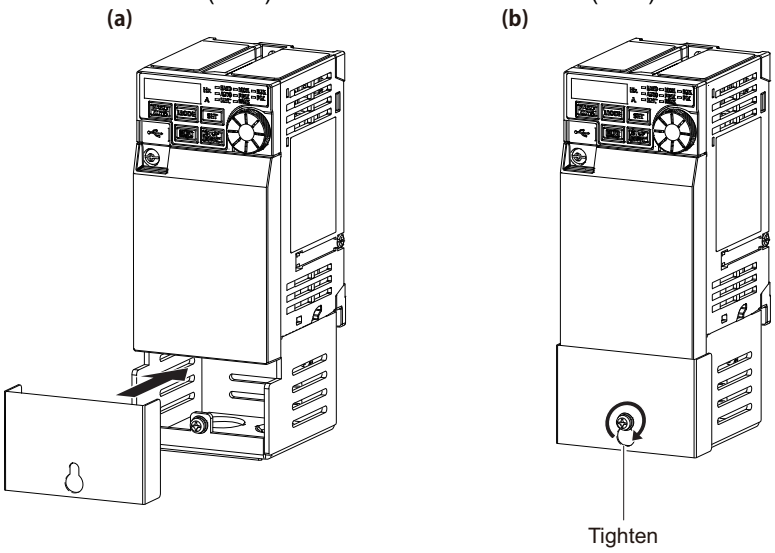


(a) Loosen the mounting screws of the wiring cover 1.

(b) Slide the cover up and pull it out.

◆ Reinstallation of the wiring cover 1

- FR-E820-0051(1.1K) or lower and FR-E820S-0017(0.4K) or lower

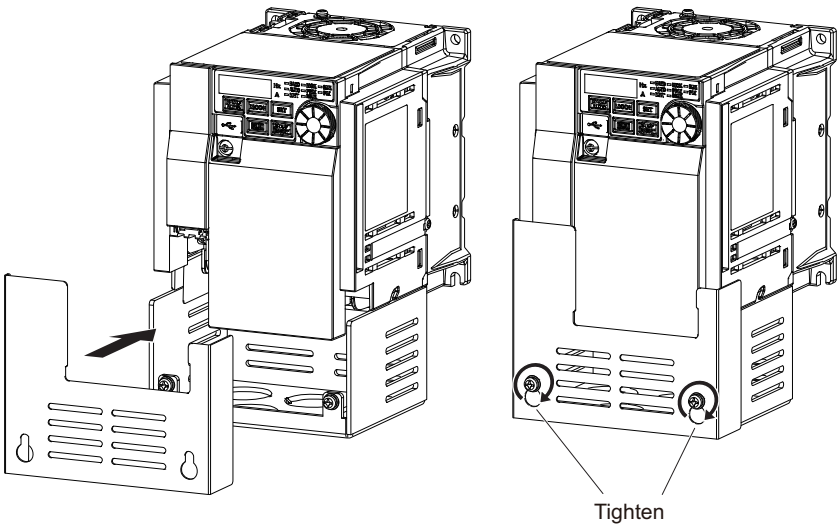


(a) Align the screw holes of the wiring cover 1 with the screw holes of the wiring cover 2.

(b) Loosen the mounting screws of the cover. (Tightening torque: 1.4 to 1.9 N·m)

- FR-E820-0082(2.2K) to 0167(5.5K), FR-E840-0196(11K) or lower, and FR-E820S-0030(0.75K) or higher

(a) **(b)**

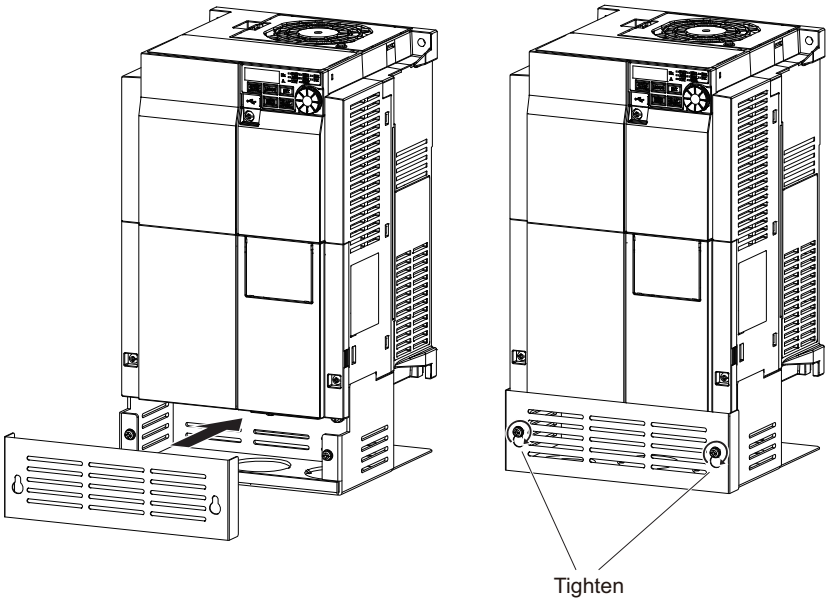


(a) Align the screw holes of the wiring cover 1 with the screw holes of the wiring cover 2.

(b) Loosen the mounting screws of the cover. (Tightening torque: 1.4 to 1.9 N·m)

- FR-E820-0255(7.5K) or higher and FR-E840-0298(15K) or higher

(a) **(b)**

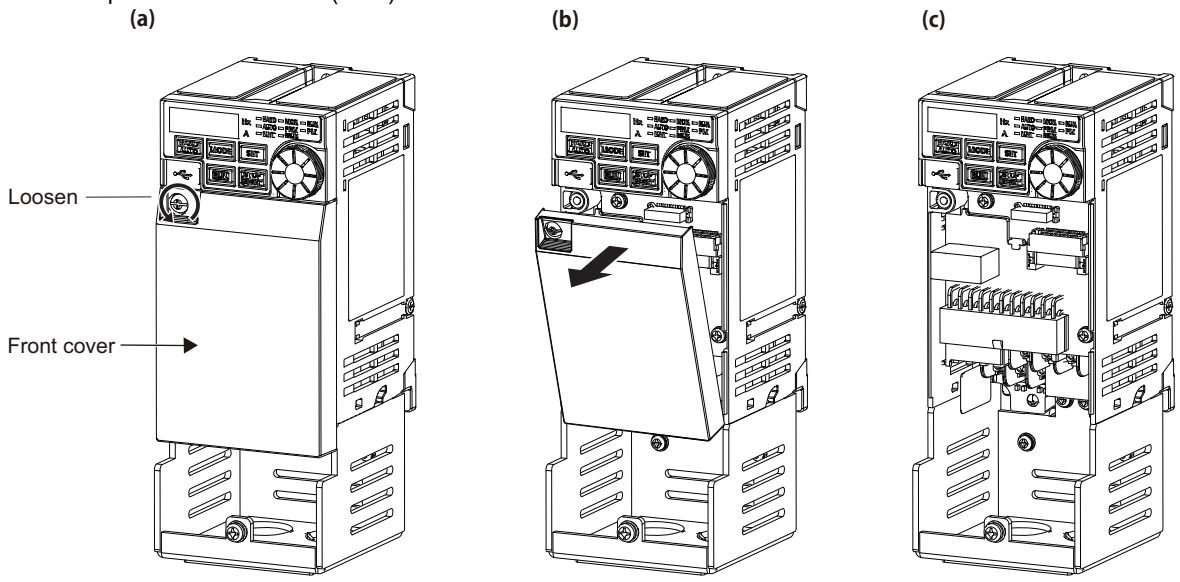


(a) Reinstall the wiring cover 1 to the inverter.

(b) Loosen the mounting screws of the cover. (Tightening torque: 1.4 to 1.9 N·m)

◆ Removal of the front cover

- Example of FR-E820-0011(0.2K)



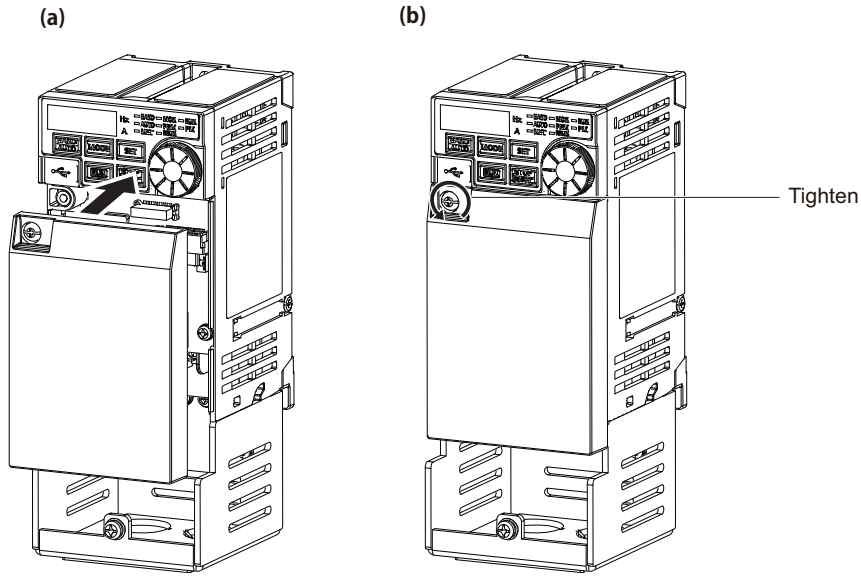
(a) Loosen the screw on the front cover. (The screw cannot be removed.)

(b) Put a finger on the recess for the screw of the front cover and pull out the cover.

(c) With the front cover removed, the control circuit terminals (connector) can be wired.

◆ Reinstallation of the front cover

- Example of FR-E820-0011(0.2K)



(a) Reinstall the front cover to the inverter.

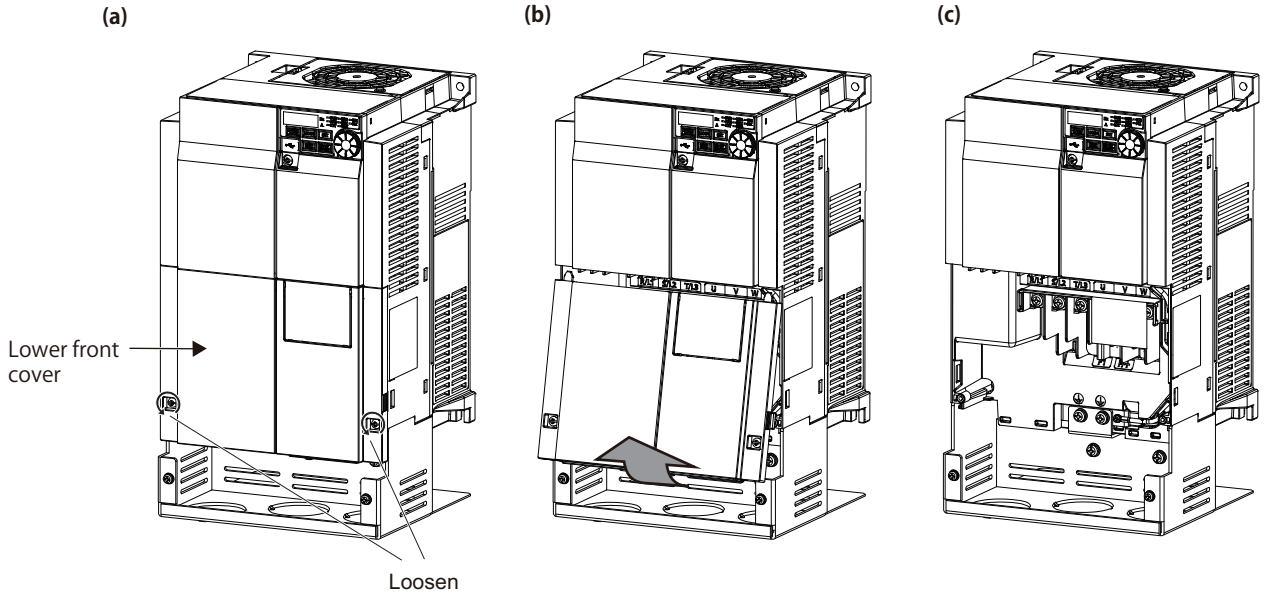
(b) Tighten the mounting screw of the front cover. (Tightening torque: 0.6 to 0.8 N·m)

NOTE

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

◆ Removal of the lower front cover

- FR-E820-0255(7.5K) or higher and FR-E840-0298(15K) or higher



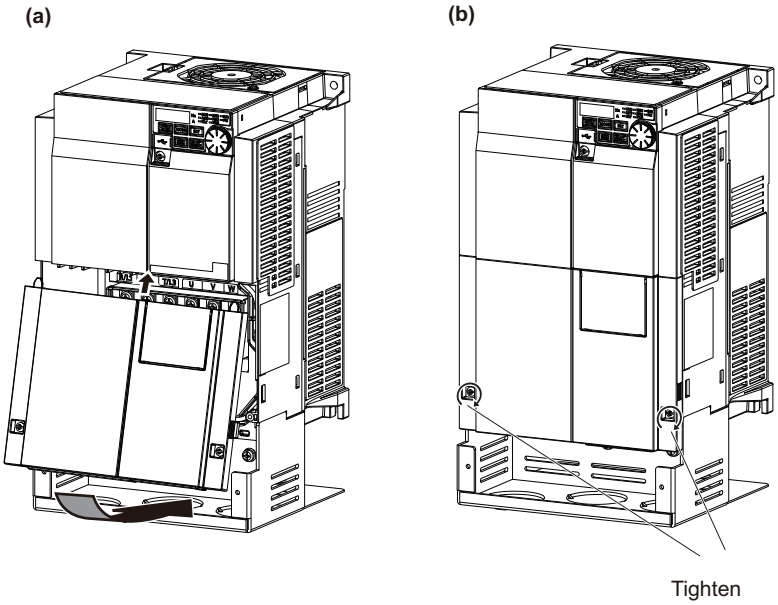
(a) With the wiring cover 1 removed, loosen the mounting screws on the lower front cover. (These screws cannot be removed.)

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

(c) With the lower front cover removed, the main circuit can be wired.

◆ Reinstallation of the lower front cover

- FR-E820-0255(7.5K) or higher and FR-E840-0298(15K) or higher



(a) Install the lower front cover by inserting the upper hooks into the sockets on the inverter.

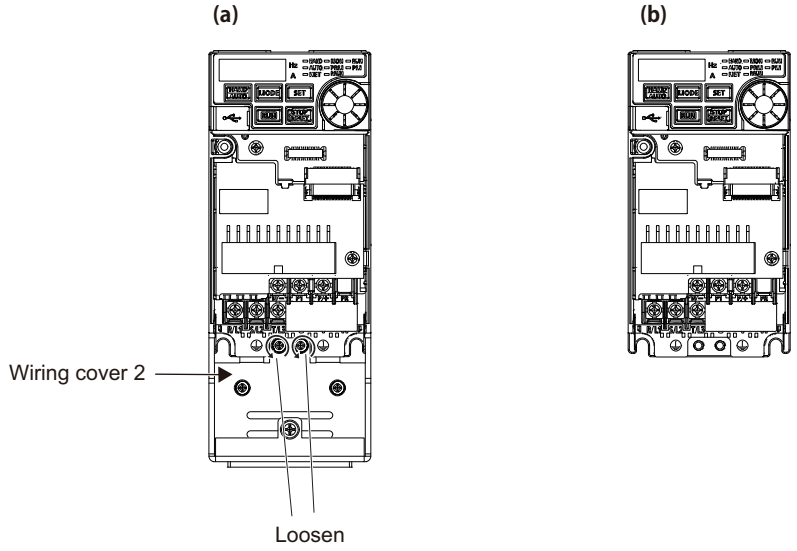
(b) Tighten the screws on the lower part of the lower front cover. (Tightening torque: 0.6 to 0.8 N·m)

NOTE

- Fully make sure that the lower front cover is reinstalled securely. Always tighten the mounting screws of the lower front cover.

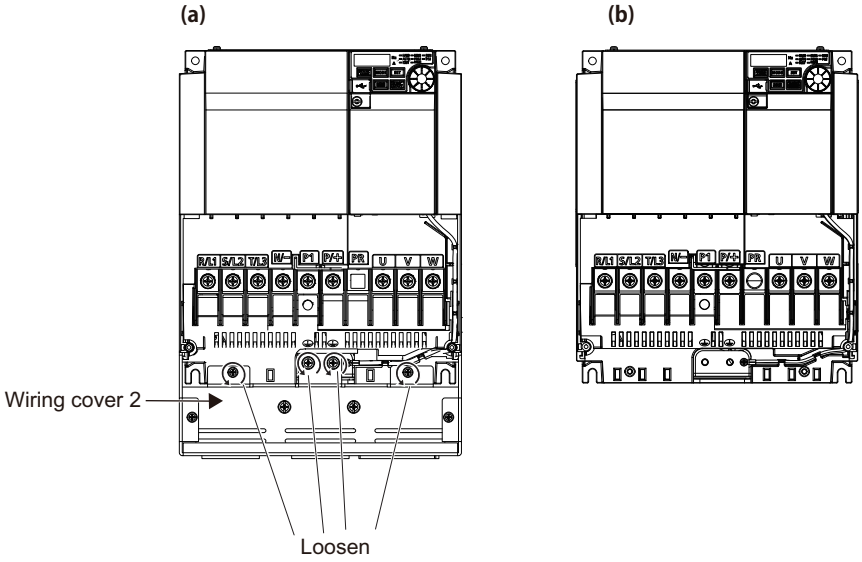
◆ Removal of the wiring cover 2

- FR-E820-0340(11K) or lower, FR-E840-0196(11K) or lower, and FR-E820S-0082(2.2K) or lower



(a) After removing the wiring cover 1 and the front cover (FR-E820-0167(5.5K) or lower, FR-E840-0196(11K) or lower, and FR-E820S-0082(2.2K) or lower) or the lower front cover (FR-E820-0255(7.5K) or higher), remove the mounting screws of the wiring cover 2.

- FR-E820-0476(15K) or higher, FR-E840-0298(15K) or higher

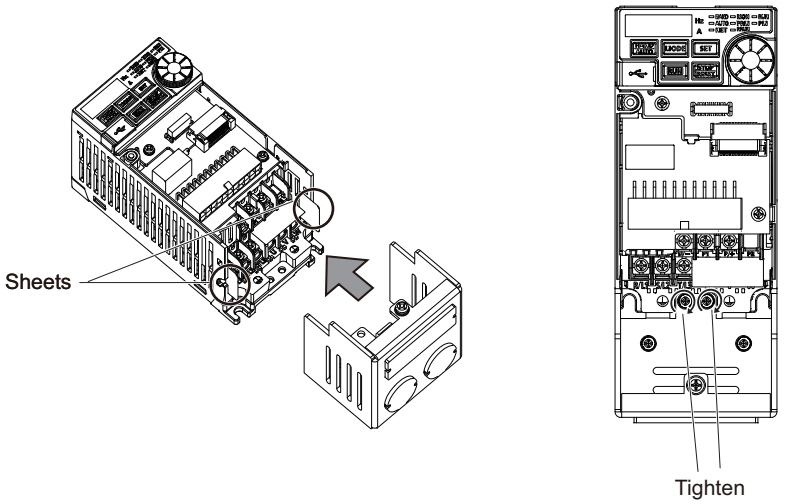


(a) After removing the wiring cover 1 and the lower front cover, remove the mounting screws of the wiring cover 2.

◆ Reinstallation of the wiring cover 2

- FR-E820-0340(11K) or lower, FR-E840-0196(11K) or lower, and FR-E820S-0082(2.2K) or lower

(a) **(b)**

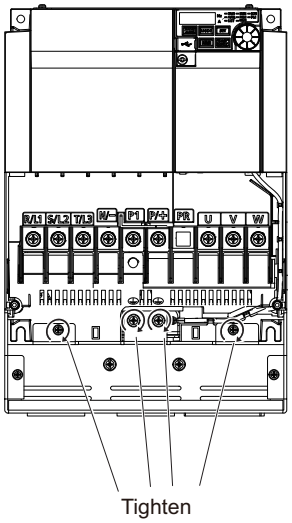


(a) When reinstalling the wiring cover 2, the sheets should be placed inside the cover.

(b) Tighten the mounting screws of the wiring cover 2.
(The tightening torque is 0.9 to 1.3 N·m for the FR-E820-0167(5.5K) or lower, FR-E840-0094(5.5K) or lower, and FR-E820S-0082(2.2K) or lower,
1.4 to 1.9 N·m for the FR-E840-0149(7.5K) and FR-E840-0196(11K),
or 2.8 to 3.6 N·m for the FR-E820-0255(7.5K) and FR-E820-0340(11K).)

- FR-E820-0476(15K) or higher, FR-E840-0298(15K) or higher

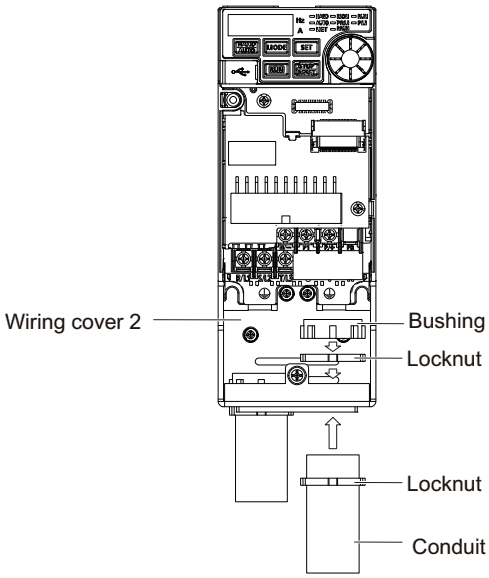
(a)



(a) Tighten the mounting screws of the wiring cover 2.
(The tightening torque is 1.4 to 1.9 N·m for the FR-E840-0298(15K),
2.8 to 3.6 N·m for the FR-E820-0476(15K), FR-E820-0587(18.5K), and FR-E840-0349(18.5K),
or 4.7 to 6.4 N·m for the FR-E820-0748(22K) and FR-E840-0383(22K) or higher.)

◆ Connection of conduits)

(b)



(a) To punch out the knockout holes in the wiring cover 2, put a go-through screwdriver against the knockout's edge and tap it with a hammer repeatedly. Be careful not to put the screwdriver directly on the joints. Remove any sharp edges and burrs from the knockout holes. (Refer to page 43.)

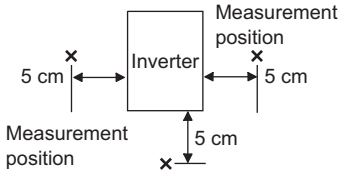
(b) Pass conduits through the round knockout holes. Fix the conduits with locknuts both inside and outside the cover. Then tighten bushings to fix the conduits to the wiring cover 2.

2.3 Installation of the inverter and enclosure design

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

Item	Description	
Surrounding air temperature	-20°C to +50°C	
Ambient humidity	95% RH or less (non-condensing)	
Storage temperature	-40°C to +70°C*1	
Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)	
Altitude	Maximum 3000 m*2	
Vibration	5.9 m/s^2 or less at 10 to 55 Hz (in either X, Y, or Z direction)	

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

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

◆ Temperature

The permissible surrounding air temperature of the inverter is between -20°C and +50°C. 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.

■ Measures against high temperature

- Use a forced ventilation system or similar cooling system. (Refer to page 35.)
- Install the enclosure in an air-conditioned electric chamber.
- Block direct sunlight.
- Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
- Ventilate the area around the enclosure well.

■ Measures against low temperature

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

■ Sudden temperature changes

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

NOTE

- For the amount of heat generated by the inverter unit, refer to page 34.

◆ Humidity

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

■ Measures against high humidity

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

■ Measures against low humidity

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

■ Measures against condensation

Condensation may occur if frequent operation stops change the in-enclosure temperature suddenly or if the outside air temperature changes suddenly.

Condensation causes such faults as reduced insulation and corrosion.

- Take the measures against high humidity.
- Do not power OFF the 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 35.)
- Purge air.
  Pump clean air from outside to make the in-enclosure air pressure higher than the outside air pressure.

◆ Corrosive gas, salt damage

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

In such places, take the measures given in the previous paragraph.

◆ Explosive, flammable gases

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

◆ High altitude

Use the inverter at an altitude of within 3000 m. For use at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

If it is used at a higher place, it is likely that thin air will reduce the cooling effect and low air pressure will deteriorate dielectric strength.

◆ Vibration, impact

The vibration resistance of the inverter is up to 5.9 m/s^2 at 10 to 55 Hz frequency and 1 mm amplitude for the directions of X, Y, Z axes. Subjecting the product to vibration and impacts over a long period of time may loosen the structure and cause poor contacts of connectors, even if those vibration and impacts are within the specified values.

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

■ Countermeasure

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

2.3.2 Amount of heat generated by the inverter

The amount of heat generated by the inverter unit is shown in the following table.

Voltage	Inverter model	Amount of heat generated (W)
Three-phase 200 V class	FR-E820-0011(0.2K)	16
	FR-E820-0017(0.4K)	21
	FR-E820-0030(0.75K)	35
	FR-E820-0051(1.1K)	61
	FR-E820-0082(2.2K)	91
	FR-E820-0102(3.0K)	107
	FR-E820-0167(5.5K)	177
	FR-E820-0255(7.5K)	251
	FR-E820-0340(11K)	317
	FR-E820-0476(15K)	426
	FR-E820-0587(18.5K)	547
	FR-E820-0748(22K)	735
	FR-E820-0978(30K)	1063
Three-phase 400 V class	FR-E840-0018(0.75K)	33
	FR-E840-0030(1.5K)	55
	FR-E840-0047(2.2K)	84
	FR-E840-0059(3.0K)	88
	FR-E840-0094(5.5K)	136
	FR-E840-0149(7.5K)	223
	FR-E840-0196(11K)	299
	FR-E840-0298(15K)	410
	FR-E840-0349(18.5K)	486
	FR-E840-0383(22K)	510
	FR-E840-0510(30K)	589
Single-phase 200 V class	FR-E820S-0011(0.2K)	17
	FR-E820S-0017(0.4K)	32
	FR-E820S-0030(0.75K)	49
	FR-E820S-0051(1.1K)	80
	FR-E820S-0082(2.2K)	95

NOTE

- The figures indicate the amount of heat generated when the output current is the rated current, power supply voltage is 220 V (200 V class) or 440 V (400 V class), and the carrier frequency is 1 kHz.

2.3.3 Standby power consumption by the inverter

The following table shows the standby power consumption during a stop.

Voltage	Inverter model	Standby power consumption (W)	
		Light duty	Heavy duty
Three-phase 200 V class	FR-E820-0011(0.2K)	4.3	11.0
	FR-E820-0017(0.4K)	4.3	11.0
	FR-E820-0030(0.75K)	4.3	11.5
	FR-E820-0051(1.1K)	4.3	11.6
	FR-E820-0082(2.2K)	4.4	13.6
	FR-E820-0102(3.0K)	4.5	13.8
	FR-E820-0167(5.5K)	4.9	14.4
	FR-E820-0255(7.5K)	7.9	22.0
	FR-E820-0340(11K)	7.6	22.1
Three-phase 400 V class	FR-E840-0018(0.75K)	6.8	14.3
	FR-E840-0030(1.5K)	6.8	14.2
	FR-E840-0047(2.2K)	7.0	16.1
	FR-E840-0059(3.0K)	9.6	17.3
	FR-E840-0094(5.5K)	9.9	17.5
	FR-E840-0149(7.5K)	10.0	22.2
	FR-E840-0196(11K)	10.1	22.2

NOTE

- Operation of the inverter alone (with the fan stopped) is assumed for the standby power consumption with the light load.
- Operation with the fan operated is assumed for the standby power consumption with the heavy load.

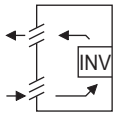
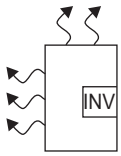
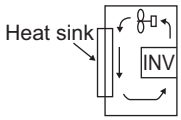
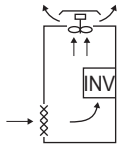
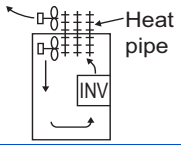
2.3.4 Cooling system types for inverter enclosure

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.

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

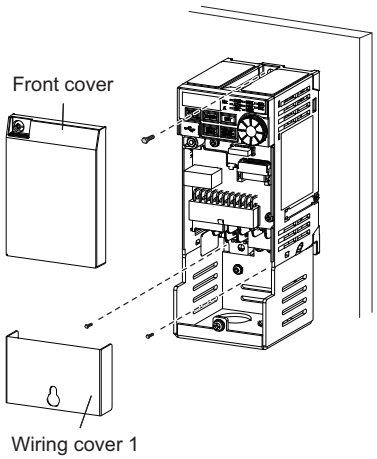
- Cooling by heat exchanger or cooler (heat pipe, cooler, etc.)

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

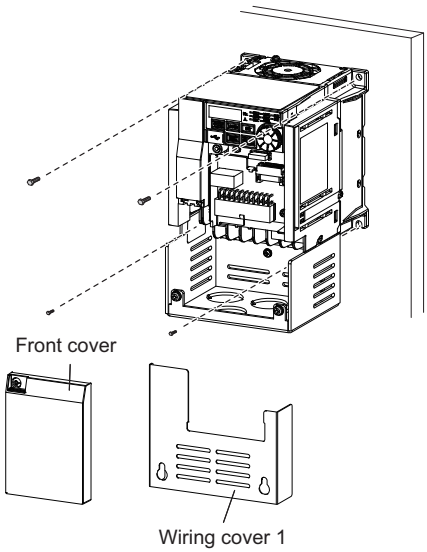
2.3.5 Inverter installation

◆ Inverter placement

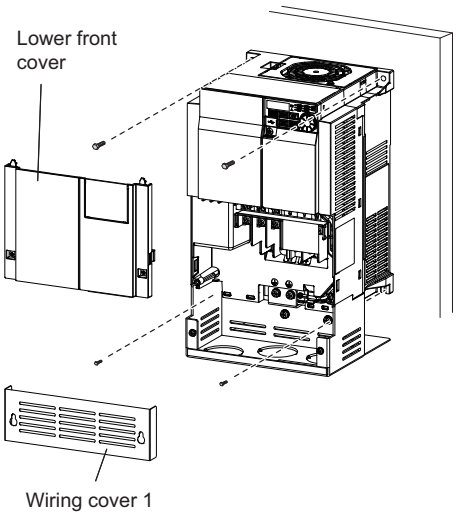
FR-E820-0011(0.2K) to 0050(1.1K)
FR-E820S-0011(0.2K), 0017(0.4K)



FR-E820-0082(2.2K) to 0167(5.5K)
FR-E840-0018(0.75K) to 0196(11K)
FR-E820S-0030(1.1K) to 0082(2.2K)

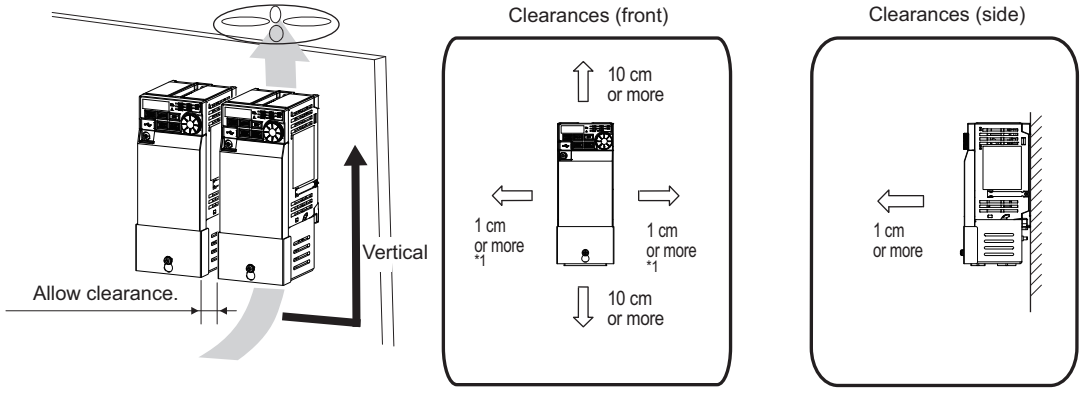


FR-E820-0255(7.5K)or higher
FR-E840-0298(15K)or higher



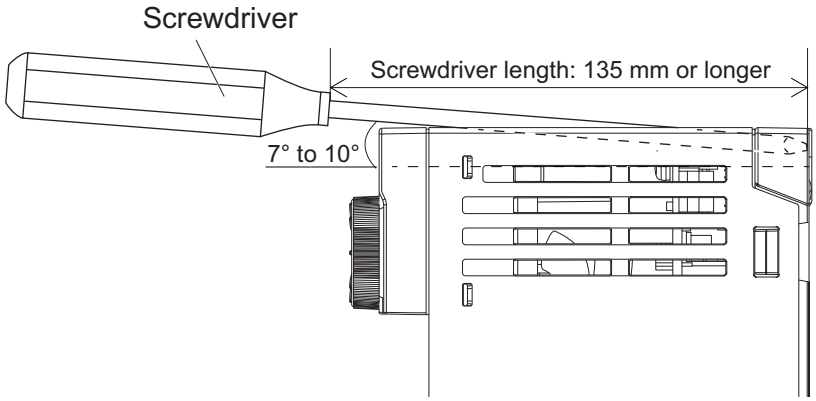
- Remove the front cover (or the lower front cover) and wiring covers 1 and 2 to fix the inverter.
- Install the inverter on a strong surface securely with screws.
- Leave enough clearances and take cooling measures.
- Avoid places where the inverter is subjected to direct sunlight, high temperature 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 space below the inverter is required for wiring, and the space above the inverter is required for heat dissipation.



*1 A clearance of 5 cm or more is required for the FR-E820-0476(15K) or higher and the FR-E840-0298(15K) or higher.

- When tightening screws into the upper mounting holes, tilt the screwdriver seven to ten degrees (FR-E820-0051(1.1K) or lower and FR-E820S-0017(0.4K) or lower).



- 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.

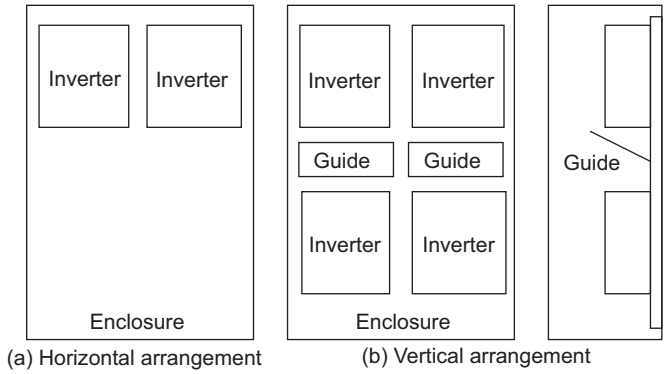
◆ Above the inverter

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.

◆ Arrangement of multiple inverters

When multiple inverters are placed in the same enclosure, generally arrange them horizontally as shown in the figure (a). When it is inevitable to arrange them vertically to minimize space, take such measures as to provide guides between the inverters since heat generated in the inverters in bottom row can increase the temperatures in the inverters in top row, causing inverter failures.

When installing multiple inverters, fully take measures to prevent the surrounding air temperature of the inverter from being higher than the permissible value by providing ventilation or increasing the enclosure size.

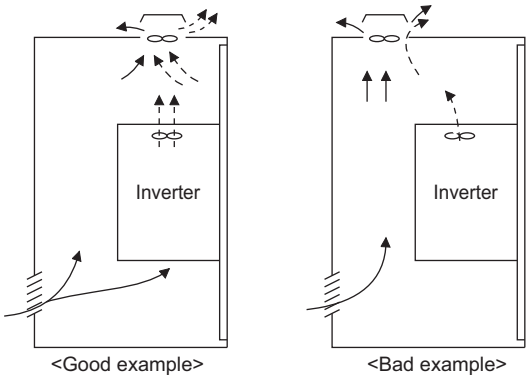


(a) Horizontal arrangement (b) Vertical arrangement

Arrangement of multiple inverters

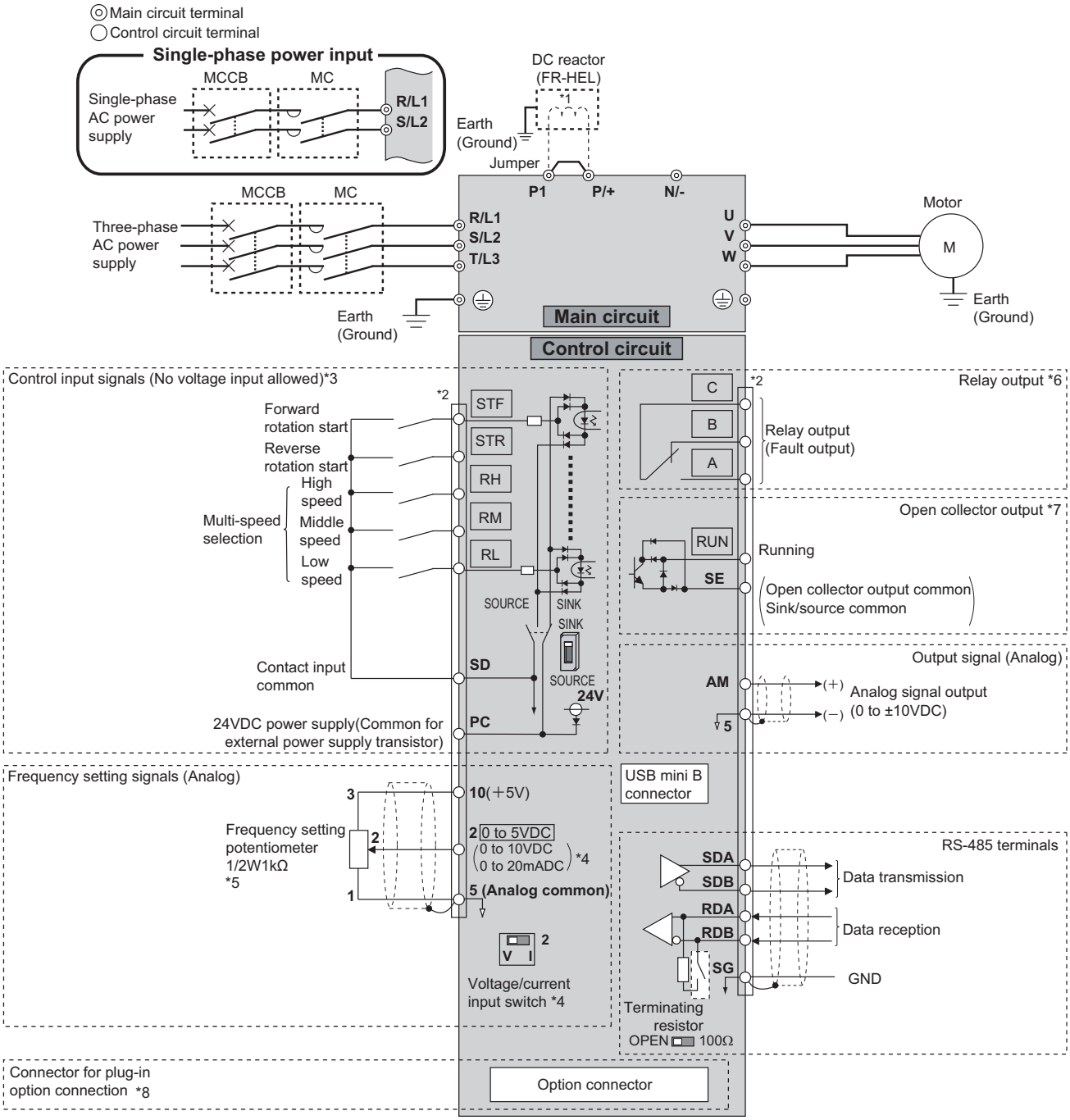
◆ Arrangement of the ventilation fan and inverter

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 an airway and airflow plates to expose the inverter to cool air.)



Arrangement of the ventilation fan and inverter

2.4 Terminal connection diagrams



*1 Remove the jumper between P1 and P/+ to connect the DC reactor.

*2 The control circuit terminals are wired using one connector. (For the wiring of the control circuit, refer to page 54.)

*3 The function of these terminals can be changed using the Input terminal function selection (**Pr.178 to Pr.182**). (Refer to the FR-E800 Instruction Manual (Function).)

*4 Terminal input specifications can be changed by analog input specification switchover (**Pr.73**). To input voltage, set the voltage/current input selection switch to "V". To input current, set the switch to "I". The switch is initially set to voltage input.

*5 It is recommended to use 2W1kΩ when the frequency setting signal is changed frequently.

*6 The function of these terminals can be changed using **Pr.192 ABC terminal function selection**. (Refer to the FR-E800 Instruction Manual (Function).)

*7 The function of these terminals can be changed using the **Pr.190 RUN terminal function selection**. (Refer to the FR-E800 Instruction Manual (Function).)

*8 Plug-in options are not available.

NOTE

- To prevent a malfunction due to noise, keep the signal cables 10 cm or more away from the power cables. Also, keep the cables of the main circuit for input and output separated.
- After wiring, wire offcuts must not be left in the inverter.
  Wire offcuts can cause a fault, 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 switches of the voltage/current input selection switch assembly correctly. Incorrect setting may cause a fault, failure or malfunction.
- The output of the single-phase power input model is three-phase 200 V.

2.5 Main circuit terminals

2.5.1 Details on the main circuit terminals

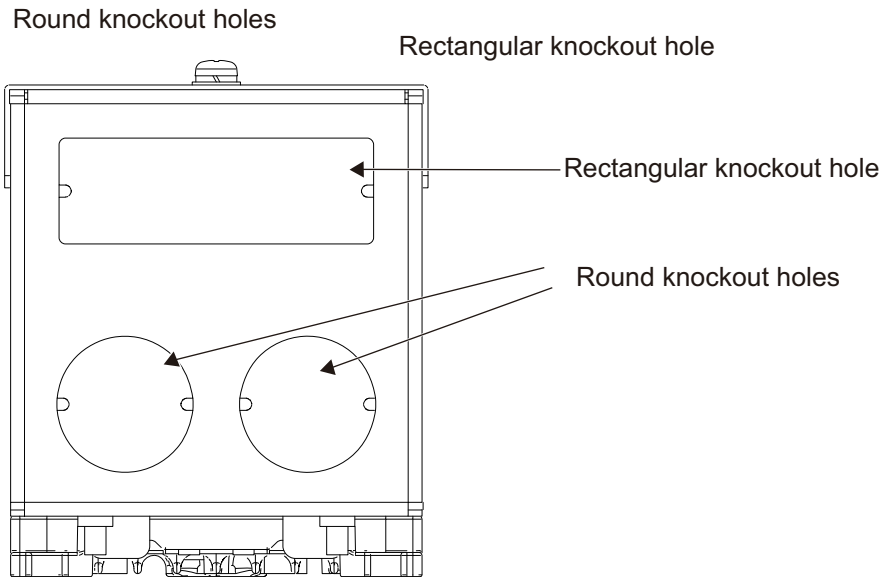
Terminal symbol	Terminal name	Terminal function description	Refer to page
R/L1, S/L2, T/L3*1	AC power input	Connect these terminals to the commercial power supply.	—
U, V, W	Inverter output	Connect these terminals to a three-phase squirrel cage motor or a PM motor.	—
P/+, P1	DC reactor connection for	Remove the jumper across terminals P/+ and P1, and connect a DC reactor. When a DC reactor is not connected, the jumper across terminals P/+ and P1 should not be removed.	61
⏚	Earth (ground)	For earthing (grounding) the inverter chassis. Be sure to earth (ground) the inverter.	49

*1 Terminal T/L3 is not available for the single-phase power input model.

2.5.2 Main circuit terminal layout and wiring to power supply and motor

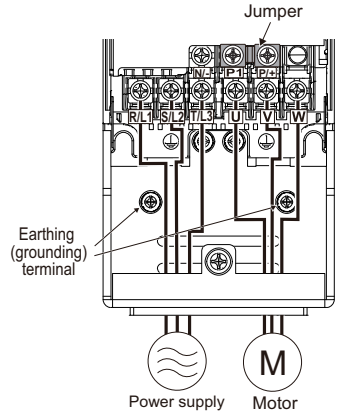
When passing wiring through the knockout holes on the wiring cover 2, separate the control circuit wiring from the main circuit wiring to reduce the influence of noise. Use the rectangular hole for the control circuit wiring and the round holes for the main circuit wiring.

(Example) FR-E820-0011(0.2K) bottom view

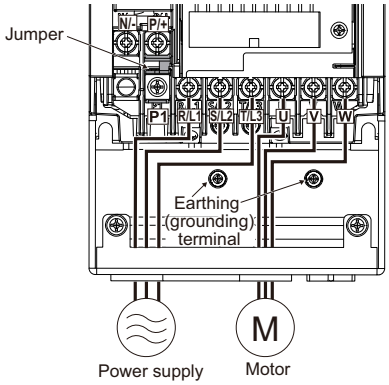


◆ Three-phase 200/400 V class

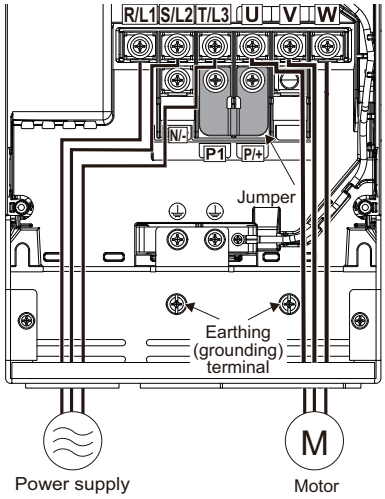
FR-E820-0011(0.2K) to 0051(1.1K)



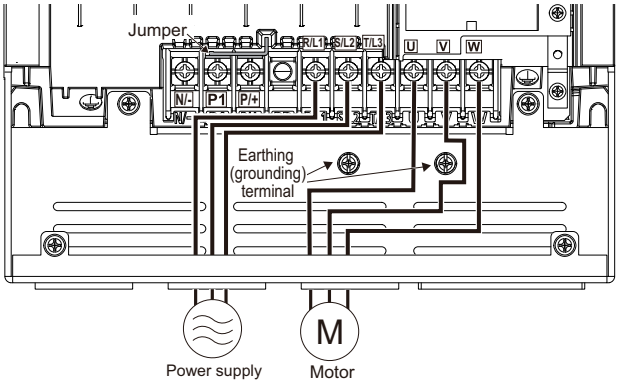
FR-E820-0082(2.2K) to 0167(5.5K)
FR-E840-0018(0.75K) to 0094(5.5K)



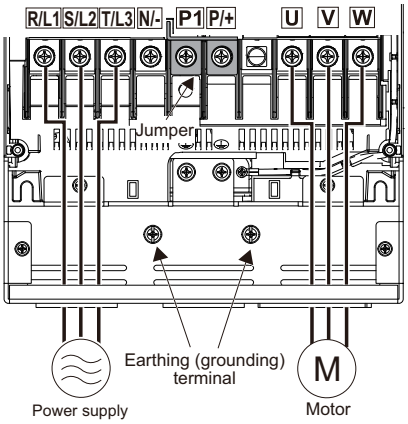
FR-E820-0255(7.5K), 0340(11K)



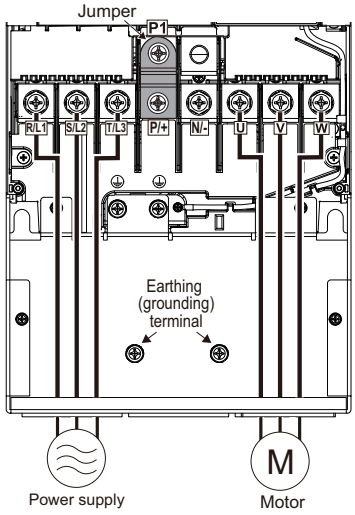
FR-E840-0149(7.5K), 0196(11K)



FR-E820-0476(15K), 0587(18.5K)
FR-E840-0298(15K), 0349(18.5K)

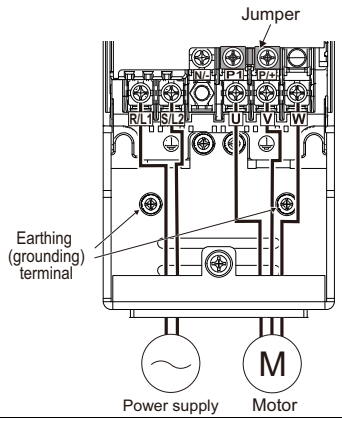


FR-E820-0748(22K), 0978(30K)
FR-E840-0383(22K), 0510(30K)

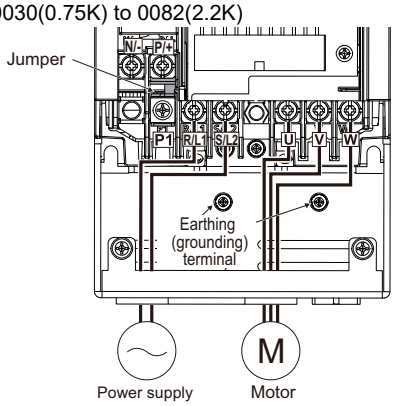


◆ Single-phase 200 V class

FR-E820S-0082(2.2K), 0017(0.4K)



FR-E820S-0030(0.75K) to 0082(2.2K)



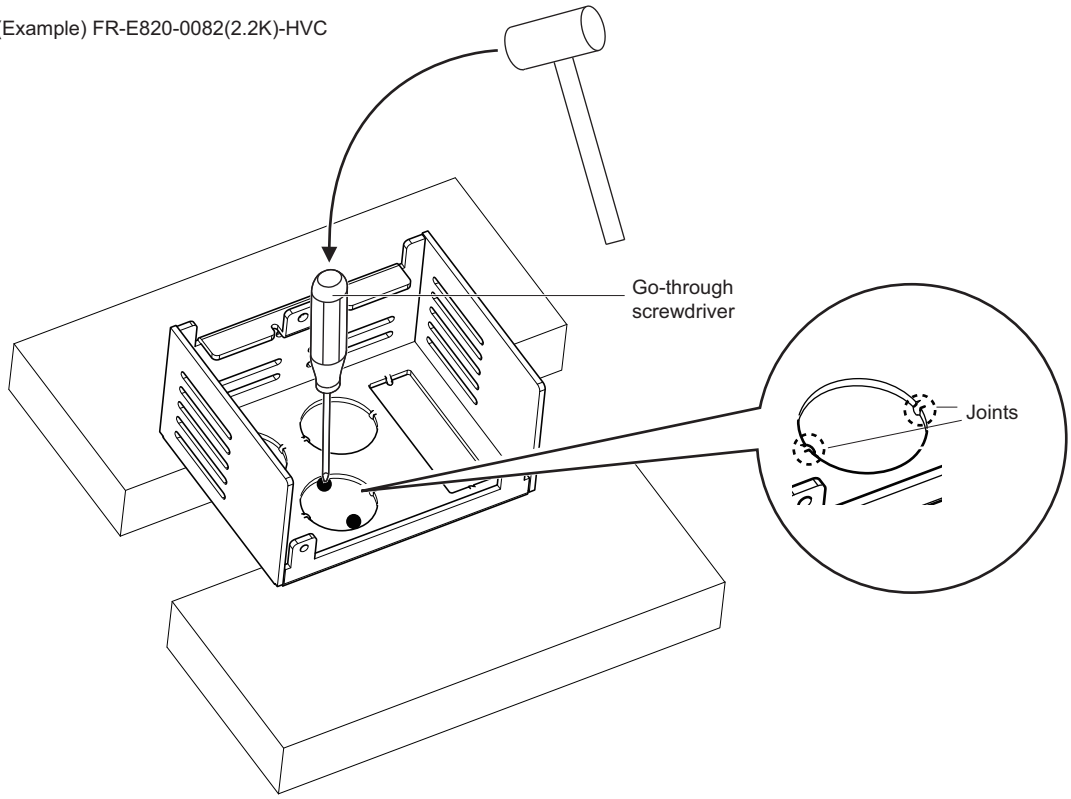
NOTE

- Make sure the power cables are connected to the R/L1, S/L2, and T/L3. (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 U, V, and W. (The phases must be matched.)

■ Handling of the wiring cover(FR-E820-0587(18.5K) or lower, FR-E840-0349(18.5K) or lower, FR-E820S-0030(0.75K) or lower or lower)

1. To prevent injury, wear protective equipment such as cut-resistant gloves.
2. Place the wiring cover 2 securely on wooden blocks or the like to punch out knockout holes easily.
3. To punch out the knockout holes in the wiring cover 2, use a go-through screwdriver and alternately tap the points marked with black circles in the following figure repeatedly. Be careful not to put the screwdriver directly on the joints. Remove any sharp edges and burrs from the knockout holes.

(Example) FR-E820-0082(2.2K)-HVC



4. Always use conduit hubs to connect conduits to the knockout holes. The hubs shall be assembled to the conduits before they are installed in the knockout holes.

Inverter capacity	Number of holes		Hole diameter for main circuit (mm)
	For main circuit	For control circuit	
FR-E820-0011(0.2K), 0017(0.4K) FR-E820S-0011(0.2K)	2	1 (Hole size: 17.5 × 52)	22.5
FR-E820-0030(0.75K), 0051(1.1K) FR-E820S-0017(0.4K)	3	1 (Hole size: 17.5 × 52)	22.5
FR-E820-0082(2.2K), 0102(3.0K) FR-E840-0018(0.75K) to 0047(2.2K) FR-E820S-0030(0.75K)	3	1 (Hole size: 60 × 17.5)	28.1
FR-E820S-0051(1.1K)	3	1 (Hole size: 17.5 × 60)	28.1
FR-E820-0167(5.5K) FR-E840-0059(3.0K), 0094(5.5K) FR-E820S-0082(2.2K)	3	1 (Hole size: 17.5 × 60)	35.3
FR-E840-0149(7.5K), 0196(11K)	3	1 (Hole size: 20 × 60)	35.3
FR-E820-0255(7.5K) to 0587(18.5K) FR-E840-0298(15K), 0349(18.5K)	3	1 (Hole size: 20 × 60)	44.9

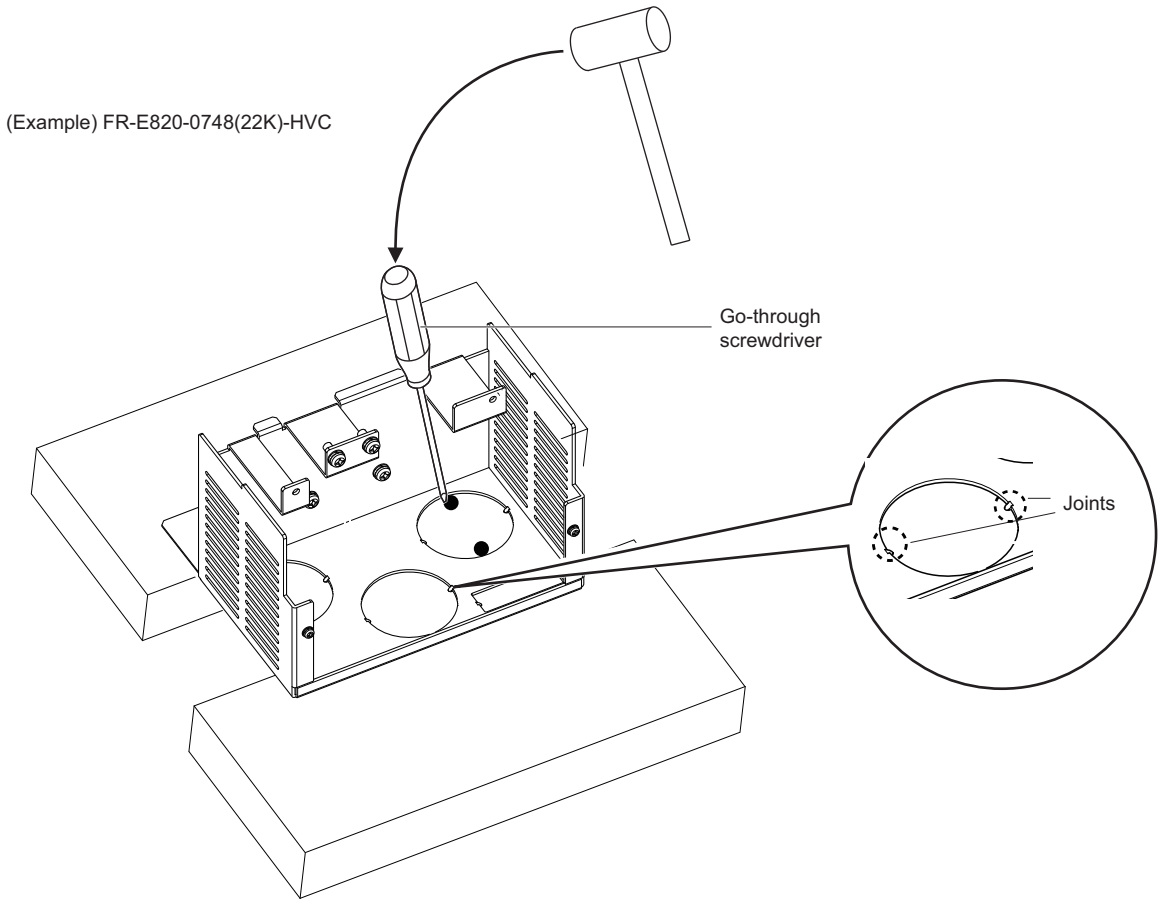
■ Handling of the wiring cover (FR-E820-0748(22K) or higher, FR-E840-0383(22K) or higher)

1. To prevent injury, wear protective equipment such as cut-resistant gloves.

2. Place the wiring cover 2 securely on wooden blocks or the like to punch out knockout holes easily.

3. To punch out the knockout holes in the wiring cover 2, use a go-through screwdriver and alternately tap the points marked with black circles in the following figure repeatedly. Tilt the screwdriver when tapping the points as the wiring cover 2 has metal sheets. Be careful not to put the screwdriver directly on the joints. Remove any sharp edges and burrs from the knockout holes.

(Example) FR-E820-0748(22K)-HVC



4. Always use conduit hubs to connect conduits to the knockout holes. The hubs shall be assembled to the conduits before they are installed in the knockout holes.

Inverter capacity	Number of holes		Hole diameter for main circuit (mm)
	For main circuit	For control circuit	
FR-E820-0748(22K), 0978(30K) FR-E840-0383(22K), 0510(30K)	3	1 (Hole size: 20 × 60)	63.9

NOTE

- Be careful not to injure yourself with the sharp edges and burrs of the knockout holes.
- To avoid wire offcuts and other foreign matter from entering the inverter, punch out only necessary holes and close holes if they are no more used.

⚠CAUTION

- Do not wire without using conduits. Otherwise, the cable sheathes may be scratched by the wiring cover edges, resulting in a short circuit or ground fault.
- When conduits are not used, protect wiring holes with grommets such as rubber grommets.

2.5.3 Applicable cables and wiring length

- Three-phase 200 V class (220 V input power supply, without a power factor improving AC or DC reactor, at LD rating)

Applicable inverter model FR-E820-[]-HVC	Terminal screw size*4	Tightening torque (N·m)	Crimp terminal		Cable gauge								
					HIV cables, etc. (mm²)*1				AWG/MCM*2		PVC cables, etc. (mm²)*3		
			R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	Earthing (grounding) cable
0011(0.2K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0017(0.4K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0030(0.75K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0051(1.1K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0082(2.2K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0102(3.0K)	M4 (M3.5)	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
0167(5.5K)	M4 (M3.5)	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	6
0255(7.5K)	M5	2.5	14-5	5.5-5	14	5.5	14	5.5	6	10	16	6	6
0340(11K)	M5	2.5	14-5	14-5	14	14	14	8	6	6	16	16	10
0476(15K)	M5	2.5	22-5	22-5	22	22	22	14	4	4	25	25	16
0587(18.5K)	M6 (M5)	4.4	38-6	22-6	38	22	38	14	2	4	35	25	25
0748(22K)	M8 (M6)	7.8	38-8	38-8	38	38	38	22	2	2	35	35	25
0978(30K)	M8 (M6)	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25

- Three-phase 200 V class (220 V input power supply, with a power factor improving AC or DC reactor, at LD rating)

Applicable inverter model FR-E820-[]-HVC	Terminal screw size*4	Tightening torque (N·m)	Crimp terminal		Cable gauge								
					HIV cables, etc. (mm²)*1				AWG/MCM*2		PVC cables, etc. (mm²)*3		
			R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	Earthing (grounding) cable
0011(0.2K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0017(0.4K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0030(0.75K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0051(1.1K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0082(2.2K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0102(3.0K)	M4 (M3.5)	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
0167(5.5K)	M4 (M3.5)	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	6
0255(7.5K)	M5	2.5	5.5-5	5.5-5	5.5	5.5	14	5.5	10	10	6	6	6
0340(11K)	M5	2.5	14-5	14-5	14	14	14	8	6	6	16	16	10
0476(15K)	M5	2.5	22-5	22-5	22	22	22	14	4	4	25	25	16
0587(18.5K)	M6 (M5)	4.4	22-6	22-6	22	22	38	14	4	4	25	25	25
0748(22K)	M8 (M6)	7.8	38-8	38-8	38	38	38	22	2	2	35	35	25
0978(30K)	M8 (M6)	7.8	60-8	60-8	60	60	60	22	1/0	1/0	50	50	25

- Three-phase 400 V class (440 V input power supply, without a power factor improving AC or DC reactor, at LD rating)

Applicable inverter model FR-E840-[]-HVC	Terminal screw size*4	Tightening torque (N·m)	Crimp terminal		Cable gauge								
					HIV cables, etc. (mm²)*1				AWG/MCM*2		PVC cables, etc. (mm²)*3		
			R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	Earthing (grounding) cable
0018(0.75K) to 0059(3.0K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0094(5.5K)	M4 (M3.5)	1.5	2-4	2-4	2	2	3.5	2	12	14	2.5	2.5	2.5
0149(7.5K)	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
0196(11K)	M4	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	6
0298(15K)	M4	1.5	8-4	5.5-4	8	5.5	8	5.5	8	10	10	6	10
0349(18.5K)	M5	2.5	14-5	8-5	14	8	14	8	6	8	16	10	16
0383(22K)	M6	4.4	14-6	14-6	14	14	22	14	6	6	16	16	16
0510(30K)	M6	4.4	22-5	22-5	22	22	22	14	4	4	25	25	16

- Three-phase 400 V class (440 V input power supply, with a power factor improving AC or DC reactor, at LD rating)

Applicable inverter model FR-E840-[]-HVC	Terminal screw size*4	Tightening torque (N·m)	Crimp terminal		Cable gauge								
					HIV cables, etc. (mm²)*1				AWG/MCM*2		PVC cables, etc. (mm²)*3		
			R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	Earthing (grounding) cable
0018(0.75K) to 0059(3.0K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0094(5.5K)	M4 (M3.5)	1.5	2-4	2-4	2	2	3.5	2	14	14	2.5	2.5	2.5
0149(7.5K)	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5	12	12	4	4	4
0196(11K)	M4	1.5	5.5-4	5.5-4	5.5	5.5	5.5	5.5	10	10	6	6	6
0298(15K)	M4	1.5	5.5-4	5.5-4	5.5	5.5	8	5.5	10	10	6	6	6
0349(18.5K)	M5	2.5	8-5	8-5	8	8	14	8	8	8	10	10	10
0383(22K)	M6	4.4	14-6	14-6	14	14	22	14	6	6	16	16	16
0510(30K)	M6	4.4	22-5	22-5	22	22	22	14	4	4	25	25	16

- Single-phase 200 V class (220 V input power supply, with a power factor improving AC or DC reactor, at LD rating)

Applicable inverter model FR-E820S-[]-HVC	Terminal screw size*4	Tightening torque (N·m)	Crimp terminal		Cable gauge								
					HIV cables, etc. (mm²)*1				AWG/MCM*2		PVC cables, etc. (mm²)*3		
			R/L1, S/L2	U, V, W	R/L1, S/L2	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2	U, V, W	R/L1, S/L2, T/L3	U, V, W	Earthing (grounding) cable
0011(0.2K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0017(0.4K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0030(0.75K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0051(1.1K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0082(2.2K)	M4 (M3.5)	1.5	5.5-4	2-4	3.5	2	2	2	12	14	4	2.5	2.5

- Single-phase 200 V class (220 V input power supply, without a power factor improving AC or DC reactor, at LD rating)

Applicable inverter model FR-E820S-[]-HVC	Terminal screw size*4	Tightening torque (N·m)	Crimp terminal		Cable gauge								
					HIV cables, etc. (mm²)*1				AWG/MCM*2		PVC cables, etc. (mm²)*3		
			R/L1, S/L2	U, V, W	R/L1, S/L2	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	Earthing (grounding) cable
0011(0.2K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0017(0.4K)	M3.5	1.2	2-3.5	2-3.5	2	2	2	2	14	14	2.5	2.5	2.5
0030(0.75K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0051(1.1K)	M4 (M3.5)	1.5	2-4	2-4	2	2	2	2	14	14	2.5	2.5	2.5
0082(2.2K)	M4 (M3.5)	1.5	5.5-4	2-4	3.5	2	2	2	12	14	4	2.5	2.5

*1 HIV cable (600 V grade heat-resistant PVC insulated wire) with a continuous maximum permissible temperature of 75°C. It assumes a surrounding air temperature of 50°C or lower and the wiring distance of 20 m or shorter.

*2 THHW cable with a continuous maximum permissible temperature of 75°C. It assumes a surrounding air temperature of 40°C or lower and the wiring distance of 20 m or shorter.
(For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the document enclosed with the product.)

*3 PVC cable with continuous maximum permissible temperature of 70°C. It assumes a surrounding air temperature of 40°C or lower and the wiring distance of 20 m or shorter.
(Selection example mainly for use in Europe.)

*4 The screw size for terminals R/L1, S/L2, T/L3, U, V, W, P/+, N/-, and P1, and the earthing (grounding) terminal are shown. (For the single-phase 200 V power input models, the screw size for terminals R/L1, S/L2, U, V, W, P/+, N/-, and P1, and the earthing (grounding) terminal are shown.)
The screw size for earthing (grounding) the FR-E820-0082(2.2K) to 0167(5.5K) is indicated in parentheses.

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

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

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

NOTE

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

◆Total wiring length

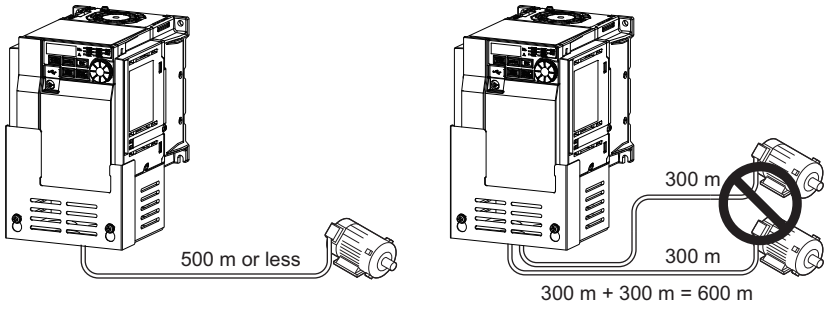
■With induction motor

Connect one or more general-purpose motors within the total wiring length shown in the following table.

Cable type	Pr.72 setting (carrier frequency)	Voltage class	Applicable inverter model: FR-E820-[]-HVC						
			0011 (0.2K)	0017 (0.4K)	0030 (0.75K)	0051 (1.1K)	0082 (2.2K)	0102 (3.0K)	0167 (5.5K) or higher
Unshielded	1 (1 kHz) or lower	200 V	200 m	200 m	300 m	500 m	500 m	500 m	500 m
	2 (2 kHz) or higher		30 m	100 m	200 m	300 m	500 m	500 m	500 m
Shielded	1 (1 kHz) or lower		50 m	50 m	75 m	100 m	100 m	100 m	100 m
	2 (2 kHz) or higher		10 m	25 m	50 m	75 m	100 m	100 m	100 m

Cable type	Pr.72 setting (carrier frequency)	Voltage class	Applicable inverter model: FR-E840-[]-HVC				
			0018(0.75K)	0030(1.5K)	0047(2.2K)	0059(3.0K)	0094(5.5K) or higher
Unshielded cable	1 (1 kHz) or lower	400 V	200 m	200 m	300 m	500 m	500 m
	2 (2 kHz) or higher		30 m	100 m	200 m	300 m	500 m
Shielded	1 (1 kHz) or lower		50 m	50 m	75 m	100 m	100 m
	2 (2 kHz) or higher		10 m	25 m	50 m	75 m	100 m

Total wiring length (FR-E820-0167(5.5K) or higher, FR-E840-0094(5.5K) or higher), unshielded cable



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 measure.

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

Wiring length 50 m or shorter	Wiring length 50 to 100 m	Wiring length longer than 100 m
14.5 kHz or lower	8 kHz or lower	2 kHz or lower

■ With PM motor

Use the wiring length of 100 m or shorter when connecting a PM motor.

Use one PM motor for one inverter. Multiple PM motors cannot be connected to an inverter.

When the wiring length exceeds 50 m for a 400 V class motor (other than EM-A) driven by an inverter under PM sensorless vector control, set "9" (6 kHz) or less in **Pr.72 PWM frequency selection**.

NOTE

- Especially for long-distance wiring, the inverter may be affected by a charging current caused by stray capacitance of the wiring, leading to an activation of the overcurrent protection, malfunction of the fast-response current limit operation, or even to an inverter failure. It may also cause a malfunction or fault of the equipment connected ON the inverter output side. If the fast-response current limit function malfunctions, disable the function. (Refer to **Pr.156 Stall prevention operation selection** in the FR-E800 Instruction Manual (Function).)
- A surge voltage suppression filter (FR-ASF-H/FR-BMF-H) can be used under V/F control and Advanced magnetic flux vector control.
- For details on **Pr.72 PWM frequency selection**, refer to the FR-E800 Instruction Manual (Function).
- Refer to page 75 to drive a 400 V class motor by an inverter.
- The carrier frequency is limited during Real sensorless vector control and PM sensorless vector control. (Refer to the FR-E800 Instruction Manual (Function).)

2.5.4 Earthing (grounding) precautions

Always earth (ground) the motor and inverter.

◆ Purpose of earthing (grounding)

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

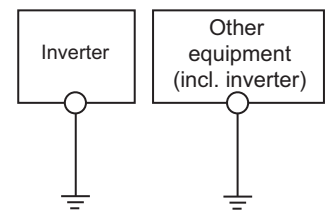
An electrical circuit is usually insulated by an insulating material and encased. However, it is impossible to manufacture an insulating material that can shut off a leakage current completely, and actually, a slight current flows into the case. The purpose of earthing (grounding) the case of an electrical apparatus is to prevent operators from getting an electric shock from this leakage current when touching it.

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

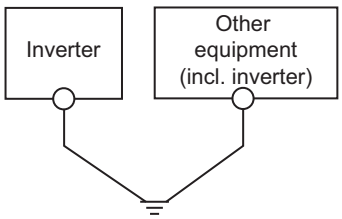
◆ Earthing (grounding) system to be established

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

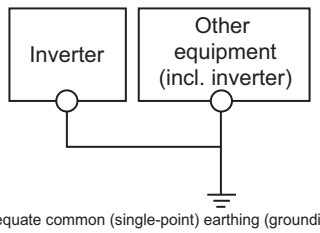
- Make the separate earth (ground) connection (I) for high frequency products such as the inverter from any other devices (EMI-sensitive devices described above) wherever possible.
  Establishing adequate common (single-point) earth (ground) system (II) shown in the following figure is allowed only in cases where the separate earth (ground) system (I) is not feasible. Do not make inadequate common (single-point) earth (ground) connection (III).
  As leakage currents containing many high frequency components flows into the earthing (grounding) cables of the inverter and peripheral devices (including a motor), the inverter must also be earthed (grounded) separately from EMI-sensitive devices described above.
  In a high building, it may be effective to use its iron structure frames as earthing (grounding) electrode for EMI prevention in order to separate from the earth (ground) system for electric shock prevention.
  - 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 for 400 V class inverter 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 45.
  - 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 the EMI-sensitive devices and run them in parallel in the minimum distance.



(I) Separate earthing (grounding): Good



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

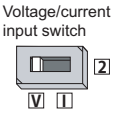


(III) Inadequate common (single-point) earthing (grounding): Bad

2.6 Control circuit

2.6.1 Details on the control circuit terminals (connector)

◆ Input signal

Type	Terminal symbol	Common	Terminal name	Terminal function description		Rated specification	Refer to page
Contact input	STF*1	SD (sink (negative common)) PC (source (positive common))	Forward rotation start	Turn ON the STF signal to start forward rotation and turn it OFF to stop.	When the STF and STR signals are turned ON simultaneously, the stop command is given.	Input resistance: 4.7 kΩ, voltage when contacts are open: 21 to 26 VDC, current when contacts are short-circuited: 4 to 6 mADC	*2
	STR*1		Reverse rotation start	Turn ON the STR signal to start reverse rotation and turn it OFF to stop.			
	RH RM RL*1		Multi-speed selection	Multi-speed can be selected according to the combination of RH, RM and RL signals.			*2
Frequency setting	10	5	Frequency setting power supply	Used as the power supply for an external frequency setting (speed setting) potentiometer.		5 ±0.5 VDC, permissible load current: 10 mA	*2
	2	5	Frequency setting (voltage)	Inputting 0 to 5 VDC (or 0 to 10 VDC) provides the maximum output frequency at 5 V (or 10 V) and makes input and output proportional. Use **Pr.73** to switch among input 0 to 5 VDC (initial setting), 0 to 10 VDC, and 0 to 20 mA. Set the voltage/current input switch to the "I" position to select current input (0 to 20 mA).		For voltage input, input resistance: 10 to 11 kΩ, maximum permissible voltage: 20 VDC. For current input, input resistance: 245 ±5 Ω, maximum permissible current: 30 mA. 	*2

*1 The terminal function can be selected by **Pr.178 to Pr.182 (Input terminal function selection)**. (Refer to the FR-E800 Instruction Manual (Function).)

*2 Refer to the FR-E800 Instruction Manual (Function).

◆ Output signal

Type	Terminal symbol	Common	Terminal name	Terminal function description		Rated specification	Refer to page
Relay	A, B, C*1	—	Relay output (fault output)	1 changeover contact output that indicates that an inverter's protective function has been activated and the outputs are stopped. Fault: discontinuity across B and C (continuity across A and C), Normal: continuity across B and C (discontinuity across A and C)		30 VDC 1 A	*3
Open collector	RUN*1	SE	Inverter running	The output is in LOW state when the inverter output frequency is equal to or higher than the starting frequency (initial value: 0.5 Hz). The output is in HIGH state during stop or DC injection brake operation.*2		Permissible load: 24 VDC (27 VDC at maximum), 0.1 A (The voltage drop is 3.4 V at maximum while the signal is ON.)	*3
Analog	AM	5	Analog voltage output	Among several monitor items such as output frequency, select one to output it via these terminals. (The signal is not output during an inverter reset.) The size of output signal is proportional to the magnitude of the corresponding monitor item.	Output item: output frequency (initial setting)	Output signal: 0 ±10 VDC, permissible load current: 1 mA (load impedance 10 kΩ or more), resolution: 12 bits	*3

*1 The terminal function can be selected by **Pr.190 and Pr.192 (Output terminal function selection)**. (Refer to the FR-E800 Instruction Manual (Function).)
*2 The open collector transistor is ON (conductive) in LOW state. The transistor is OFF (not conductive) in HIGH state.
*3 Refer to the FR-E800 Instruction Manual (Function).

◆ Common terminal

Terminal symbol	Common	Terminal name	Terminal function description	Rated specification	Refer to page
SD	—	Contact input common (sink (negative common))	Common terminal for the contact input terminal (sink logic).	—	—
		External transistor common (source (positive common))	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable current.		
		24 VDC power supply common	Common terminal for the 24 VDC power supply (terminal PC). Isolated from terminals 5 and SE.		
PC	—	External transistor common (sink (negative common))	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic to avoid malfunction by undesirable current.	Power supply voltage range: 22 to 26.5 VDC, permissible load current: 100 mA	—
		Contact input common (source (positive common))	Common terminal for contact input terminal (source logic).		
	SD	24 VDC power supply	Can be used as a 24 VDC 0.1 A power supply.		
5	—	Frequency setting common	Common terminal for the frequency setting signal (terminal 2) . Do not earth (ground).	—	*1
SE	—	Open collector output common	Common terminal for terminal RUN.	—	—

*1 Refer to the FR-E800 Instruction Manual (Function).

◆ Communication

Type	Terminal symbol		Terminal name	Terminal function description	Refer to page
RS-485	RS-485 terminals	SDA	Inverter transmission terminal	RS-485 communication can be made through the RS-485 terminals. Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 300 to 115200 bps Wiring length: 500 m	57
		SDB			
		RDA	Inverter reception terminal		
		RDB			
		SG	Earth (ground)		
USB	—		USB B connector*1	Mini B connector (receptacle). The inverter can be connected to a personal computer using the USB connector. Interface: conforms to USB 1.1 (USB 2.0 full-speed compatible) Transmission speed: 12 Mbps Power supply: 5 V, 100 mA (500 mA maximum)	59

*1 USB bus power connection is available. The maximum SCCR is 500 mA.

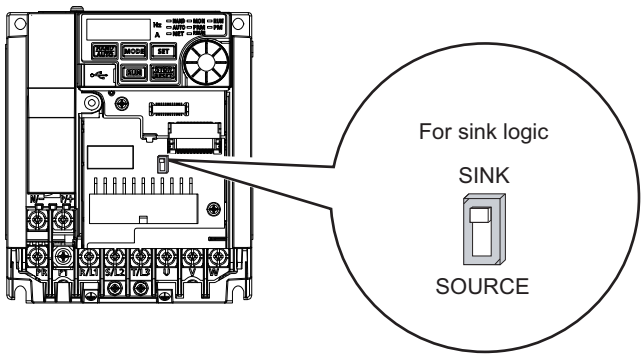
2.6.2 Control logic (sink/source) change

The control logic of input signals can be switched as necessary.

To change the control logic, change the DIP switch position on the control circuit board.

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

(The output signals may be used in either the sink or source logic independently of the switch setting.)



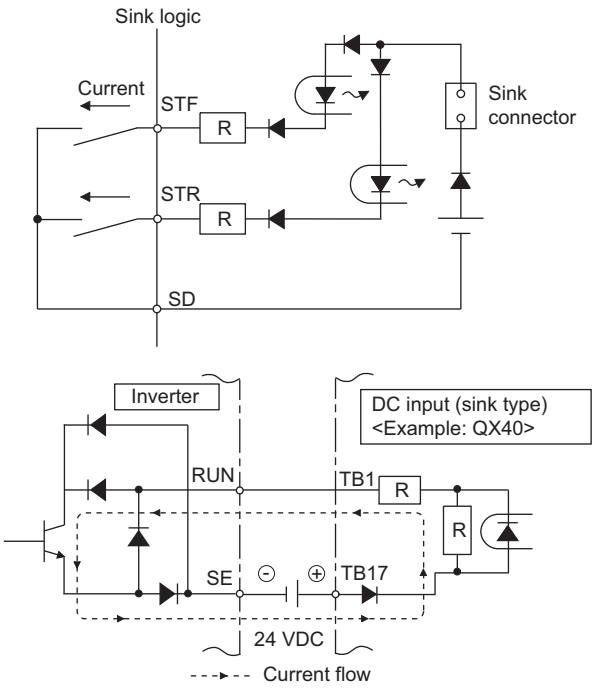
NOTE

- Never change the control logic while power is ON.

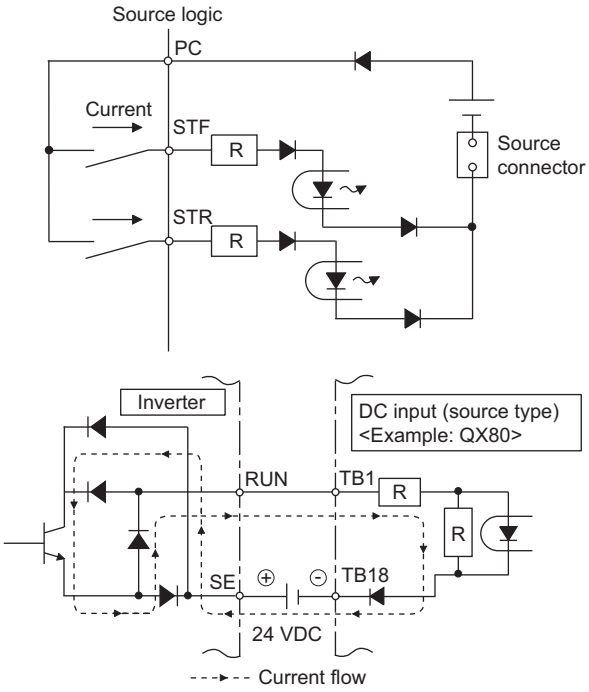
◆Sink logic and source logic

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

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

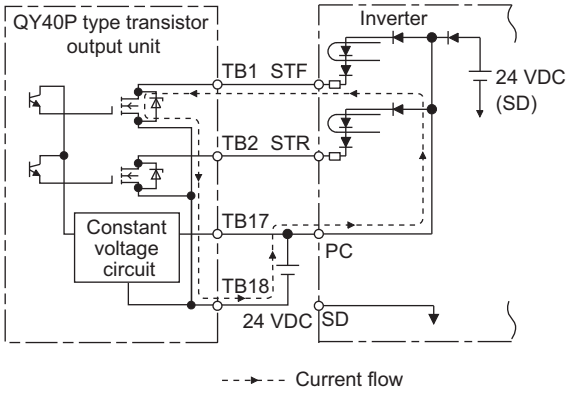


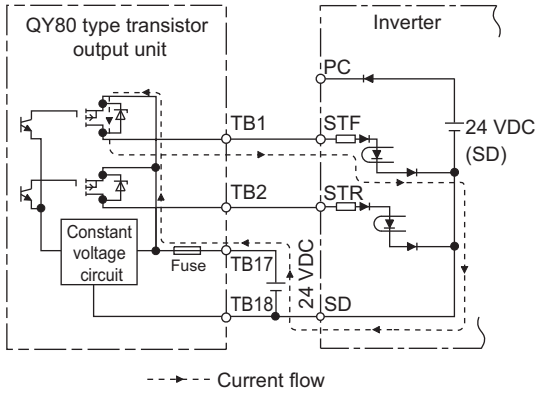
●Current flow concerning the input/output signal when source logic is selected



- When using an external power supply for transistor output

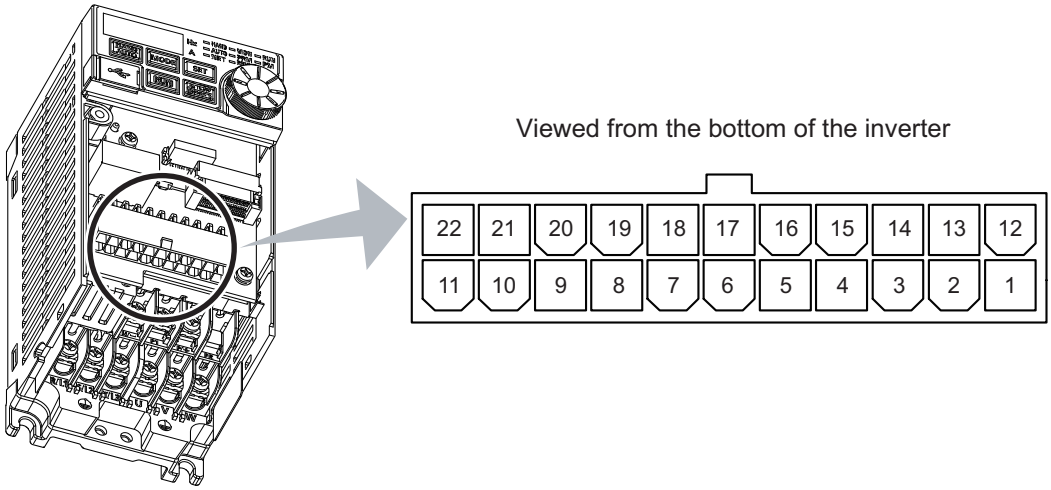
Sink logic	Source logic
Use terminal PC as a common terminal, and perform wiring as follows. (Do not connect terminal SD on the inverter with the terminal of 0 V for the external power supply. When using terminals PC and SD as a 24 VDC power supply, do not install an external power supply in parallel with the inverter. Doing so may cause a malfunction in the inverter due to undesirable currents.)	Use terminal SD as a common terminal, and perform wiring as follows. (Do not connect terminal PC on the inverter with the terminal of +24 V for the external power supply. When using terminals PC and 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.)





2.6.3 Wiring of control circuit

◆ Control circuit terminals (connector) layout



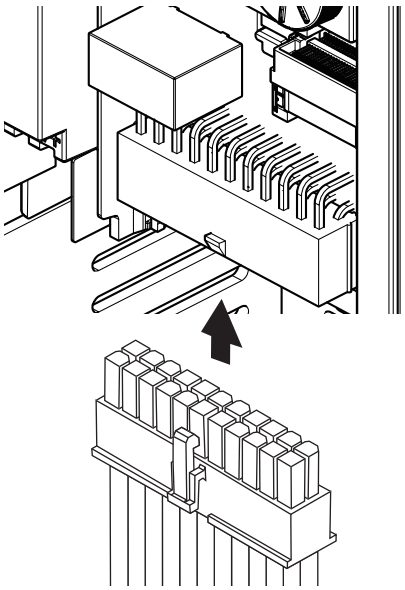
Pin number	Terminal symbol	Pin number	Terminal symbol
1	SDA (RS-485)	12	RDB (RS-485)
2	SDB (RS-485)	13	RDA (RS-485)
3	SG (RS-485)	14	2
4	5	15	AM
5	10	16	PC
6	RH	17	RL
7	RM	18	STF
8	STR	19	SD
9	RUN	20	SE
10	—	21	C
11	A	22	B

NOTE

- For the cable parts to be used, refer to the following.
- Commercially available products (as of July 2021)

Product name	Model	Manufacturer
Housing	2-1586019-2	Tyco Electronics
Contact	1586315-1	

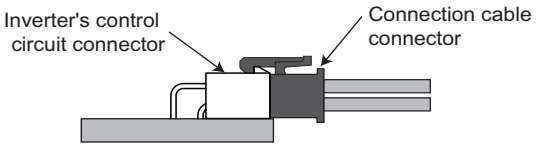
◆Wiring method

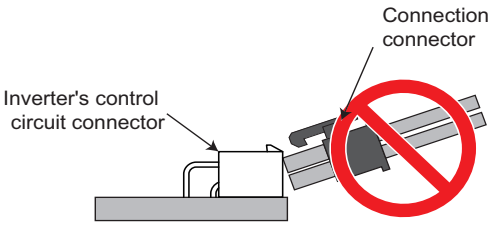


◆Removal and reinstallation precautions

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

- Remove or reinstall the connection cable connector so that it is parallel with the control circuit terminal connector of the inverter. If the cable connector is not parallel with the terminal connector, it cannot be removed or reinstalled.
- Before removing the connection cable, remove the circuit board from the inverter.





◆Common terminals of the control circuit (SD, PC, 5, SE)

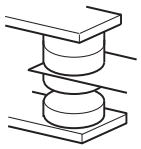
- Terminals SD (sink logic), PC (source logic), 5, and SE are common terminals (0 V) for I/O signals. (All common terminals are isolated from each other.) Do not earth (ground) these terminals. Avoid connecting terminal SD (sink logic) with terminal 5, terminal PC (source logic) with terminal 5, and terminal SE with terminal 5.
- In the sink logic, terminal SD is a common terminal for the contact input terminals (STF, STR, RH, RM, RL). 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). The open collector circuit is isolated from the internal control circuit by photocoupler.
- Terminal 5 is a common terminal for the frequency setting terminal (2) and the analog output terminals (AM). It should be protected from external noise.
- Terminal SE is a common terminal for the open collector output terminal (RUN). The contact input circuit is isolated from the internal control circuit by photocoupler.

◆Signal inputs by contactless switches

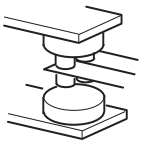
The contact input terminals of the inverter (STF, STR, RH, RM, RL) can be controlled using a transistor instead of a contact switch. Refer to page 53 for the connection diagram.

2.6.4 Wiring precautions

- It is recommended to use a cable of 0.2 to 0.8 mm^2 for the connection to the control circuit terminals.
- The wiring length should be 30 m at the maximum.
- Do not short across terminals PC and SD. Doing so may cause an inverter failure.
- Use two or more parallel micro-signal contacts or twin contacts to prevent contact faults when using contact inputs since the control circuit input signals are micro-currents.

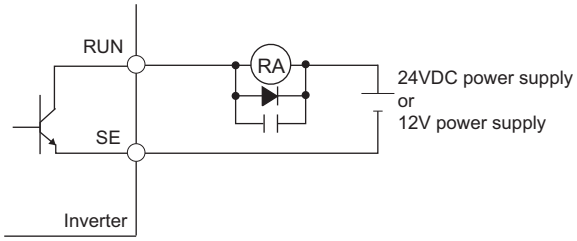


Micro signal contacts



Twin contacts

- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200 V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A, B, and C) via a relay coil, lamp, etc.
- When a relay coil is connected to the output terminals, use one with a surge absorbing function (reflux diode). When the voltage application direction is incorrect, the inverter will be damaged. Pay attention to the diode direction or other precautions to avoid incorrect wiring.

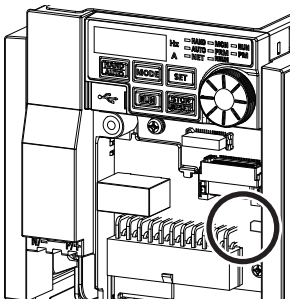


2.7 Communication connectors and terminals

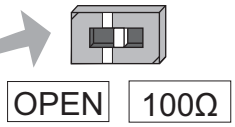
2.7.1 RS-485 terminals (connector)

◆ Communication operation

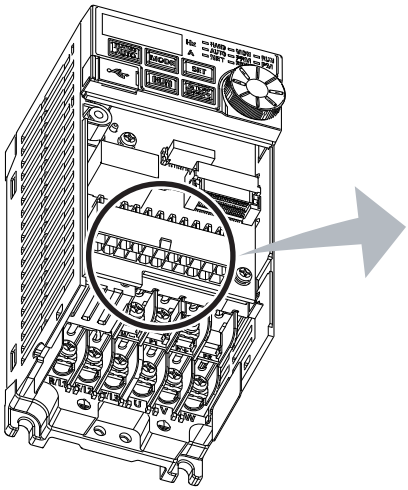
- The RS-485 terminals enable communication operation from a personal computer, etc. When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run to monitor the inverter or read and write parameters.
  Communication can be performed with the Mitsubishi inverter protocol (computer link communication), the MODBUS RTU protocol, or the BACnet MS/TP protocol.
  For details, refer to the FR-E800 Instruction Manual (Communication).



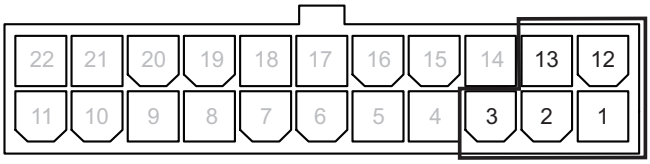
Terminating resistor switch
Initially-set to "OPEN".
Set only the terminating resistor switch of the remotest inverter to the "100Ω" position.



◆ Control circuit terminals (connector) layout



Viewed from the bottom of the inverter



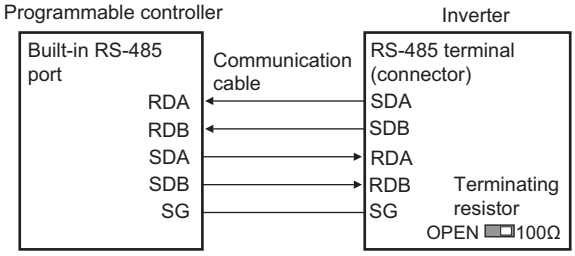
Pin number	Terminal symbol	Pin number	Terminal symbol
1	SDA (RS-485)	12	RDB (RS-485)
2	SDB (RS-485)	13	RDA (RS-485)
3	SG (RS-485)		

NOTE

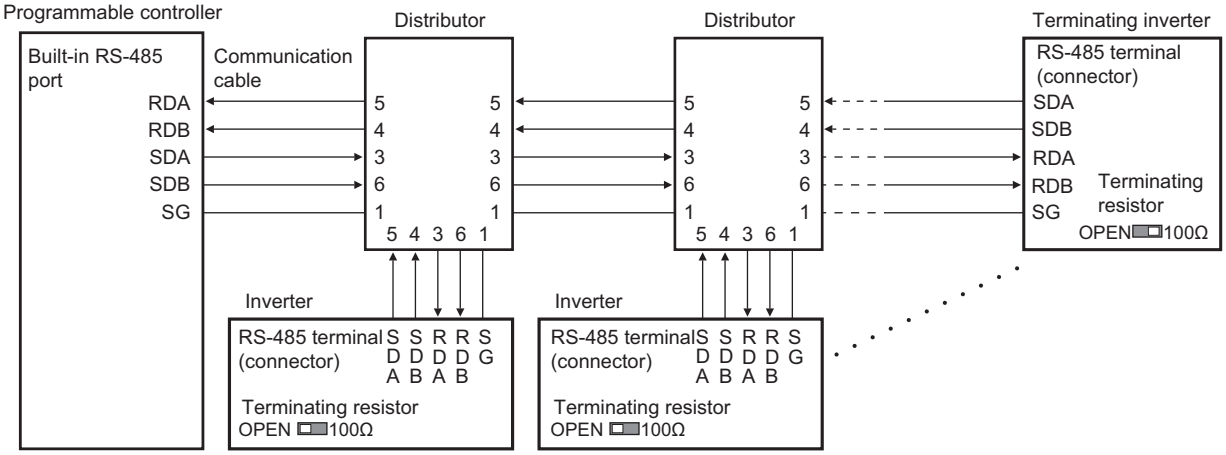
- For information on other pin numbers and connection cables, refer to page 54.

◆ Wiring method

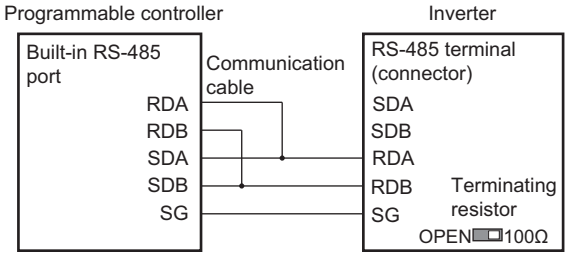
- Connecting one inverter (four-wire type)



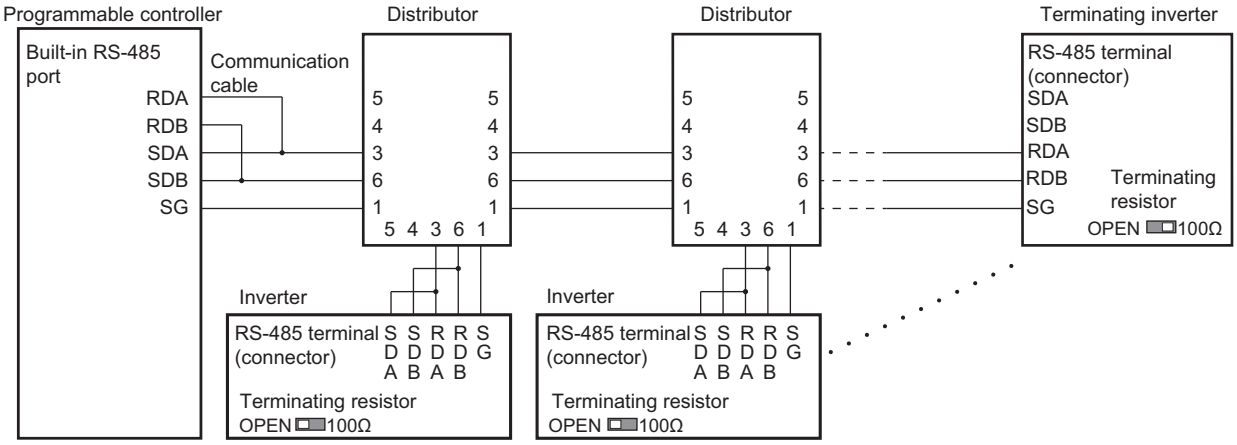
- Connecting multiple inverters (four-wire type)



- Connecting one inverter (two-wire type)



- Connecting multiple inverters (two-wire type)

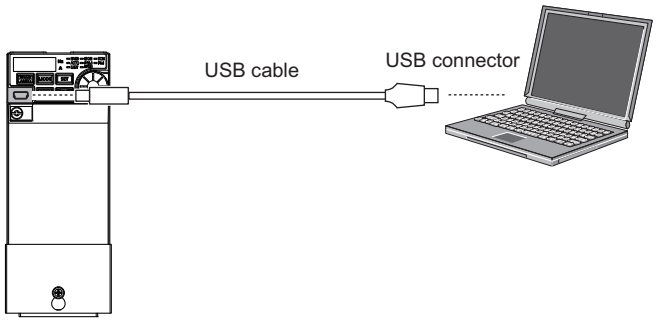


2.7.2 USB connector

◆ USB device communication

The inverter can be connected to a computer with a USB (ver. 1.1) cable.

Interface	Conforms to USB1.1 (USB2.0 full speed)
Transmission speed	12 Mbps
Wiring length	Maximum 5 m
Connector	USB mini B connector (receptacle)
Power supply	Self-powered
Recommended USB cable	MR-J3USBCBL3M (cable length 3 m)

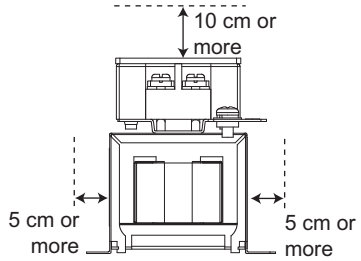


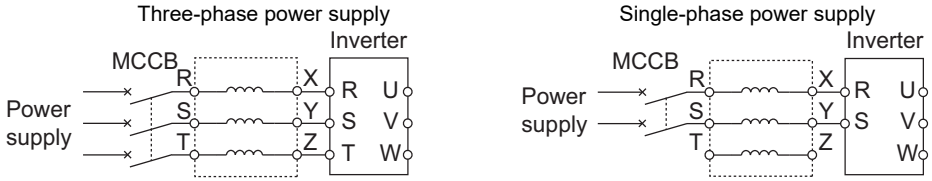
2.8 Connection of stand-alone option units

The inverter accepts 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 Instruction Manual of the corresponding option unit.

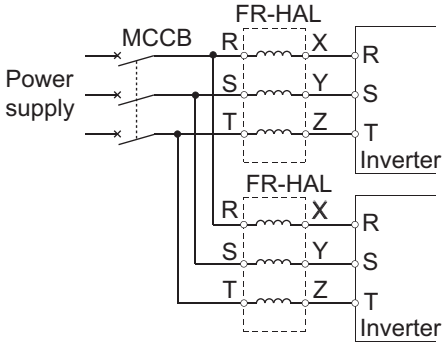
2.8.1 Connection of the AC reactor (FR-HAL)

- Keep the surrounding air temperature within the permissible range (-10°C to +50°C). Keep enough clearance around the reactor because it heats up. (Take 10 cm or more clearance on top and bottom and 5 cm or more on left and right regardless of the installation direction.)





- For multiple inverters, an AC reactor (FR-HAL) should be installed per inverter. If one reactor is used for multiple inverters, the power factor improving effect will be insufficient unless all inverters are operated.



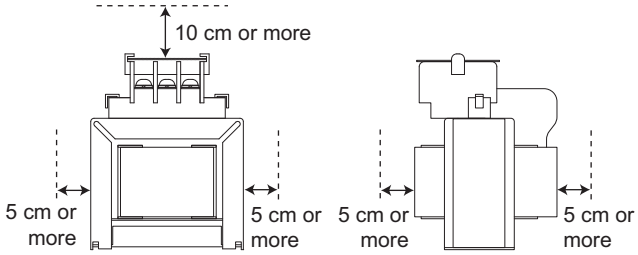
- Select an AC reactor according to the applied motor capacity. When using a motor with capacity lower than 0.4 kW, select the reactor for a 0.4kW motor. For the single-phase 200 V power input models, select the reactor whose capacity is one rank higher than the motor capacity. (Refer to page 84.)
- Securely perform grounding (earthing) by using the earthing (grounding) terminal.

NOTE

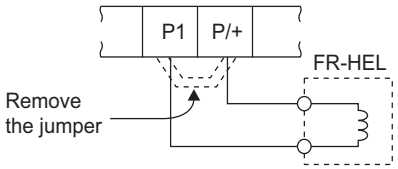
- As a reference, the cable gauge for the connection must be equal to or larger than that of the power cables (R/L1, S/L2, T/L3) and the earthing (grounding) cable. (Refer to page 45.)

2.8.2 Connection of the DC reactor (FR-HEL)

- Keep the surrounding air temperature within the permissible range (-10 to +50°C). Keep enough clearance around the reactor because it heats up. (Take 10 cm or more clearance on top and bottom and 5 cm or more on left and right regardless of the installation direction.)



- When using the DC reactor (FR-HEL), connect it to terminals P/+ and P1.
  In this case, the jumper connected across terminals P/+ and P1 must be removed. Otherwise, the reactor will not be effective.



- Select a DC reactor according to the applied motor capacity. (Refer to page 84.)
- Since the DC reactor (FR-HEL) is electrically connected to the enclosure through mounting screws, the DC reactor is earthed (grounded) by being securely mounted to the enclosure. However, if the DC reactor is not earthed (grounded) securely enough, an earthing (grounding) cable may be used.

NOTE

- The wiring distance must be within 5 m.
- As a reference, the cable gauge for the connection must be equal to or larger than that of the power cables (R/L1, S/L2, T/L3) and the earthing (grounding) cable. (Refer to page 45.)

MEMO

CHAPTER 3 Precautions for Use of the Inverter

3 Precautions for Use of the Inverter

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

3.1 Electro-magnetic interference (EMI) and leakage currents

3.1.1 Leakage currents and countermeasures

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

◆To-earth (ground) leakage currents

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

■Precautions

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

NOTE

- Long wiring will increase the leakage current.
- High motor capacity will increase the leakage current. The leakage current of the 400 V class is larger than that of the 200 V class.

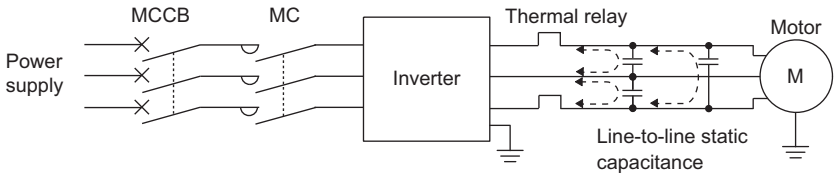
◆Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacitance between the inverter output cables may operate the external thermal relay unnecessarily. When the wiring length is long (50 m or more) for the 400 V class small-capacity models (FR-E840-0149(7.5K) or lower), the external thermal relay is likely to operate unnecessarily because the ratio of the leakage current to the rated motor current increases.

■Line-to-line leakage current example (200 V class)

Motor capacity (kW)	Rated motor current (A)	Leakage current (mA)*1		Condition
		Wiring length 50 m	Wiring length 100 m	
0.4	1.8	310	500	• Motor: SF-JR 4P • Carrier frequency: 14.5 kHz • Cable: 2 mm^2, 4 cores • Cabtyre cable
0.75	3.2	340	530	
1.5	5.8	370	560	
2.2	8.1	400	590	
3.7	12.8	440	630	
5.5	19.4	490	680	
7.5	25.6	535	725	

*1 The leakage currents of the 400 V class are about twice as large.



Line-to-line leakage currents path

■ Precautions

- Use **Pr.9 Electronic thermal O/L relay**.
- If the carrier frequency setting is high, decrease the **Pr.72 PWM frequency selection** setting.
  Note that motor noise increases. Selecting **Pr.240 Soft-PWM operation selection** makes the sound inoffensive.
  To ensure that the motor is protected against line-to-line leakage currents, it is recommended to use a temperature sensor to directly detect motor temperature.

■ Installation and selection of the molded case circuit breaker

Install a molded case circuit breaker (MCCB) on the power receiving side to protect the wiring at the 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.

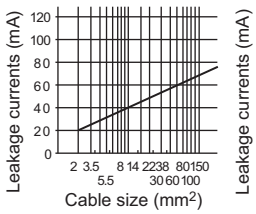
◆ Selecting the rated sensitivity current for the earth leakage circuit breaker

To install the earth leakage circuit breaker on the inverter circuit, select its rated sensitivity current as follows, independently of the PWM carrier frequency.

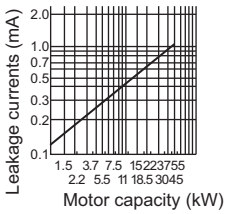
- Breaker designed for harmonic and surge suppression
  Rated sensitivity current
  $I\Delta n \geq 10 \times (Ig1 + Ign + Igi + Ig2 + Igm)$
- Standard breaker
  Rated sensitivity current
  $I\Delta n \geq 10 \times \{Ig1 + Ign + Igi + 3 \times (Ig2 + Igm)\}$

Ig1, Ig2: Leakage currents in wire path during commercial power supply operation
Ign: Leakage current from noise filters on the input side of the inverter
Igm: Leakage current from the motor during commercial power supply operation
Igi: Leakage current of inverter unit

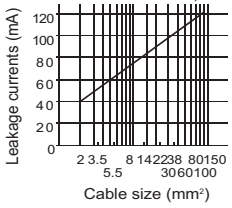
Example of leakage current of cable path per 1 km during the commercial power supply operation when the CV cable is routed in metal conduit (200 V 60 Hz)



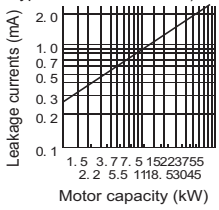
Leakage current example of three-phase induction motor during the commercial power supply operation (200 V 60 Hz)



Example of leakage current of cable path per 1km during the commercial power supply operation when the CV cable is routed in metal conduit (Three-phase three-wire delta connection 400 V 60 Hz)

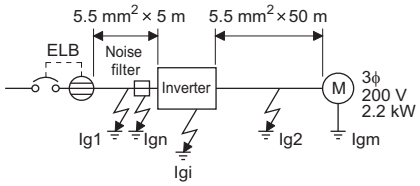


Leakage current example of three-phase induction motor during the commercial power supply operation (Totally-enclosed fan-cooled type motor 400 V 60 Hz)



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

Example



Item	Breaker designed for harmonic and surge suppression	Standard breaker
Leakage current Ig1 (mA)	$33 \times \frac{5m}{1000m} = 0.17$	
Leakage current Ign (mA)	0 (without noise filter)	
Leakage current Igi (mA)	1 (without EMC filter)	
Leakage current Ig2 (mA)	$33 \times \frac{50m}{1000m} = 1.65$	
Motor leakage current Igm (mA)	0.18	
Total leakage current (mA)	3.00	6.66
Rated sensitivity current (mA) (≥ Ig × 10)	30	100

NOTE

- Install the earth leakage circuit breaker (ELB) on the input side of the inverter.
- In the 人 connection earthed-neutral system, the sensitivity current is blunt against a ground fault in the inverter output side. Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 61140 class 1 and other applicable standards)
- When the breaker is installed on the output side of the inverter, it may be unnecessarily operated by harmonics even if the effective value is within the rating.
  In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.
- The following models and products are standard breakers: the models BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, and NV-2F, the earth leakage circuit breakers with AA neutral wire open-phase protection, and the earth leakage relays (except NV-ZHA).
  The other series, models, and products are designed for harmonic and surge suppression: the NV-C series, NV-S series, MN series, the models NV30-FA, NV50-FA, NV-H, and BV-C2, earth leakage alarm breaker NF-Z, and the earth leakage relay NV-ZHA.

3.1.2 Techniques and measures for electromagnetic compatibility (EMC)

Some electromagnetic noises enter the inverter to cause the inverter malfunction, and others are radiated by the inverter to cause the peripheral devices to malfunction. (The former is called EMS problem, the latter is called EMI problem, and both is called EMC problem.) Though the inverter is designed to be immune to noises, it requires the following basic measures and EMS measures as it handles low-level signals. Pay attention to the electromagnetic noises that could be generated by the inverter since the inverter chops outputs at high carrier frequency. If these electromagnetic noises cause peripheral devices to malfunction, EMI countermeasures should be taken to suppress noises. These techniques differ slightly depending on EMI paths.

◆ Basic measures

- Do not run the power cables (I/O cables) and signal cables of the inverter 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, motor, etc. at one point.

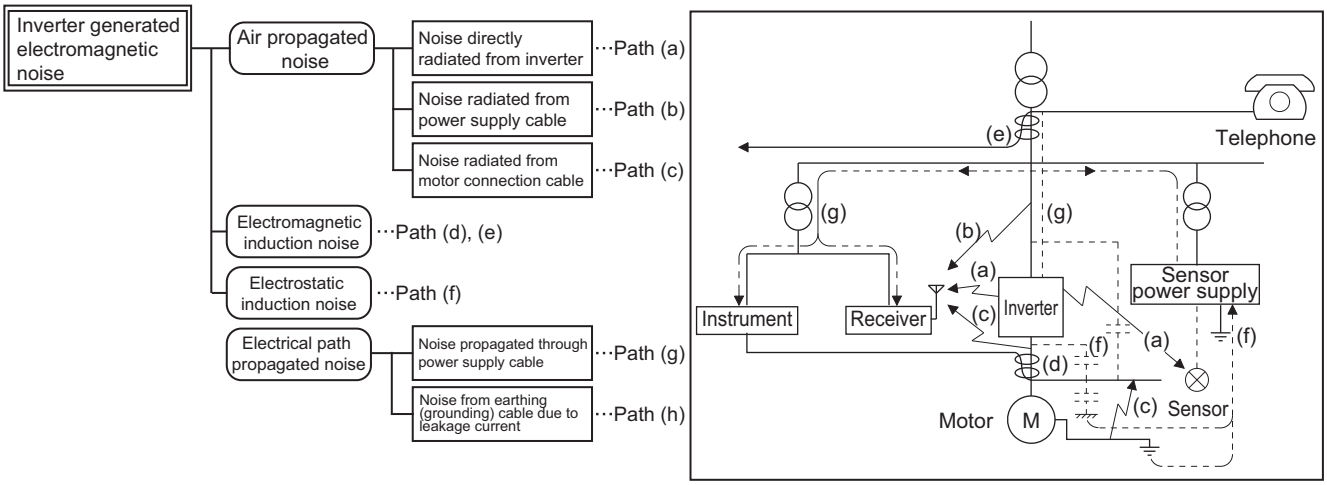
◆ EMS measures to reduce electromagnetic noises that enter the inverter and cause it to malfunction

When devices that generate many electromagnetic noises (which use magnetic contactors, electromagnetic brakes, many relays, for example) are installed near the inverter and the inverter 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 to signal cables (refer to page 67).
- Ground (Earth) the shields of the detector connection and control signal cables with cable clamp metal.

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

Inverter-generated noises are largely classified into those radiated by the inverter itself and by the I/O cables connected to its main circuit, those electromagnetically and electrostatically induced to the signal cables of the peripheral devices close to the power cable connected to the inverter main circuit, and those transmitted through the power cables.



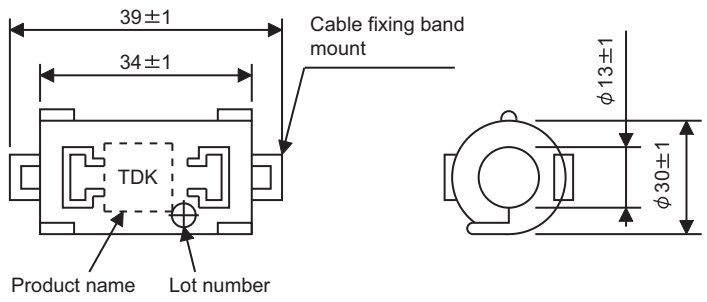
Noise propagation path	Countermeasure
(a), (b), (c)	When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or when their signal cables are run near the inverter, the devices may malfunction due to by air-propagated electromagnetic noises. The following countermeasures must be taken: • Install easily affected devices as far away as possible from the inverter. • Run easily affected signal cables as far away as possible from the inverter and its I/O cables. • Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. • Install an external EMC filter. • Install a line noise filter or radio noise filter on the input side and install a line noise filter on the output side to suppress the radiated noise from the cables. • Use shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(d), (e), (f)	When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables to cause malfunction of the devices and the following countermeasures must be taken: • Install easily affected devices as far away as possible from the inverter. • Run easily affected signal cables as far away as possible from the inverter and its I/O cables. • Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. • Use shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(g)	When the power supplies of the peripheral devices are connected to the power supply of the inverter in the same power system, inverter-generated noises may flow back through the power supply cables to cause malfunction of the devices and the following countermeasures must be taken: • Install an external EMC filter. • Install the line noise filter (FR-BLF/FR-BSF01) to the power cables (output cables) of the inverter.
(h)	When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage currents may flow through the earthing (grounding) cable of the inverter to cause the device to malfunction. In that case, disconnecting the earthing (grounding) cable from the device may stop the malfunction of the device.

■ Data line filter

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

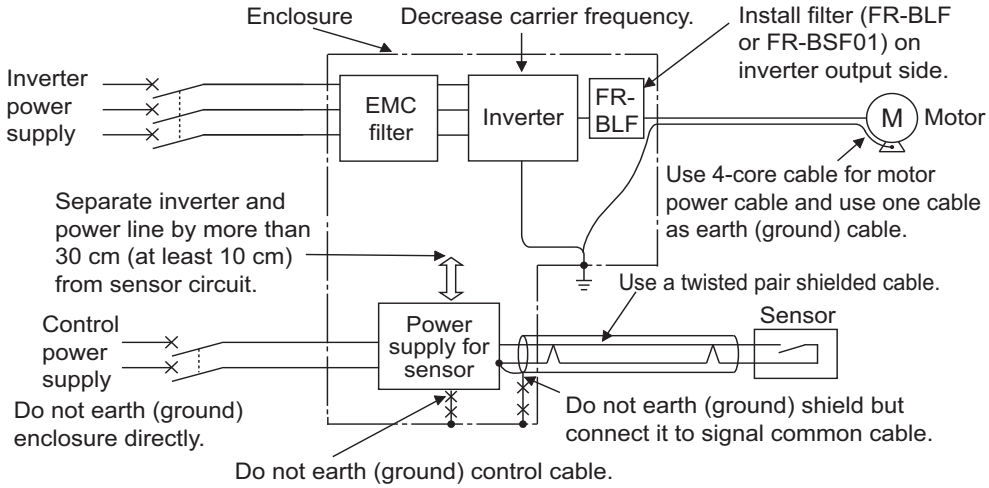
- Commercially available data line filter: ZCAT3035-1330 (by TDK), ESD-SR-250 (by TOKIN)

- Specification example (ZCAT3035-1330 by TDK)

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

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

■ EMI measure example



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.

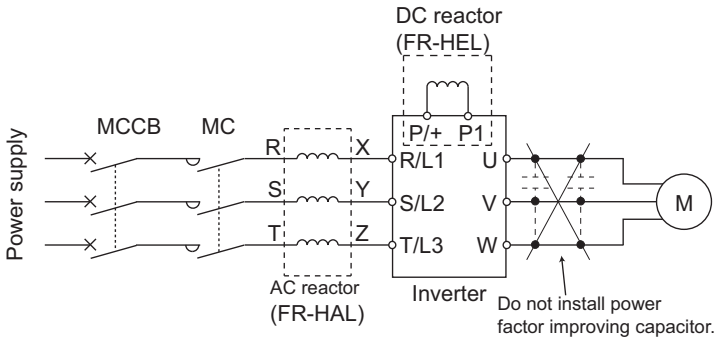
- Differences between harmonics and noises

Item	Harmonics	Noise
frequency	Normally 40th to 50th degrees or less (3 kHz or less).	High frequency (several 10 kHz to 1 GHz order).
Location	To-electric channel, power impedance.	To-space, distance, wiring path.
Quantitative understanding	Theoretical calculation possible.	Random occurrence, quantitative grasping difficult.
Generated amount	Nearly proportional to the load capacity.	Changes with the current variation ratio. (Gets larger as switching speed increases.)
Affected equipment immunity	Specified by standards per equipment.	Different depending on maker's equipment specifications.
Countermeasure	Provide a reactor.	Increase distance.

- Countermeasures

  The harmonic current generated from the inverter 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.



NOTE

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

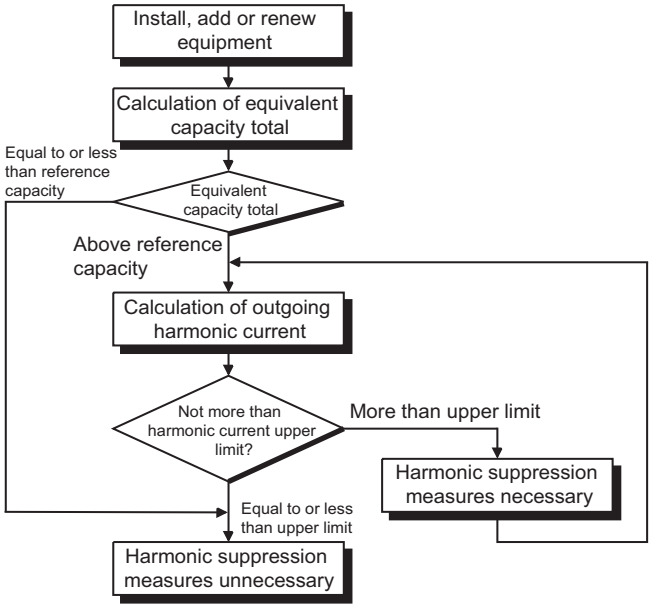
Harmonic currents flow from the inverter to a power receiving point via a power transformer. The Harmonic Suppression Guidelines was established to protect other consumers from these outgoing harmonic currents.

The three-phase 200 V input specifications 3.7 kW or lower (or single-phase 200 V input specifications 2.2 kW or lower) were previously covered by the Harmonic Suppression Guidelines for Household Appliances and General-purpose Products and other models were covered by the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage. However, the transistorized inverter has been excluded from the target products covered by the Harmonic Suppression Guidelines for Household Appliances and General-purpose Products in January 2004 and the Harmonic Suppression Guideline for Household Appliances and General-purpose Products was repealed on September 6, 2004.
All capacity and all models of general-purpose inverter used by specific consumers are now covered by "the Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage" (hereinafter referred to as "the Specific Consumer Guidelines").

- "Specific Consumer Guidelines"
  This guideline sets forth the maximum harmonic currents outgoing from a high-voltage or especially high-voltage receiving consumer who will install, add or renew harmonic generating equipment. If any of the maximum values is exceeded, this guideline requires that consumer to take certain suppression measures.
- Maximum values of outgoing harmonic currents per 1 kW contract power

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

◆ Application of the specific consumer guidelines



■ Conversion factor

Classification	Circuit type		Conversion factor Ki
3	Three-phase bridge (capacitor smoothing)	Without reactor	K31 = 3.4
		With reactor (AC side)	K32 = 1.8
		With reactor (DC side)	K33 = 1.8
		With reactors (AC, DC sides)	K34 = 1.4
4	Single-phase bridge (capacitor smoothing, double voltage rectification)	Without reactor	K41 = 2.3
		With reactor (AC side)	K42 = 0.35
	Single-phase bridge (capacitor smoothing, full-wave rectification)	Without reactor	K43 = 2.9
		With reactor (AC side)	K44 = 1.3
5	Self-excitation three-phase bridge	When a high power factor converter is used	K5 = 0

■ Equivalent capacity limit

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

■ Harmonic content (when the fundamental current is considered as 100%)

	Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Three-phase bridge (capacitor smoothing)	Not used	65	41	8.5	7.7	4.3	3.1	2.6	1.8
	Used (AC side)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
	Used (DC side)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
	Used (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4
Single-phase bridge (capacitor smoothing, double voltage rectification)	Not used	50	24	5.1	4.0	1.5	1.4	—	—
	Used (AC side)	6.0	3.9	1.6	1.2	0.6	0.1	—	—
Single-phase bridge (capacitor smoothing, full-wave rectification)	Not used	60	33.5	6.1	6.4	2.6	2.7	1.5	1.5
	Used (AC side)	31.9	8.3	3.8	3.0	1.7	1.4	1.0	0.7

■ Calculation of equivalent capacity P0 of harmonic generating equipment

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

P0 = Σ (Ki × Pi) [kVA]

Ki: Conversion factor (Refer to the list of the conversion factors.)

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

i: Number indicating the conversion circuit type

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

■ Calculation of outgoing harmonic current

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

- Operation ratio: actual load factor × operation time ratio during 30 minutes
- Harmonic content: Refer to the list of the harmonic content.

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

Applicable motor (kW)	Fundamental wave current (A)		Fundamental wave current converted from 6.6 kV (mA)	Rated capacity (kVA)	Outgoing harmonic current converted from 6.6 kV (mA) (No reactor, 100% operation ratio)							
	200 V	400 V			5th	7th	11th	13th	17th	19th	23rd	25th
0.4	1.61	0.81	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882
0.75	2.74	1.37	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494
1.5	5.50	2.75	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2	7.93	3.96	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320
3.7	13.0	6.50	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092
5.5	19.1	9.55	579	6.77	376.1	237.4	49.22	44.58	24.90	17.95	15.05	10.42
7.5	25.6	12.8	776	9.07	504.4	318.2	65.96	59.75	33.37	24.06	20.18	13.97
11	36.9	18.5	1121	13.1	728.7	459.6	95.29	86.32	48.20	34.75	29.15	20.18
15	49.8	24.9	1509	17.6	980.9	618.7	128.3	116.2	64.89	46.78	39.24	27.16
18.5	61.4	30.7	1860	21.8	1209	762.6	158.1	143.2	79.98	57.66	48.36	33.48
22	73.1	36.6	2220	25.9	1443	910.2	188.7	170.9	95.46	68.82	57.72	39.96
30	98.0	49.0	2970	34.7	1931	1218	252.5	228.7	127.7	92.07	77.22	53.46

■ Determining if a countermeasure is required

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

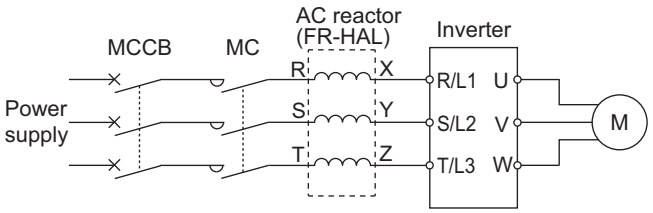
■ Harmonic suppression techniques

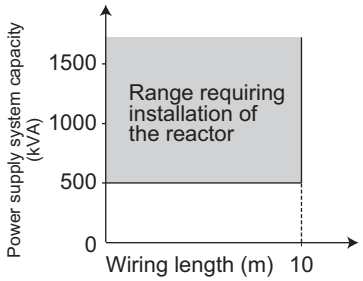
No.	Item	Description
1	Reactor installation (FR-HAL, FR-HEL)	Install an AC reactor (FR-HAL) on the AC side of the inverter or a DC reactor (FR-HEL) on its DC side, or install both to suppress outgoing harmonic currents.
2	Installation of power factor improving capacitor	When used with a reactor connected in series, the power factor improving correction capacitor can absorb harmonic currents.
3	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° in combinations of 人 to Δ and Δ to Δ, to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
4	Passive filter (AC filter)	A capacitor and a reactor are used together to reduce impedances at specific frequencies. Harmonic currents are expected to be absorbed greatly by using this technique.
5	Active filter	This filter detects the current in a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress the harmonic current at the detection point. Harmonic currents are expected to be absorbed greatly by using this technique.

3.3 Installation of a reactor

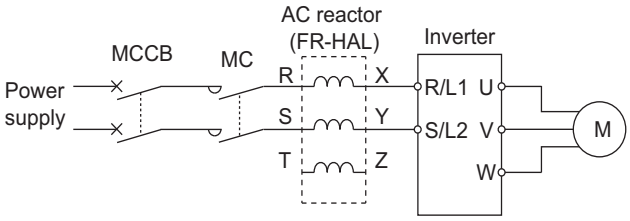
When the inverter is connected near a large-capacity power transformer (500 kVA or more) or when a power factor correction capacitor is to be switched over, an excessive peak current may flow in the power input circuit, damaging the converter circuit. To prevent this, always install an AC reactor (FR-HAL), which is available as an option. Select a DC reactor according to the applied motor capacity. When using a motor with capacity lower than 0.4 kW, select the reactor for a 0.4kW motor. For the single-phase 200 V power input models, select the reactor whose capacity is one rank higher than the motor capacity.

- Three-phase power input





- Single-phase power input



3.4 Power shutdown and magnetic contactor (MC)

◆Inverter input side magnetic contactor (MC)

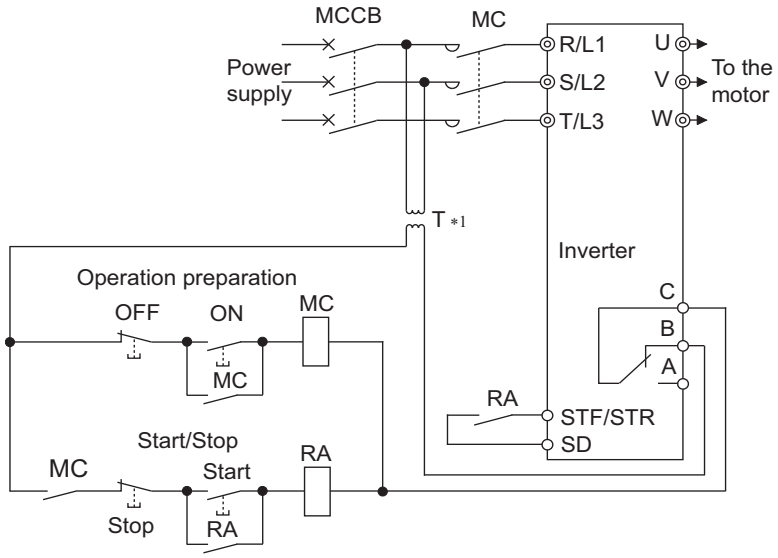
On the inverter input side, it is recommended to provide an MC for the following purposes. (Refer to page 22 for selection.)

- To disconnect the inverter from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.).
- To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure.
- To separate the inverter from the power supply to ensure safe maintenance and inspection work.
  Use the inverter input current as a reference for selection of an MC to perform an emergency stop during operation, and select the MC conforming to JEM 1038-AC-3 class rated operational current.

NOTE

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

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



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

◆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.

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

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

NOTE

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

3.5 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.

	Wiring length		
	Shorter than 50 m	**50 to 100 m**	**Longer than 100 m**
Pr.72 PWM frequency selection	14.5 kHz or less	8 kHz or less	2 kHz or less

■ Suppressing the surge voltage on the inverter side

- Connect the surge voltage suppression filter (FR-ASF-H/FR-BMF-H) to the output side of the inverter.

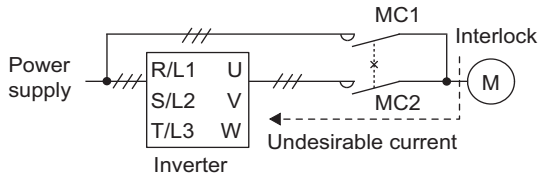
NOTE

- For details on the surge voltage suppression filter (FR-ASF-H/FR-BMF-H), refer to the Instruction Manual of each option.

3.6 Checklist before starting operation

The FR-E800 series inverter is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product. Before starting operation, always recheck the following points.

Checkpoint	Countermeasure	Refer to page	Check by user
Crimp terminals are insulated.	Use crimp terminals with insulation sleeves to wire the power supply and the motor.	—	
The wiring between the power supply (terminals R/L1, S/L2, T/L3) and the motor (terminals U, V, W) is correct.	Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.	41	
There is no offcuts such as burrs of the knockout holes inside the wiring cover.	Offcuts can cause a fault, failure, or malfunction. Take caution not to allow chips and other foreign matter to enter the wiring cover and inverter.	43	
No wire offcuts are left from the time of wiring.	Wire offcuts can cause a fault, 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.	—	
The main circuit cable gauge is correctly selected.	Use an appropriate cable gauge to suppress the voltage drop to 2% or less. If the wiring distance is long between the inverter and motor, a voltage drop in the main circuit will cause the motor torque to decrease especially during the output of a low frequency.	45	
The total wiring length is within the specified length.	Keep the total wiring length within the specified length. In long distance wiring, charging currents due to stray capacitance in the wiring may degrade the fast-response current limit operation or cause the equipment on the inverter's output side to malfunction. Pay attention to the total wiring length.	45	
Countermeasures are taken against EMI.	The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. Connect radio noise filters or EMC filters on the input side of the inverter to minimize interference.	66	
On the inverter's output side, there is no power factor correction capacitor, surge suppressor, or radio noise filter installed.	Doing so will shut off the inverter output or damage the capacitor or surge suppressor. If any of the above devices is connected, immediately remove it.	—	
When performing an inspection or rewiring on the product that has been energized, the operator has waited long enough after shutting off the power supply.	For a short time after the power-OFF, a high voltage remains in the smoothing capacitor, and it is dangerous. Before performing an inspection or rewiring, wait 10 minutes or longer after the power supply turns OFF, then confirm that the voltage across the main circuit terminals P/+ and N/- of the inverter is low enough using a digital multimeter, etc.	—	
The inverter's output side has no short circuit or ground fault occurring.	• A short circuit or 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.	—	
The circuit is not configured to use the inverter's input-side magnetic contactor to start/stop the inverter frequently.	Since repeated inrush currents at power ON will shorten the life of the converter circuit, frequent starts and stops of the magnetic contactor must be avoided. Turn ON or OFF the inverter's start (STF/STR) signal to run or stop the inverter.	74	
The voltage applied to the inverter I/O signal circuits is within the specifications.	Application of a voltage higher than the permissible voltage to the inverter I/O signal circuits or opposite polarity may damage the I/O devices.	50	

Checkpoint	Countermeasure	Refer to page	Check by user
When using the electronic bypass operation, electrical and mechanical interlocks are provided between the electronic bypass contactors MC1 and MC2.	When using a switching circuit as shown below, chattering due to misconfigured sequence or arc generated at switching may allow undesirable current to flow in and damage the inverter. Miswiring may also damage the inverter. (Note that a PM motor cannot be driven by the commercial power supply.)  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.	—	
A countermeasure is provided for power restoration after a power failure.	If the machine must not be restarted when power is restored after a power failure, provide an MC on the inverter's input side and also make up a sequence which will not switch ON the start signal. If the start signal (start switch) remains ON after a power failure, the inverter will automatically restart as soon as the power is restored.	—	
A magnetic contactor (MC) is installed on the inverter's input side.	On the inverter's input side, connect 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. To use an MC to perform an emergency stop during operation, select the MC conforming to JEM 1038-AC-3 rated current for the inverter rated input current.	74	
The magnetic contactor on the inverter's output side is properly handled.	Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop.	74	
When using a PM motor, a low-voltage manual contactor is installed on the inverter's output side.	A PM motor is a synchronous motor with high-performance magnets embedded inside. High-voltage is generated at the motor terminals while the motor is running even after the inverter power is turned OFF. In an application, such as fan and blower, where the motor is driven by the load, a low-voltage manual contactor must be connected on the inverter's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.	74	
An EMI countermeasure is provided for the frequency setting signals.	If electromagnetic noise generated from the inverter causes the frequency setting signal to fluctuate 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 I/O cables) in parallel with each other and do not bundle them. • Run the signal cables as far away as possible from the power cables (inverter I/O cables). • Use shielded cables. • Install a data line filter to signal cable (example: ZCAT3035-1330 by TDK).	66	
A countermeasure is provided for an overload operation.	When performing frequent starts/stops by the inverter, rise/fall in the temperature of the transistor element of the inverter will repeat due to a repeated flow of large current, shortening the life from thermal fatigue. Since thermal fatigue is related to the amount of current, the life can be increased by reducing current at locked condition, starting current, etc. Reducing current may extend the service life but may also cause torque shortage, which leads to a start failure. Adding a margin to the current can eliminate such a condition. For an induction motor, use an inverter of a higher capacity (up to two ranks). For a PM motor, use an inverter and PM motor of higher capacities.	—	
The specifications and rating match the system requirements.	Make sure that the specifications and rating match the system requirements.	84	

Checkpoint	Countermeasure	Refer to page	Check by user
Countermeasures are taken against electrical corrosion on the motor bearing.	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). Contact your sales representative to take appropriate countermeasures for the motor. The following shows examples of countermeasures for the inverter. • Decrease the carrier frequency. • Provide a common mode choke*1 on the output side of the inverter.	—	

*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 activates and outputs the Fault signal. However, the Fault signal may not be output at an inverter's fault occurrence when the detection circuit or output circuit fails, etc. Although Mitsubishi 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. (For details of each signal, refer to the FR-E800 Instruction Manual (Function).)

No.	Interlock method	Check method	Used signals
a	Inverter protective function operation	Operation check of an alarm contact. Circuit error detection by negative logic.	Fault (ALM) signal
b	Inverter operating status	Operation ready signal check.	Inverter operation ready (RY) signal
c	Inverter running status	Logic check of the start signal and running signal.	Start (STF or STR) signal Inverter running (RUN) signal
d	Inverter running status*1	Logic check of the start signal and output current.	Start (STF or STR) signal Output current detection (Y12) signal

*1 This interlock method cannot be used when a PM motor is used.

- When using various signals, assign the functions to **Pr.190 to Pr.196 (Output terminal function selection)** referring to the following table.

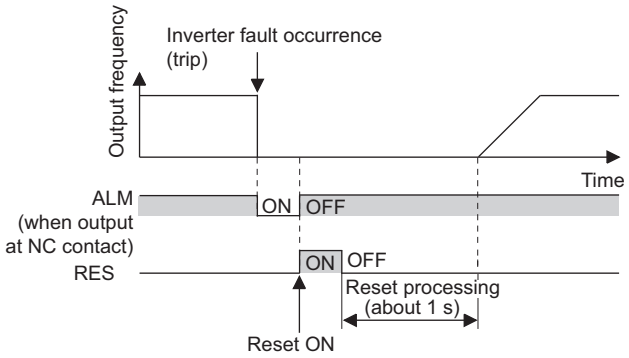
Output signal	Pr.190 to Pr.196 settings	
	Positive logic	Negative logic
ALM	99	199
RY	11	111
RUN	0	100
Y12	12	112

NOTE

- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

■ Checking by using the Fault signal output from the inverter... (a)

When the inverter's protective function is activated and the inverter output is stopped, the Fault (ALM) signal is output. (The ALM signal is assigned to terminals A, B, and C in the initial setting). With this signal, check that the inverter operates properly. In addition, negative logic can be set. (ON when the inverter is normal, OFF when the fault occurs.)

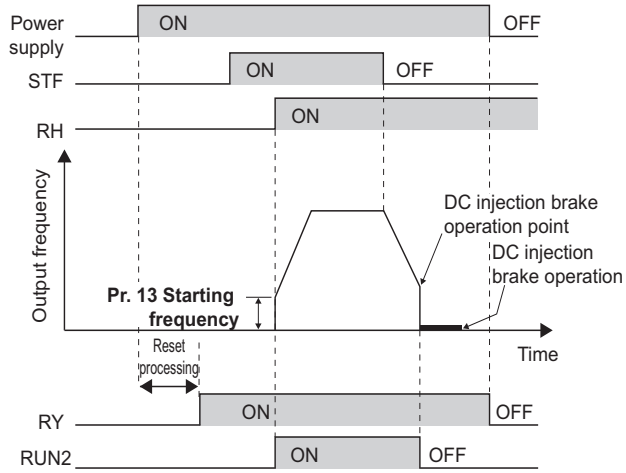


■ Checking the inverter operating status by using the Inverter operation ready signal output from the inverter ... (b)

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

■ Checking the inverter operating status by using the start signal input to the inverter and the Inverter running signal output from the inverter ... (c)

The Inverter running (RUN2) signal is output when the inverter is running. Check if the RUN2 signal is output while a start signal (the STF/STR signal for forward/reverse rotation command) is input to the inverter. Even after the start signal is turned OFF, the RUN2 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.



■ Checking the motor operating status by using the start signal input to the inverter and the Output current detection signal output from the inverter ... (d)

This interlock method cannot be used when a PM motor is used.

The Output current detection (Y12) signal is output when the inverter operates and currents flows into the motor.

Check if the Y12 signal is output while a start signal (the STF/STR signal for forward/reverse rotation command) is input to the inverter. 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.

◆ Backup method which does not use the inverter

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

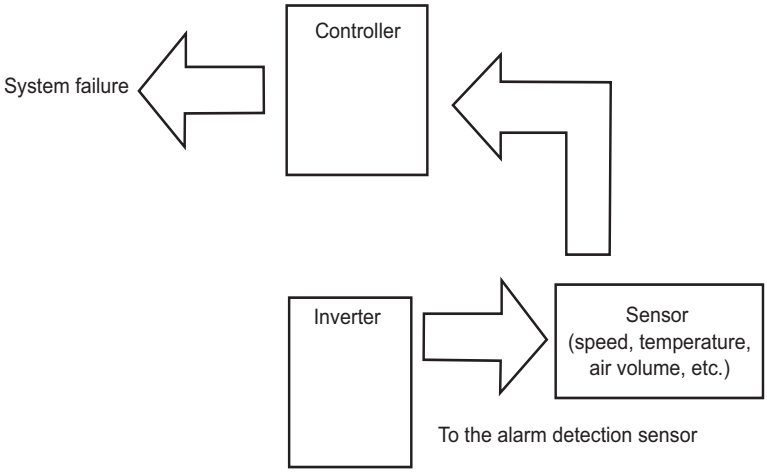
Provide a speed detector to detect the motor speed and current detector to detect the motor current, and consider the backup system such as performing a check as follows according to the level of importance of the system.

■ 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.

■ 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.


Controller
System failure
Inverter
Sensor
(speed, temperature,
air volume, etc.)
To the alarm detection sensor

3.8 Replacement of parts

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

Part name	Estimated lifespan*1	Description
Cooling fan	8 years*2	Replace (as required)
Main circuit smoothing capacitor	8 years*2	Replace (as required)
On-board smoothing capacitor	8 years*2	Replace the board (as required).
ABC relay contact	—	As required

*1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C.
(Without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
*2 10 years when the part is used 16 hours per day.

NOTE

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

◆Inverter parts life display

The inverter diagnoses the main circuit capacitor, control circuit capacitor, cooling fan, inrush current limit circuit, inverter module, and relay contacts of terminals A, B, and C, and estimates their lives.
The self-diagnostic warning is output when the life span of each part is near its end. It gives an indication of replacement time.

Guideline for life judgment using the life warning output

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

NOTE

- Refer to the FR-E800 Instruction Manual (Function) to perform the life check of the inverter parts.

CHAPTER 4 Specifications

4 Specifications

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

4.1 Inverter rating

◆Three-phase 200 V power supply

Model FR-E820-[]-HVC				0011	0017	0030	0051	0082	0102	0167	0255	0340	0476	0587	0748	0978
Applicable motor capacity (kW)*1			LD	0.2	0.4	0.75	1.1	2.2	3.0	5.5	7.5	11	15	18.5	22	30
Output	Rated capacity (kVA)*2		LD	0.4	0.7	1.2	2.0	3.3	4.1	6.7	10.2	13.5	19.0	23.4	29.8	39.0
	Rated current (A)*3		LD	1.1	1.7	3.0	5.1	8.2	10.2	16.7	25.5	34.0	47.6	58.7	74.8	97.8
	Overload current rating*4		LD	120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature of 50°C												
	Voltage*5			Three-phase 200 to 240 V												
Power supply	Rated input AC (DC) voltage/frequency			Three-phase 200 to 240 V, 50/60 Hz (283 to 339 VDC*8)												
	Permissible AC (DC) voltage fluctuation			170 to 264 V, 50/60 Hz (240 to 373 VDC*8)												
	Permissible frequency fluctuation			±5%												
	Rated input current (A)*7	Without DC reactor	LD	1.9	3.0	5.1	8.2	12.5	16.1	25.5	37.1	48.6	74.3	90.5	112.9	139.5
		With DC reactor	LD	1.3	2.0	3.5	6.0	9.6	12.0	20.0	30.0	40.0	56.0	69.0	88.0	115.0
	Power supply capacity (kVA)*6	Without DC reactor	LD	0.7	1.1	1.9	3.1	4.8	6.2	9.7	15.0	19.0	29.0	35.0	43.0	54.0
		With DC reactor	LD	0.5	0.8	1.3	2.3	3.7	4.6	7.5	11.0	15.0	21.0	26.0	34.0	44.0
Protective structure (UL 50)				UL Type 1 (Enclosed Type*9)												
Cooling system				Natural				Forced air								
Approx. mass (kg)				0.7	0.7	0.9	1.1	1.9	1.9	2.3	4.2	4.2	6.6	6.8	12.3	12.3

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi Electric standard 4-pole motor.
To drive a Mitsubishi Electric high-performance energy-saving motor, use the 0.75K inverter for a 1.1 kW motor, or 2.2K inverter for a 3 kW motor.

*2 The rated output capacity is the value with respect to 230 V output voltage.

*3 The following table shows the current value initially set in **Pr.9 Electronic thermal O/L relay, Pr.56 Current monitoring reference, and Pr.557 Current average value monitor signal output reference current**. The value in the table is also used as the reference current value (100% value) for **Pr.22 Stall prevention operation level (Torque limit level), Pr.150 Output current detection level, Pr.165 Stall prevention operation level for restart, and Pr.874 OLT level setting**.

Model FR-E820-[]-HVC	0011	0017	0030	0051	0082	0102	0167	0255	0340	0476	0587	0748	0978
Current value (A)	1.3	2.0	3.5	6.0	9.6	12.0	19.6	30.0	40.0	56.0	69.0	88.0	115.0

*4 The percentage of the overload current rating is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*5 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range.
The maximum point of the voltage waveform at the output side of the inverter is approximately the power supply voltage multiplied by $\sqrt{2}$.

*6 The power supply capacity varies with the value of the input power impedance (including those of the input reactor and cables).

*7 The rated input current is the value at a rated output voltage. The input power impedances (including those of the input reactor and cables) affect the value.

*8 · Connect the DC power supply to the inverter terminals P/+ and N/-. Connect the positive terminal of the power supply to terminal P/+ and the negative terminal to terminal N/-.
· When the energy is regenerated from the motor, the voltage between terminals P/+ and N/- may temporarily rise to 415 V or more. Use a DC power supply resistant to the regenerative voltage/energy. When a power supply that cannot resist the regenerative voltage/energy is used, connect a reverse current prevention diode in series.
· Powering ON produces up to four times as large current as the inverter rated current. Prepare a DC power supply resistant to the inrush current at power ON, although an inrush current limit circuit is provided in the FR-E800 series inverter.
· The power capacity depends on the output impedance of the power supply. Select a power capacity around the AC power supply capacity.

*9 The structure is suitable for installation in a compartment handling conditioned air (plenum).

◆ Three-phase 400 V power supply

Model FR-E840-[]-HVC				0018	0030	0047	0059	0094	0149	0196	0298	0349	0383	0510
Applicable motor capacity (kW)*1		LD		0.75	1.5	2.2	3.0	5.5	7.5	11	15	18.5	22	30
Output	Rated capacity (kVA)*2	LD		1.4	2.3	3.6	4.5	7.2	11.4	14.9	22.7	26.6	26.6	38.9
	Rated current (A)*3	LD		1.8	3.0	4.7	5.9	9.4	14.9	19.6	29.8	34.9	34.9	51.0
	Overload current rating*4	LD		120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature of 50°C										
	Voltage*5			Three-phase 380 to 480 V										
Power supply	Rated input AC (DC) voltage/frequency			Three-phase 380 to 480 V, 50/60 Hz (537 to 679 VDC*8)										
	Permissible AC (DC) voltage fluctuation			323 to 528 V, 50/60 Hz (457 to 740 VDC*8)										
	Permissible frequency fluctuation			±5%										
	Rated input current (A)*7	Without DC reactor	LD	3.3	6.0	8.9	10.7	16.2	24.9	32.4	46.7	54.2	59.1	75.5
		With DC reactor	LD	2.1	3.5	5.5	6.9	11.0	18.0	23.0	35.0	41.0	45.0	60.0
	Power supply capacity (kVA)*6	Without DC reactor	LD	2.5	4.5	6.8	8.2	12.0	19.0	25.0	36.0	42.0	45.0	58.0
		With DC reactor	LD	1.6	2.7	4.2	5.3	8.5	13.0	18.0	27.0	31.0	34.0	46.0
Protective structure (UL 50)				UL Type 1 (Enclosed Type*9)										
Cooling system				Natural		Forced air								
Approx. mass (kg)				1.6	1.6	1.8	2.4	2.4	3.2	3.2	6.0	6.1	12.3	12.3

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi Electric standard 4-pole motor.
To drive a Mitsubishi Electric high-performance energy-saving motor, use the 2.2K inverter for a 3 kW motor.

*2 The rated output capacity is the value with respect to 440 V output voltage.

*3 The following table shows the current value initially set in **Pr.9 Electronic thermal O/L relay, Pr.56 Current monitoring reference, and Pr.557 Current average value monitor signal output reference current**. The value in the table is also used as the reference current value (100% value) for **Pr.22 Stall prevention operation level (Torque limit level), Pr.150 Output current detection level, Pr.165 Stall prevention operation level for restart, and Pr.874 OLT level setting**.

Model FR-E840-[]-HVC	0018	0030	0047	0059	0094	0149	0196	0298	0349	0383	0510
Current value (A)	2.1	3.5	5.5	6.9	11.1	17.5	23.0	35.0	41.0	45.0	60.0

*4 The percentage of the overload current rating is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*5 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range.
The maximum point of the voltage waveform at the output side of the inverter is approximately the power supply voltage multiplied by $\sqrt{2}$.

*6 The power supply capacity varies with the value of the input power impedance (including those of the input reactor and cables).

*7 The rated input current is the value at a rated output voltage. The input power impedances (including those of the input reactor and cables) affect the value.

*8 · Connect the DC power supply to the inverter terminals P/+ and N/-. Connect the positive terminal of the power supply to terminal P/+ and the negative terminal to terminal N/-.
· When the energy is regenerated from the motor, the voltage between terminals P/+ and N/- may temporarily rise to 830 V or more. Use a DC power supply resistant to the regenerative voltage/energy. When a power supply that cannot resist the regenerative voltage/energy is used, connect a reverse current prevention diode in series.
· Powering ON produces up to four times as large current as the inverter rated current. Prepare a DC power supply resistant to the inrush current at power ON, although an inrush current limit circuit is provided in the FR-E800 series inverter.
· The power capacity depends on the output impedance of the power supply. Select a power capacity around the AC power supply capacity.

*9 The structure is suitable for Installation in a Compartment Handling Conditioned Air (Plenum).

◆ Single-phase 200 V power supply

Model FR-E820S-[]-HVC				0011	0017	0030	0051	0082
Applicable motor capacity (kW)*1		LD		0.2	0.4	0.75	1.1	2.2
Output	Rated capacity (kVA)*2	LD		0.4	0.7	1.2	2.0	3.3
	Rated current (A)*3	LD		1.1	1.7	3.0	5.1	8.2
	Overload current rating*4	LD		120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature of 50°C				
	Voltage*5			Three-phase 200 to 240 V				
Power supply	Rated input AC (DC) voltage/frequency			Single-phase 200 to 240 V, 50/60 Hz				
	Permissible AC (DC) voltage fluctuation			170 to 264 V, 50/60 Hz				
	Permissible frequency fluctuation			±5%				
	Rated input current (A)*7	Without DC reactor	LD	3	4.5	6.7	11.4	18.6
		With DC reactor	LD	1.8	2.8	5.0	9.1	14.7
	Power supply capacity (kVA)*6	Without DC reactor	LD	0.9	1.7	2.5	3.9	5.5
		With DC reactor	LD	0.6	1.1	1.9	3.0	4.2
Protective structure (UL 50)				UL Type 1 (Enclosed Type*8)				
Cooling system				Natural			Forced air	
Approx. mass (kg)				0.8	1.1	1.9	2.0	2.3

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

*2 The rated output capacity is the value with respect to 230 V output voltage.

*3 The following table shows the current value initially set in **Pr.9 Electronic thermal O/L relay, Pr.56 Current monitoring reference, and Pr.557 Current average value monitor signal output reference current**. The value in the table is also used as the reference current value (100% value) for **Pr.22 Stall prevention operation level (Torque limit level), Pr.150 Output current detection level, Pr.165 Stall prevention operation level for restart, and Pr.874 OLT level setting**.

Model FR-E820S-[]-HVC	0011	0017	0030	0051	0082
Current value (A)	1.3	2.0	3.5	6.0	9.6

*4 The percentage of the overload current rating is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load. For single-phase power input model, the bus voltage decreases to power failure detection level and the load of 100% or higher may not be available if the automatic restart after instantaneous power failure function (**Pr.57**) or the power failure stop function (**Pr.261**) is set and power supply voltage is low while the load increases.

*5 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range.

The maximum point of the voltage waveform at the output side of the inverter is approximately the power supply voltage multiplied by $\sqrt{2}$.

*6 The power supply capacity varies with the value of the input power impedance (including those of the input reactor and cables).

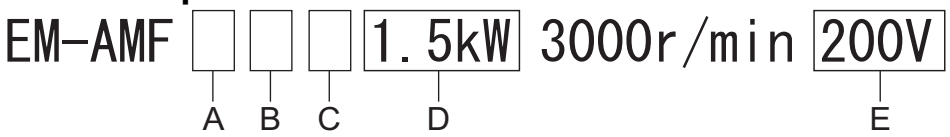
*7 The rated input current is the value at a rated output voltage. The input power impedances (including those of the input reactor and cables) affect the value.

*8 The structure is suitable for Installation in a Compartment Handling Conditioned Air (Plenum).

4.2 Motor rating

4.2.1 PM motor EM-A

◆ Motor specifications



- A: Electromagnetic brake

Symbol	Electromagnetic brake
None	Without
B	With

- B: Shaft end

Symbol	Shaft end
None	Standard
K	Key shaft

- C: Protective structure

Symbol	Protective structure
None	IP44
W	IP65

- D: Output power

Symbol	Description
0.75kW to 7.5kW	Rated capacity (kW)

- E: Voltage class

Symbol	Description
200V	200 V class
400V	400 V class

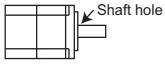
◆ Specifications of the dedicated PM motor (EM-A motor) (200 V class)

■ Motor specifications (standard)

Motor model: EM-AMF[]		0.75kW	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW
Applicable inverter model: FR-E820-[]-HVC*7		0051	0082	0102	0167	0255	0340
Rated speed (r/min)		3000					
Maximum speed (r/min)		4000					
Number of poles		4	6				
Rated current (A)		3.3	6.1	9.3	16.5	22	31
Rated torque (N·m)*1*8		2.39	4.78	7.00	11.78	17.50	23.88
Maximum torque (%)		200%					
Insulation class		130(B)			155(F)		
Recommended load inertia moment ratio		10 times max.					
Structure		Totally enclosed self-cooling					
Protective structure		IP44*2, IP65*2*3					
Environment*5	Surrounding air temperature and humidity	0°C to +40°C (non-freezing), 90% RH or less (non-condensing)					
	Altitude	Maximum 1000 m					
	Vibration*4	4.9 m/s^2 or less (momentarily tolerable up to 9.8 m/s^2)					
Permissible load on the shaft*6	L (mm)	22	30		41.5		
	Radial (N)	490	686		1470		
	Thrust (N)	294	490		980		
Mass (kg)	Without brake	6.4	9.5	11.7	22	28	34
	With brake	8.2	12.2	14.4	28	34	40

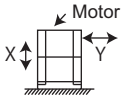
*1 The above characteristics apply when the rated AC voltage is input from the inverter (refer to page 87). The rated output power or speed is not guaranteed at low supply voltages.

*2 Except for the shaft hole.



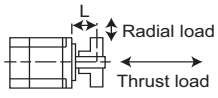
*3 Applicable for EM-AMF[][]W motors.

*4 For the vibration direction, X indicates the direction of the motor output axis and Y indicates the direction perpendicular to the motor output axis. The numbers are values at points where the maximum values are indicated (normally the bracket at the non-load side). Bearings are subjected to fretting while the motor is stopped. Suppress the vibration to about the half of the permissible value.



*5 The standard motor may not be used under the condition where it is constantly exposed to oil mist, oil, or water. For details, contact your sales representative.

*6 For the permissible load on the shaft, refer to the following figure. On the shaft, do not apply a load exceeding the value in the table. Each value in the table shows the permissible value for the single load application.



L: Distance from the flange mounting surface to the center of the load

*7 To use a motor with one rank lower capacity, set **Pr.80 Motor capacity** before performing PM parameter initialization. (Refer to the FR-E800 Instruction Manual (Function).)

*8 To drive a machine that produces unbalanced torque, such as a lift axis, the unbalanced torque is recommended to be equal to or less than the 90% of the rated torque.

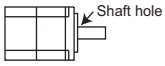
◆ Specifications of the dedicated PM motor (EM-A motor) (400 V class)

■ Motor specifications (standard)

Motor model: EM-AMF[]		3.7kW	5.5kW
Applicable inverter model: FR-E840-[]-HVC*7		0094	0149
Rated speed (r/min)		3000	
Maximum speed (r/min)		4000	
Number of poles		6	
Rated current (A)		8.3	11
Rated torque (N·m)*1*8		11.78	17.50
Maximum torque (%)		200%	
Insulation class		155(F)	
Recommended load inertia moment ratio		10 times max.	
Structure		Totally enclosed self-cooling	
Protective structure		IP44*2, IP65*2*3	
Environment*5	Surrounding air temperature and humidity	0°C to +40°C (non-freezing), 90% RH or less (non-condensing)	
	Altitude	Maximum 1000 m	
	Vibration*4	4.9 m/s^2 or less (momentarily tolerable up to 9.8 m/s^2)	
Permissible load on the shaft*6	L (mm)	41.5	
	Radial (N)	1470	
	Thrust (N)	980	
Mass (kg)	Without brake	22	28
	With brake	28	34

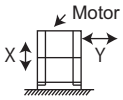
*1 The above characteristics apply when the rated AC voltage is input from the inverter (refer to page 87). The rated output power or speed is not guaranteed at low supply voltages.

*2 Except for the shaft hole.



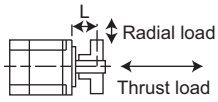
*3 Applicable for EM-AMF[][]W motors.

*4 For the vibration direction, X indicates the direction of the motor output axis and Y indicates the direction perpendicular to the motor output axis. The numbers are values at points where the maximum values are indicated (normally the bracket at the non-load side). Bearings are subjected to fretting while the motor is stopped. Suppress the vibration to about the half of the permissible value.



*5 The standard motor may not be used under the condition where it is constantly exposed to oil mist, oil, or water. For details, contact your sales representative.

*6 For the permissible load on the shaft, refer to the following figure. On the shaft, do not apply a load exceeding the value in the table. Each value in the table shows the permissible value for the single load application.

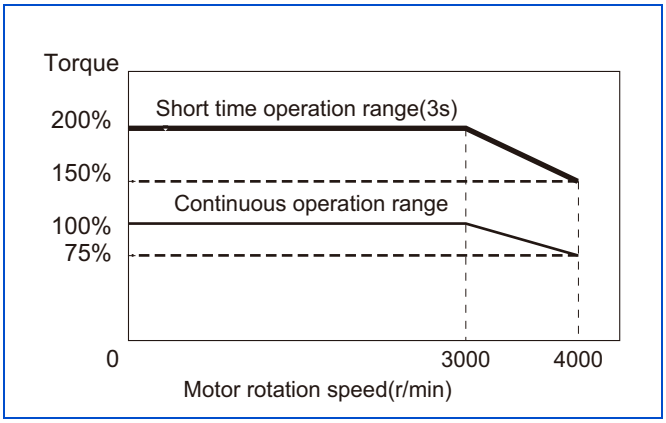


L: Distance from the flange mounting surface to the center of the load

*7 To use a motor with one rank lower capacity, set **Pr.80 Motor capacity** before performing PM parameter initialization. (Refer to the FR-E800 Instruction Manual (Function).)

*8 To drive a machine that produces unbalanced torque, such as a lift axis, the unbalanced torque is recommended to be equal to or less than the 90% of the rated torque.

◆ Motor torque



- When the input voltage is low, the torque may be reduced.
- The continuous operation torque is 90% at 10 r/min or less (for 1.5 kW or higher EM-A motor).
- When driving the EM-A motor under high load in the low-speed range (especially at 15 r/min or lower for 0.75 kW or lower, or at 10 r/min or lower for 1.5 kW or higher), the protective function of the electronic thermal O/L relay (E.THT or E.THM) may be activated and short time operation range torque may not be generated.

4.3 Common specifications

Control	Control method		Soft-PWM control / High carrier frequency PWM control
		Induction motor	Selectable among V/F control, Advanced magnetic flux vector control, and Real sensorless vector control
		PM motor	PM sensorless vector control
	Output frequency range	Induction motor	0.2 to 590 Hz (The upper-limit frequency is 400 Hz under Advanced magnetic flux vector control and Real sensorless vector control.)
		PM motor	0.2 to 400 Hz (not operable at a frequency higher than the maximum motor frequency)
	Frequency setting and resolution	Analog input	0.015 Hz /60 Hz at 0 to 10 V / 12 bits (terminal 2) 0.03 Hz /60 Hz at 0 to 5 V / 11 bits or 0 to 20 mA / 11 bits (terminal 2)
		Digital input	0.01 Hz
	Frequency accuracy	Analog input	Within ±0.2% of the maximum output frequency (25°C ±10°C)
		Digital input	0.01% or less of the set output frequency
	Voltage/frequency characteristics		Base frequency can be set from 0 to 590 Hz. Constant-torque/variable-torque pattern can be selected (with induction motor only).
	Starting torque	Induction motor	Advanced magnetic flux vector control: 150% at 0.5 Hz, Real sensorless vector control: 200% at 0.3 Hz (0.1K to 3.7K), 150% at 0.3 Hz (5.5K or higher)
		PM motor	50%
	Torque boost		Manual torque boost (induction motor only)
	Acceleration/deceleration time setting		0 to 3600 s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration modes are available.
	DC injection brake	Induction motor	Operation frequency (0 to 120 Hz), operation time (0 to 10 s), operation voltage (0% to 30%) variable
		PM motor	Operation time (0 to 10 s) variable. Operating voltage (operating current) fixed.
	Stall prevention operation level		Operation current: 0% to 150% variable, with selectable availability of the function
	Torque limit level		Torque limit value can be set (0 to 400% variable). (Real sensorless vector control, PM sensorless vector control)
Operation	Frequency setting signal	Analog input	Terminal 2: 0 to 10 V / 0 to 5 V / 4 to 20 mA (0 to 20 mA)
		Digital input	Input using the operation panel.
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
	Input signal (5)		Low-speed operation command, Middle-speed operation command, High-speed operation command, Forward rotation command, Reverse rotation command The signal to be input can be changed using **Pr.178 to Pr.182 (Input terminal function selection)**.
	Operational function		Maximum and minimum frequency settings, multi-speed operation, acceleration/deceleration pattern, thermal protection, DC injection brake, starting frequency, JOG operation, output stop (MRS), stall prevention, regeneration avoidance, increased magnetic excitation deceleration, frequency jump, rotation display, automatic restart after instantaneous power failure, remote setting, automatic acceleration/deceleration, retry function, carrier frequency selection, fast-response current limit, forward/reverse rotation prevention, operation mode selection, slip compensation, droop control, speed smoothing control, traverse, auto tuning, applied motor selection, RS-485 communication, PID control, easy dancer control, cooling fan operation selection, stop selection (deceleration stop/coasting), power failure time deceleration-to-stop function, stop-on-contact control, PLC function, life diagnosis, maintenance timer, current average monitor, speed control, torque control, pre-excitation, torque limit, position control, test operation, emergency drive
	Output signal	Open collector output (1) Relay output (1)	Inverter running, Fault The signal to be output can be changed using **Pr.190 and Pr.192 (Output terminal function selection)**.
		Analog output	-10 to +10 V / 12 bits

Protective function	**Fault**	Overcurrent trip during acceleration, Overcurrent trip during constant speed, Overcurrent trip during deceleration or stop, Regenerative overvoltage trip during acceleration, Regenerative overvoltage trip during constant speed, Regenerative overvoltage trip during deceleration or stop, Inverter overload trip (electronic thermal relay function), Motor overload trip (electronic thermal relay function), Heat sink overheat, Undervoltage, Input phase loss, Stall prevention stop, Loss of synchronism detection*1, Upper limit fault detection, Lower limit fault detection, Output side earth (ground) fault overcurrent, Output short circuit, Output phase loss, External thermal relay operation, PTC thermistor operation*1, Parameter storage device fault, Retry count excess, CPU fault, Abnormal output current detection, Inrush current limit circuit fault, USB communication fault, Analog input fault, Overspeed occurrence*1, Speed deviation excess detection*1, Excessive position fault*1, Brake sequence fault*1, Acceleration error*1, PID signal fault, Opposite rotation deceleration fault*1, Internal circuit fault, User definition error by the PLC function, Board combination fault
	Alarm, Warning, Error message	Fan alarm, stall prevention (overcurrent), stall prevention (overvoltage), regenerative brake pre-alarm*1, electronic thermal relay function pre-alarm, PU stop, maintenance timer alarm, parameter write error, operation panel lock*1, Password locked, speed limit indication*1, stroke limit warning*1, home position return setting error*1, home position return uncompleted*1, load fault warning, emergency drive in operation, incorrect parameter setting
Environment	**Surrounding air temperature**	-20°C to +50°C
	Surrounding air humidity	95% RH or less (non-condensing)
	Storage temperature*2	-40°C to +70°C
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude/vibration	Maximum 3000 m*3, 5.9 m/s^2 or less at 10 to 55 Hz in X, Y, and Z directions

*1 Not activated in the inverter in the initial state.

*2 Applicable to conditions for a short time, for example, in transit.

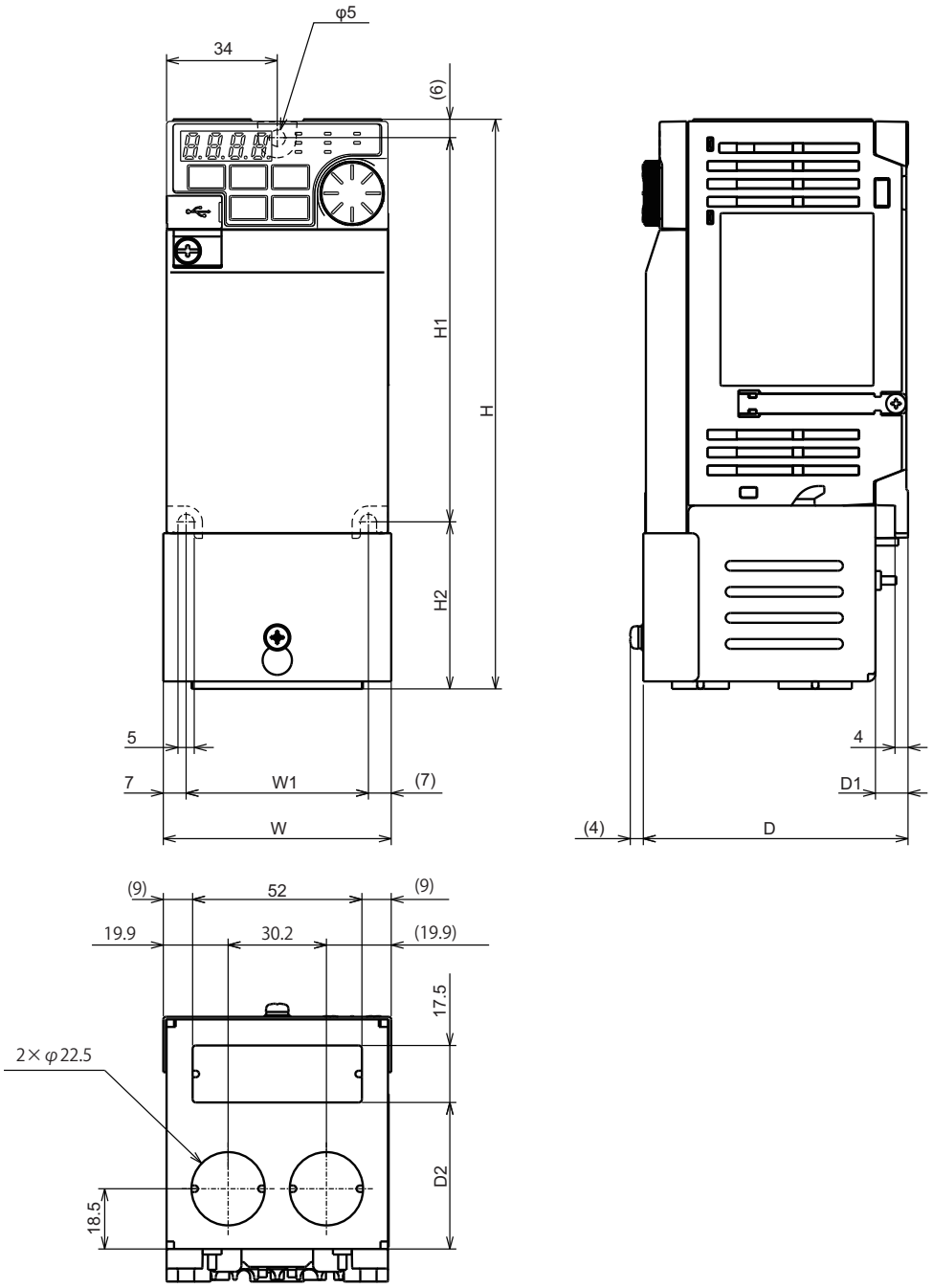
*3 For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

4.4 Outline dimension drawings

4.4.1 Inverter outline dimension drawings

FR-E820-0011(0.2K), FR-E820-0017(0.4K), FR-E820-0030(0.75K)

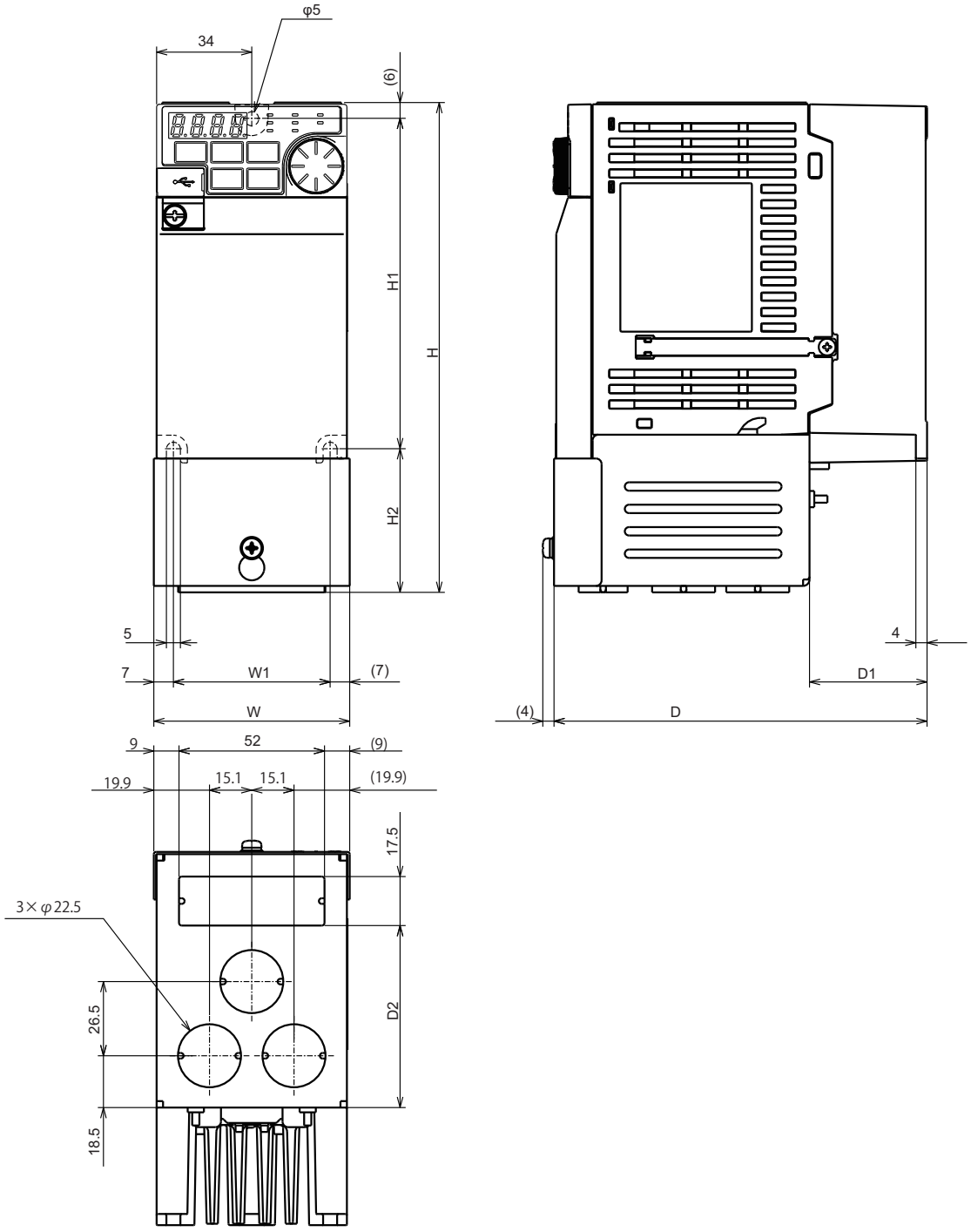
FR-E820S-0011(0.2K)



Inverter model	W	W1	H	H1	H2	D	D1	D2	C
FR-E820-0011(0.2K) FR-E820-0017(0.4K)	70	56	174.9	118	51.3	81.3	10	45	5
FR-E820-0030(0.75K)						113.3	42		
FR-E820S-0011(0.2K)						81.3	10		

(Unit: mm)

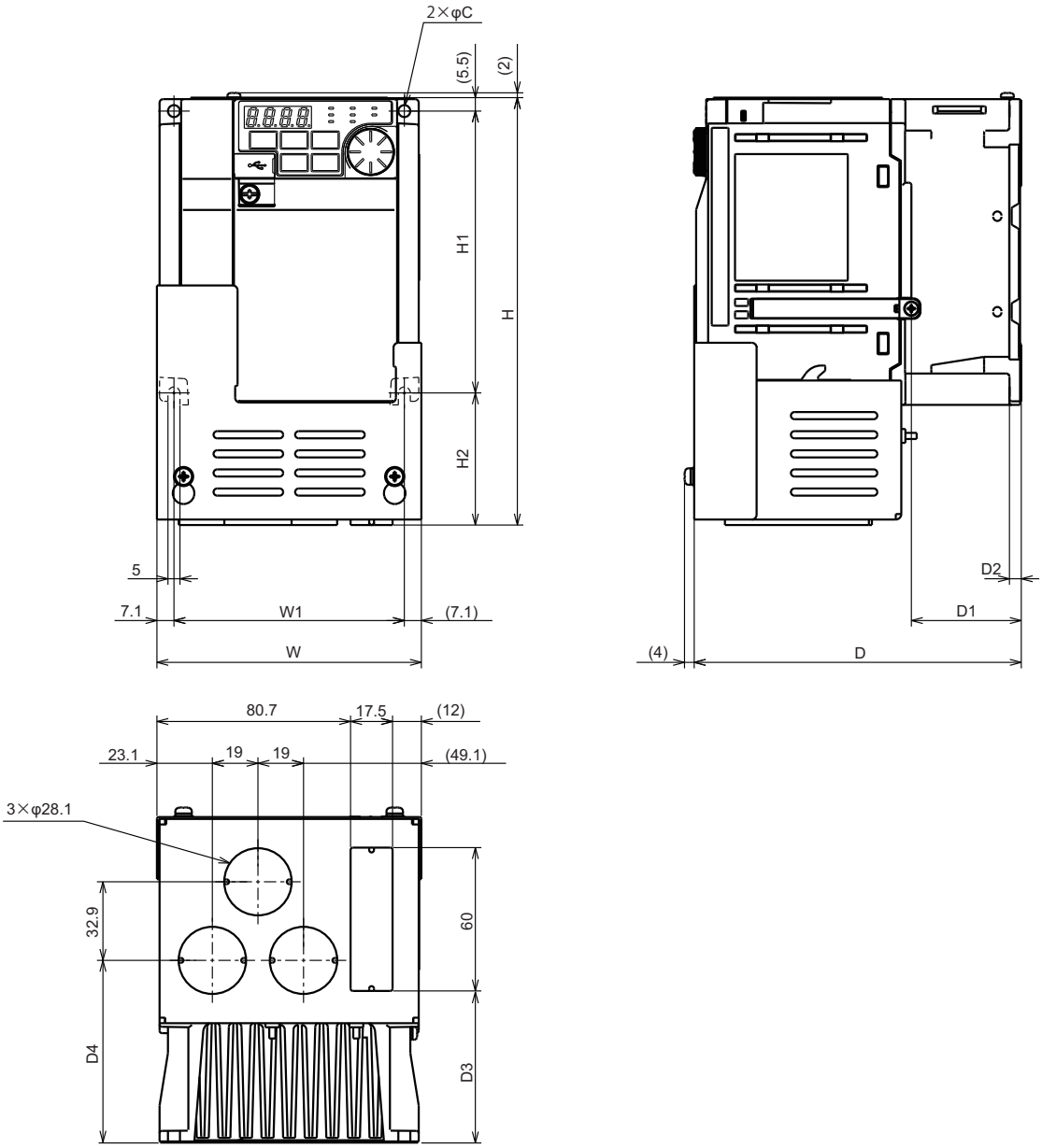
FR-E820-0051(1.1K)
FR-E820S-0017(0.4K)



Inverter model	W	W1	H	H1	H2	D	D1	D2	C
FR-E820-0051(1.1K)	70	56	174.9	118	51.3	133.3	42	65	5
FR-E820S-0017(0.4K)						143.3		75	

(Unit: mm)

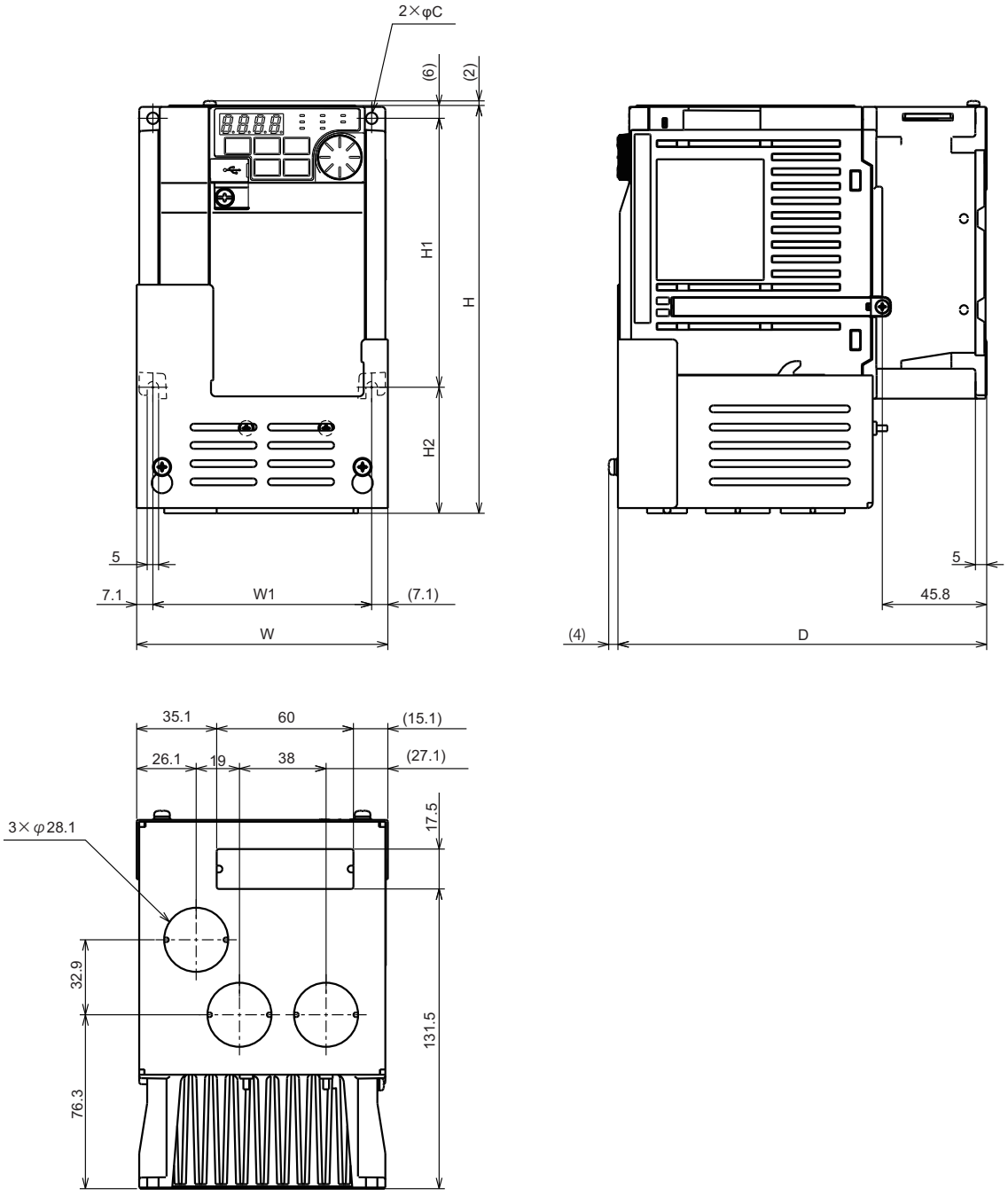
FR-E820-0082(2.2K), FR-E820-0102(3.0K)
FR-E840-0018(0.75K), FR-E840-0030(1.5K), FR-E840-0047(2.2K)
FR-E820S-0030(0.75K)



Inverter model	W	W1	H	H1	H2	D	D1	D2	D3	D4	C
FR-E820-0082(2.2K) FR-E820-0102(3.0K)	110.2	96	178.9	118	55.3	136.3	46	5	63.5	76.3	5
FR-E840-0018(0.75K) FR-E840-0030(1.5K)						130.3	40		58	70.5	
FR-E840-0047(2.2K)						135.8	46		64	76.5	
FR-E820S-0030(0.75K)						135.8	45.3	4.5	63	75.8	

(Unit: mm)

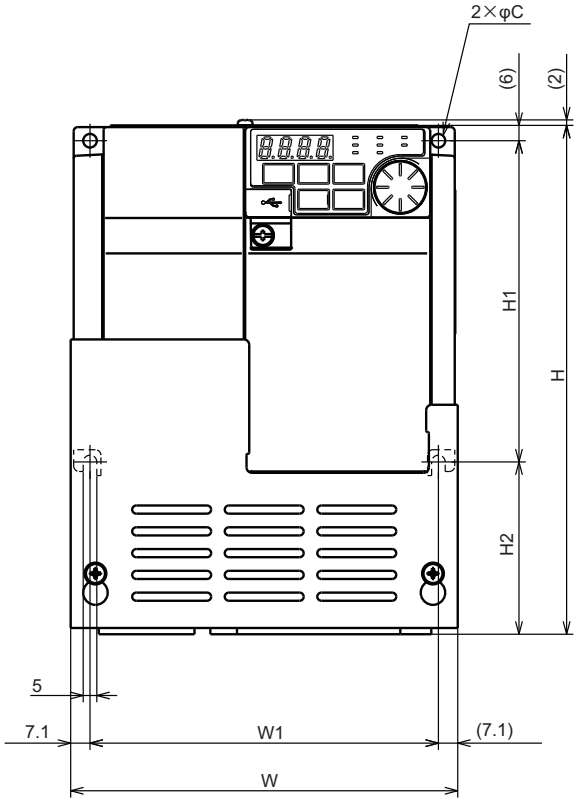
FR-E820S-0051(1.1K)

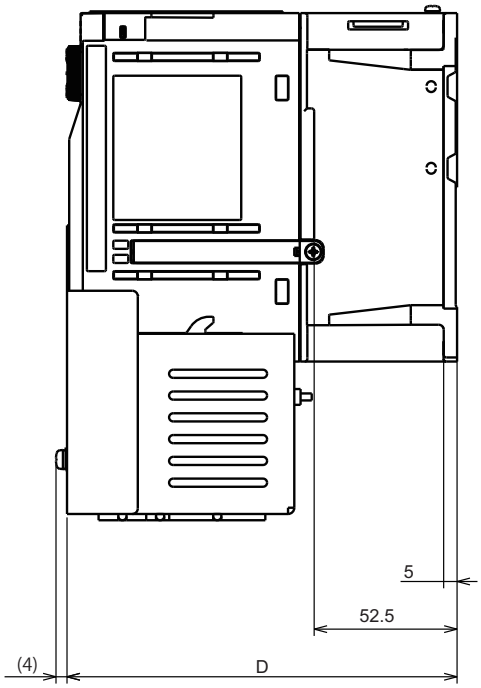


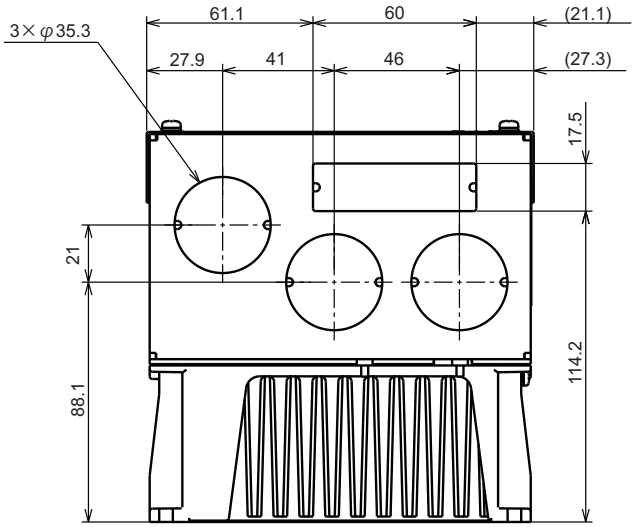
Inverter model	W	W1	H	H1	H2	D	C
FR-E820S-0051(1.1K)	110.2	96	178.9	118	55.3	161.8	5

(Unit: mm)

FR-E820-0167(5.5K)
FR-E820S-0082(2.2K)



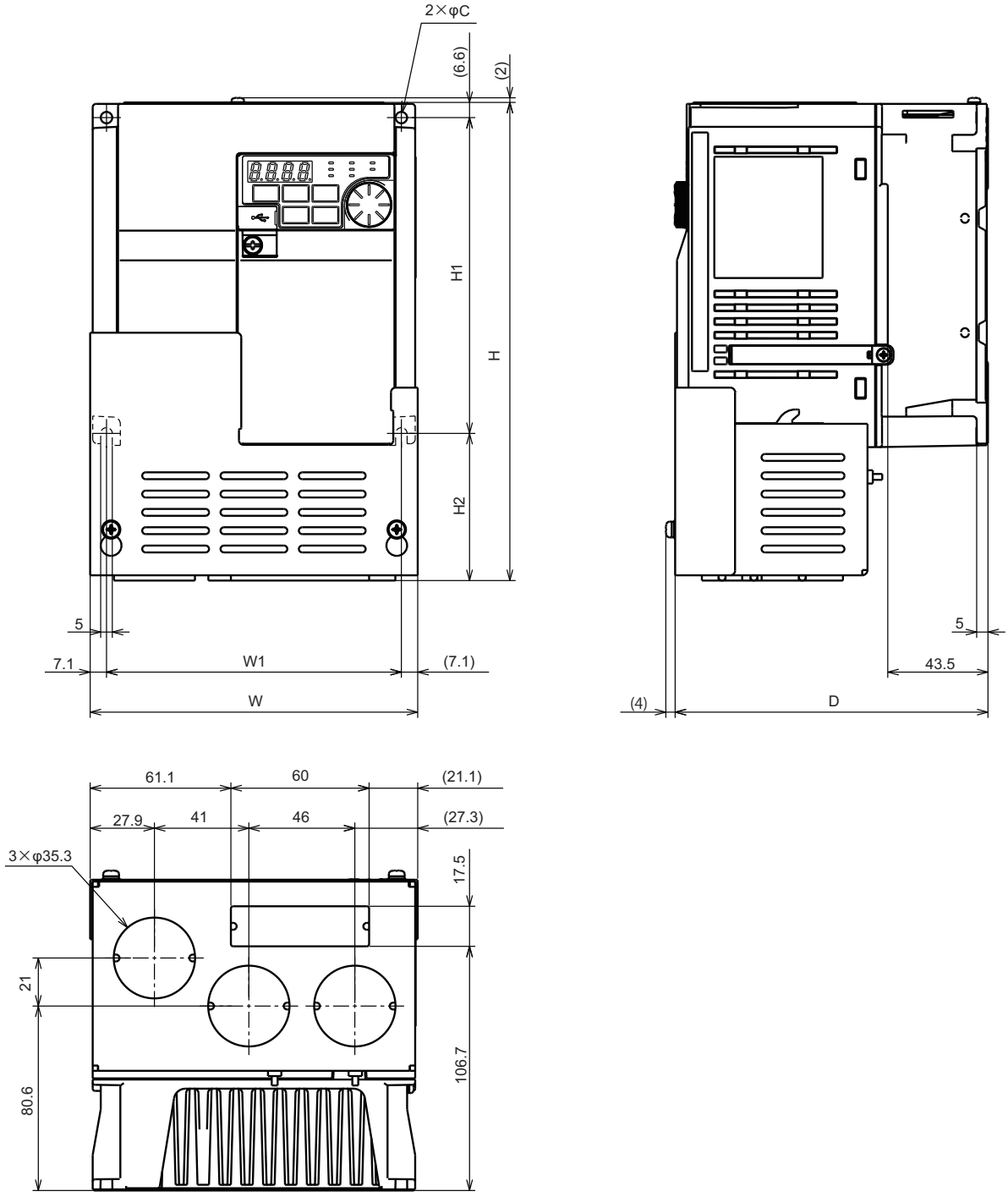




Inverter model	W	W1	H	H1	H2	D	C
FR-E820-0167(5.5K)	142.2	128	186.9	118	63.3	143.3	5
FR-E820S-0082(2.2K)							

(Unit: mm)

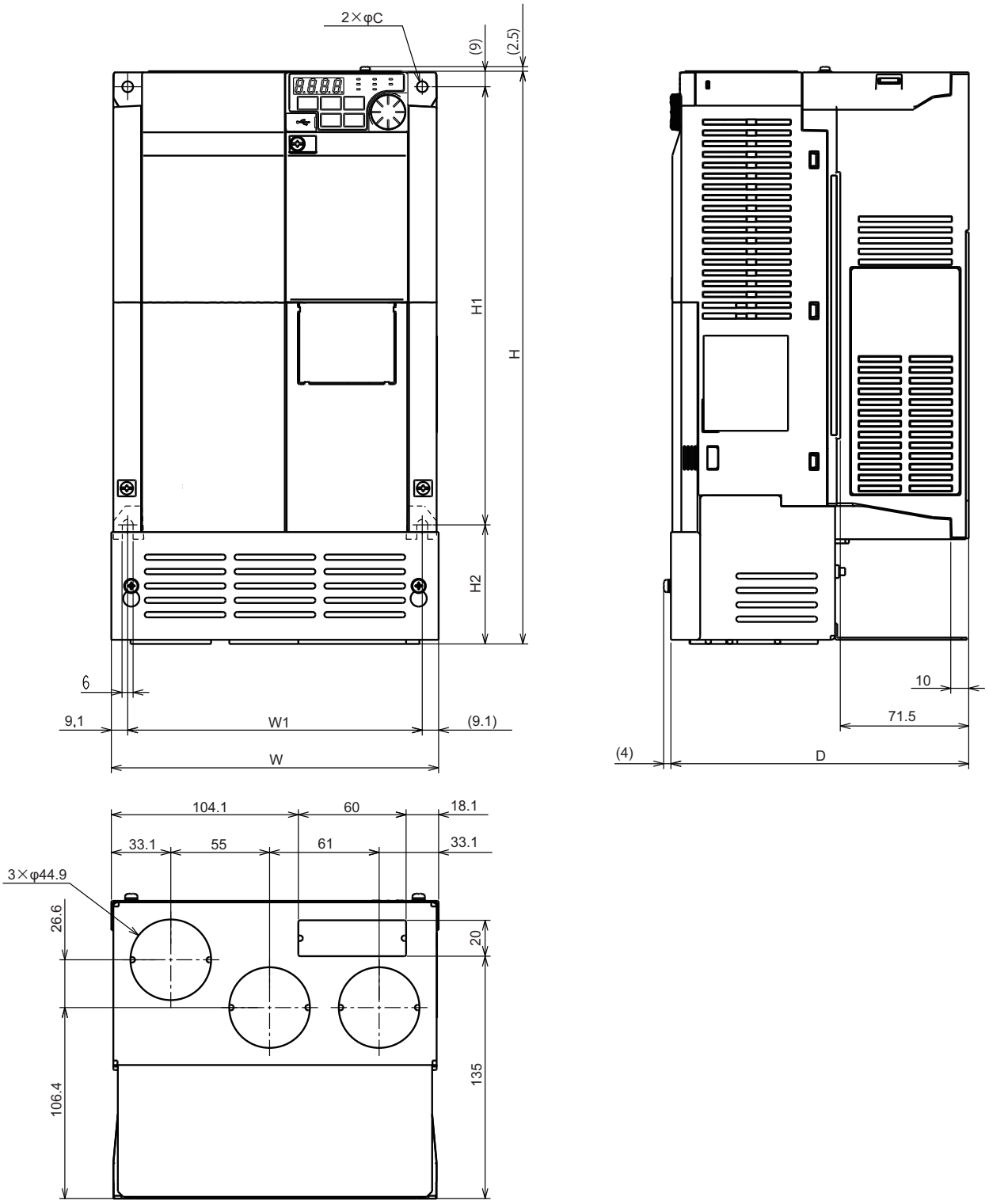
FR-E840-0059(3.0K), FR-E840-0094(5.5K)



Inverter model	W	W1	H	H1	H2	D	C
FR-E840-0059(3.0K) FR-E840-0094(5.5K)	142.2	128	208.9	138	64.3	135.8	5

(Unit: mm)

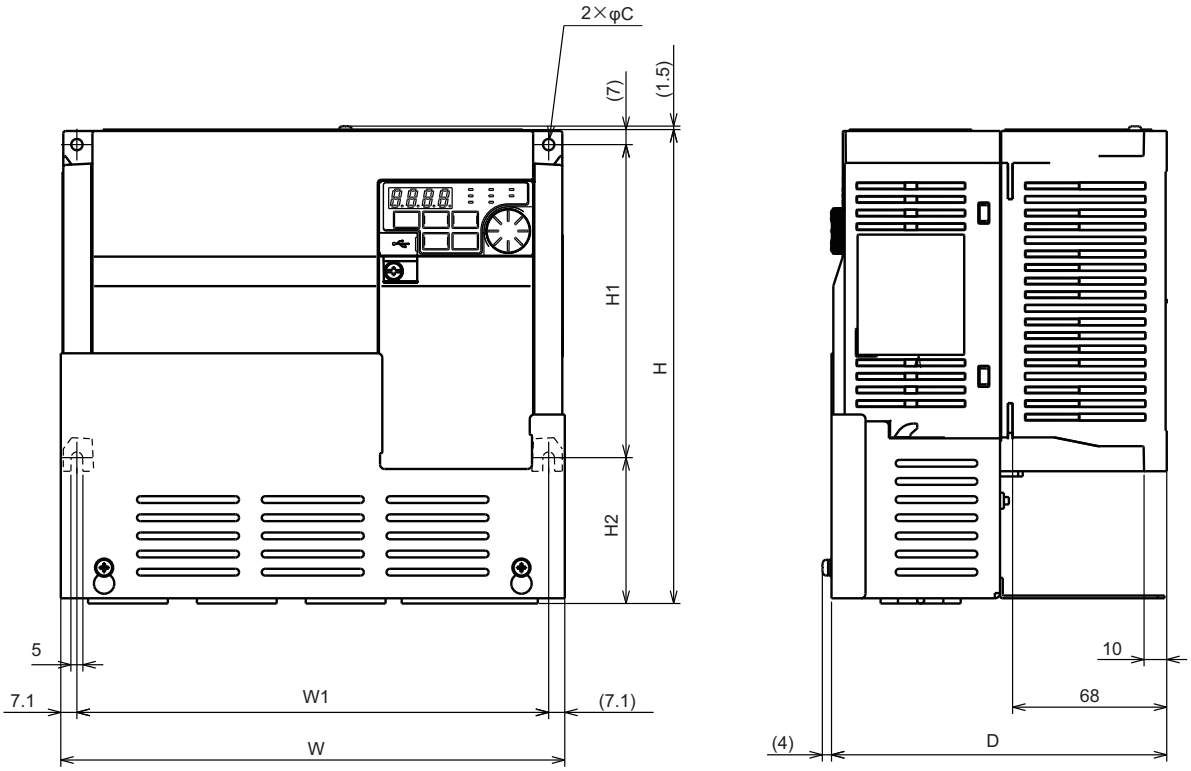
FR-E820-0255(7.5K), FR-E820-0340(11K)

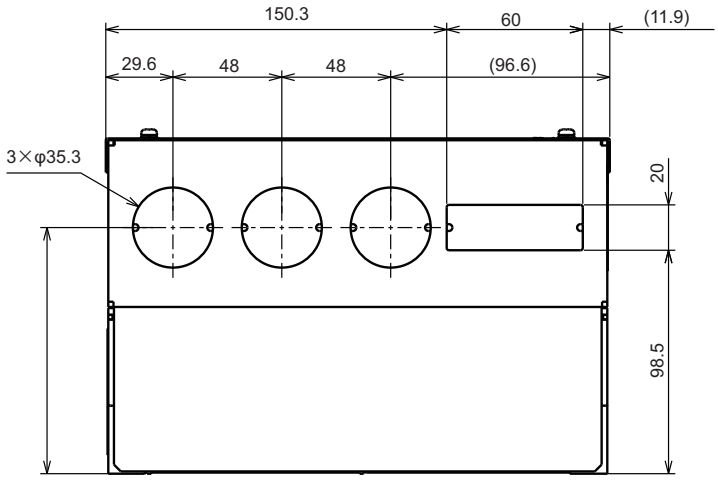


Inverter model	W	W1	H	H1	H2	D	C
FR-E820-0255(7.5K) FR-E820-0340(11K)	182.2	164	318.9	244	66.3	165.8	6

(Unit: mm)

FR-E840-0149(7.5K), FR-E840-0196(11K)

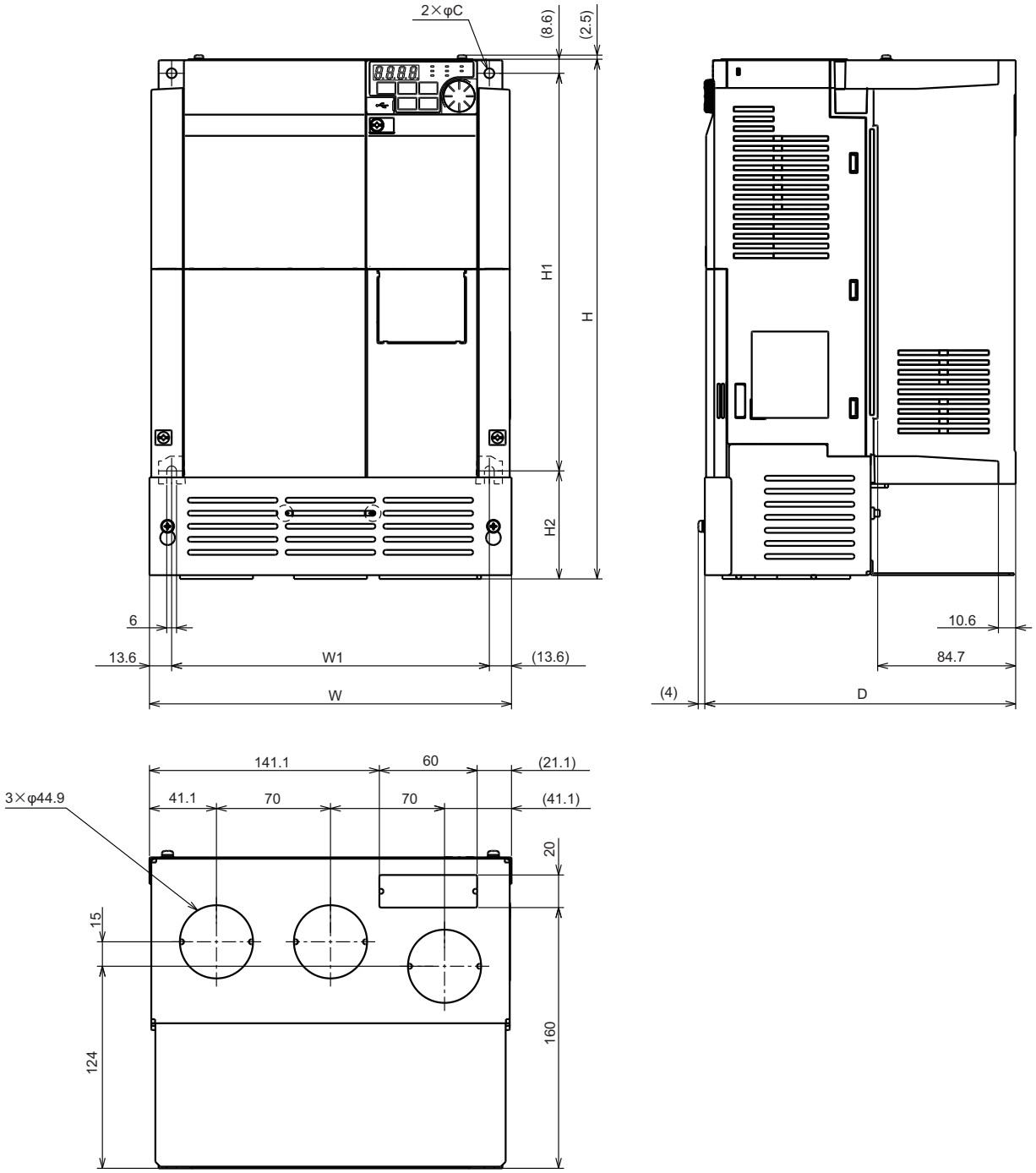




Inverter model	W	W1	H	H1	H2	D	C
FR-E840-0149(7.5K) FR-E840-0196(11K)	222.2	208	208.9	138	64.3	147.8	5

(Unit: mm)

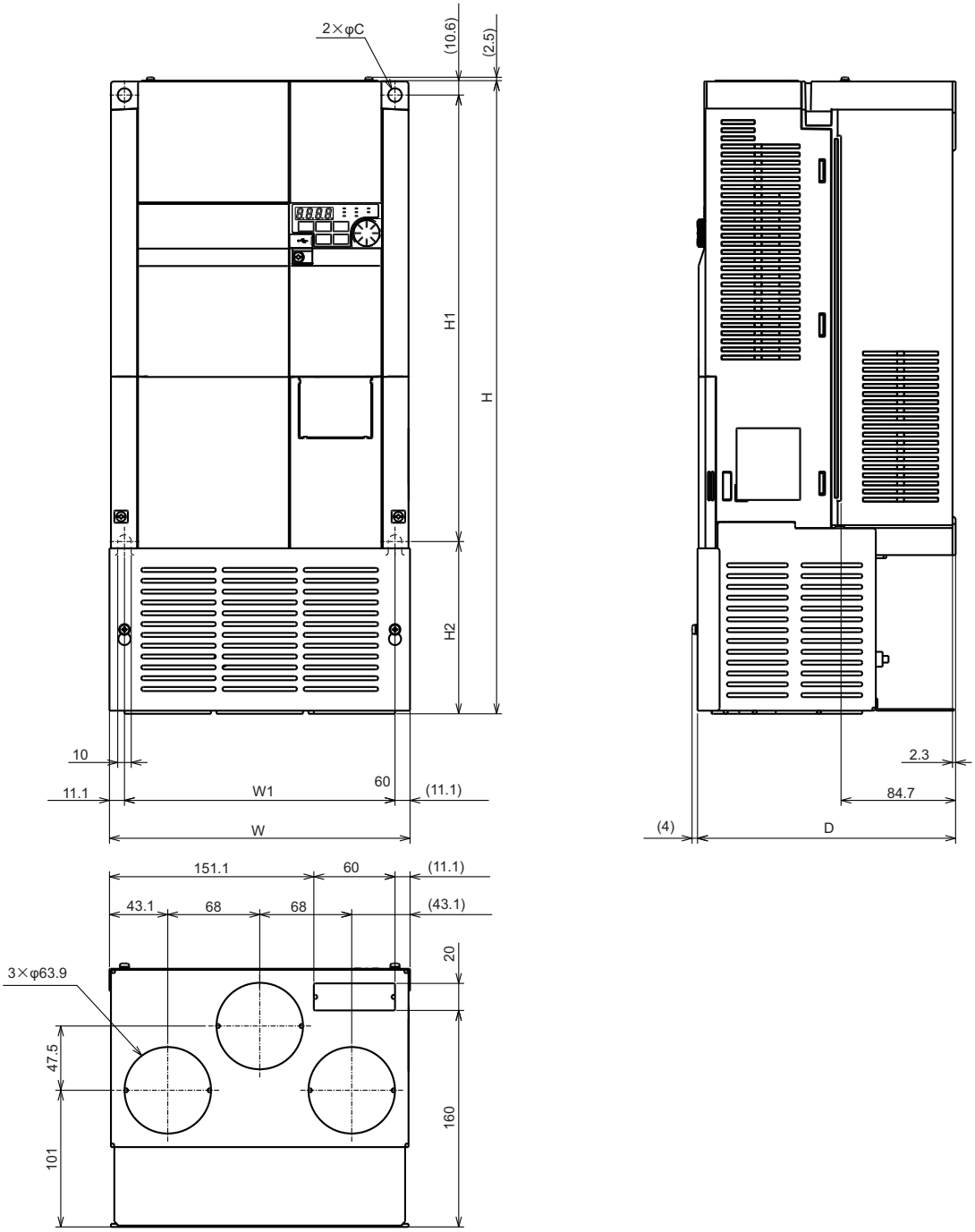
FR-E820-0476(15K), FR-E820-0587(18.5K)
FR-E840-0298(15K), FR-E840-0349(18.5K)



Inverter model	W	W1	H	H1	H2	D	C
FR-E820-0476(15K) FR-E820-0587(18.5K) FR-E840-0298(15K) FR-E840-0349(18.5K)	222.2	195	318.9	244	66.3	190.8	6

(Unit: mm)

FR-E820-0748(22K), FR-E820-0978(30K)
FR-E840-0383(22K), FR-E840-0510(30K)



Inverter model	W	W1	H	H1	H2	D	C
FR-E820-0748(22K) FR-E820-0978(30K) FR-E840-0383(22K) FR-E840-0510(30K)	222.2	200	467.9	330	127.3	190.8	10

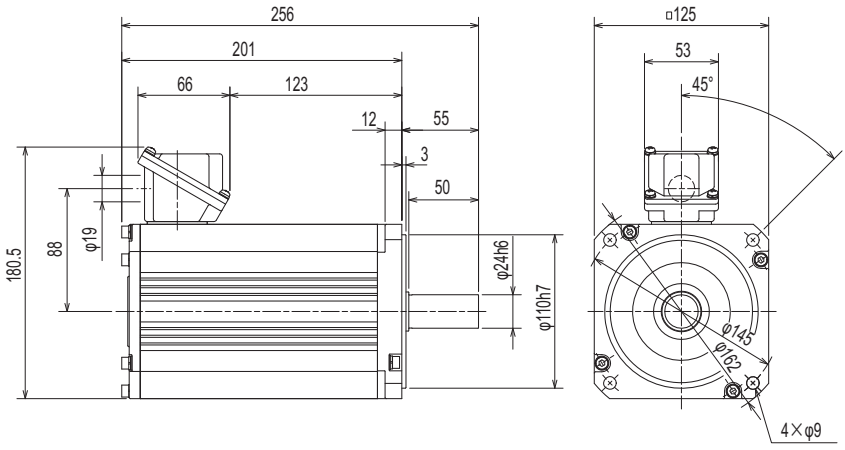
(Unit: mm)

4.4.2 Dedicated motor outline dimension drawings

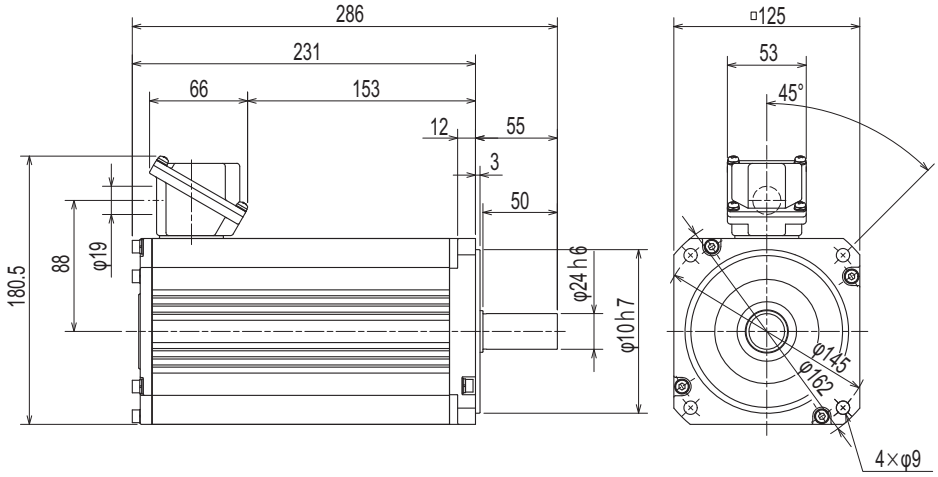
◆ Dedicated PM motor (EM-A) outline dimension drawings

■ EM-AMF

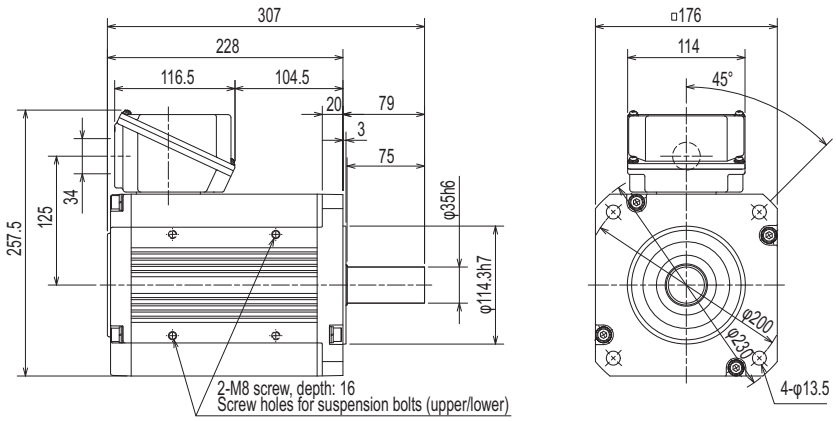
1.5kW



2.2kW

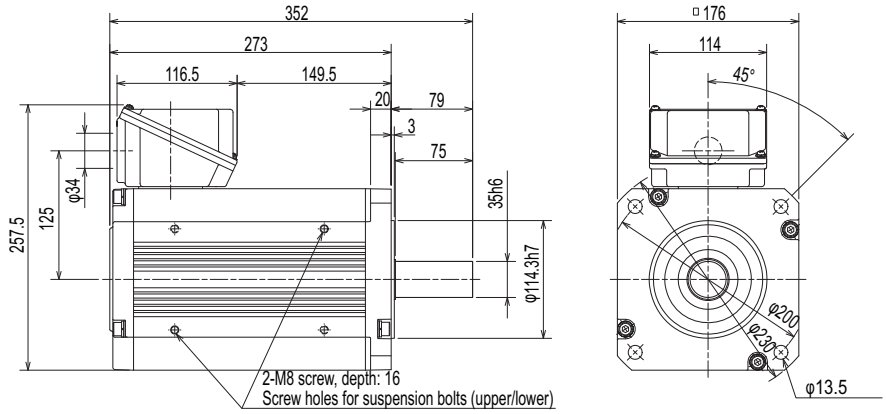


3.7kW

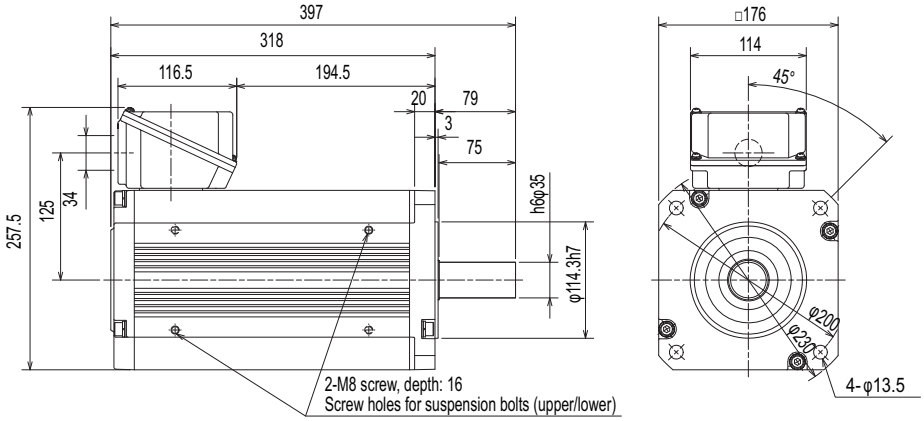


(Unit: mm)

5.5kW



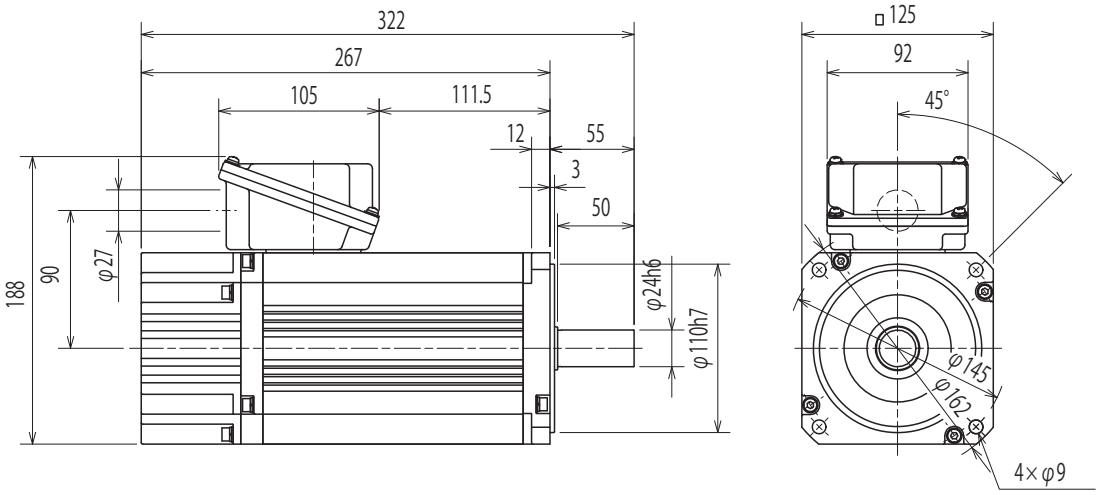
7.5kW



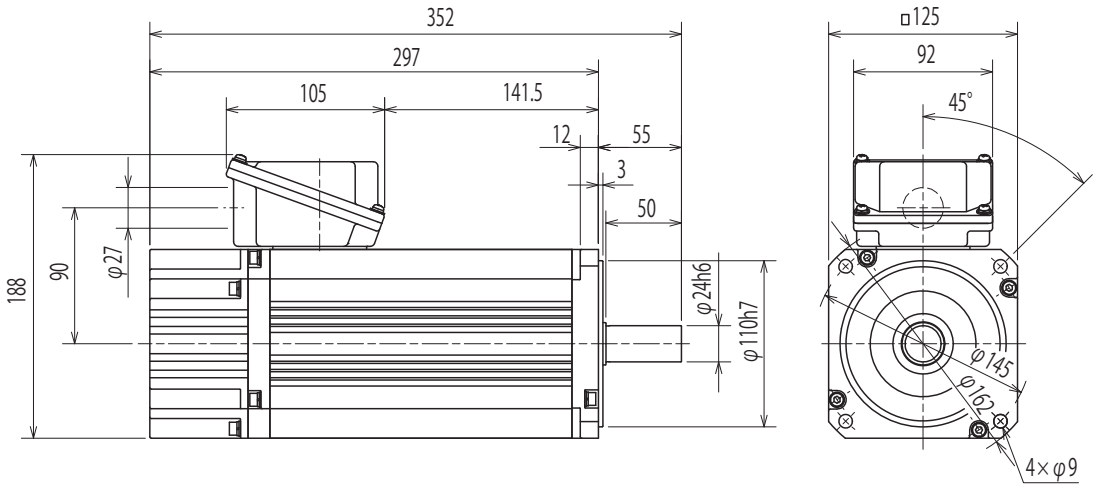
(Unit: mm)

■ EM-AMFB

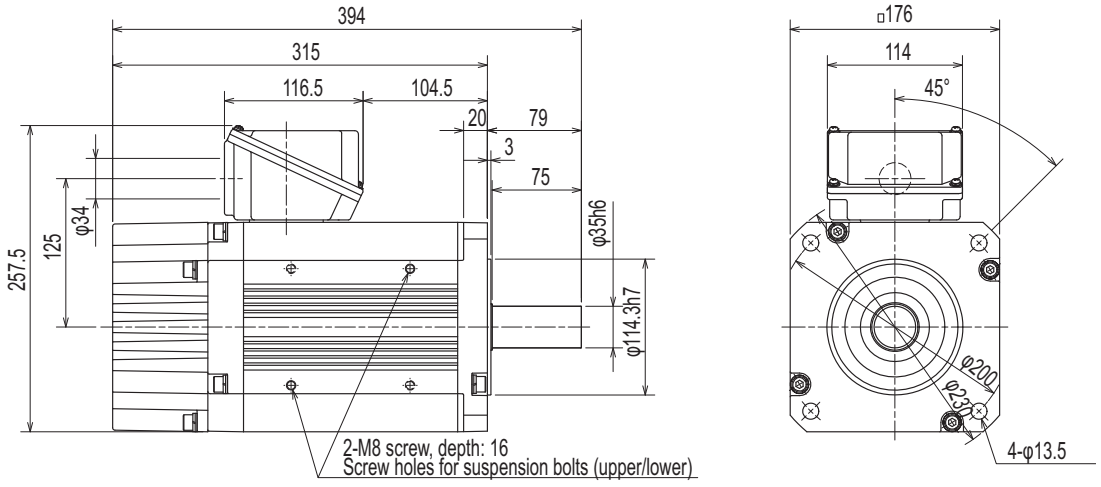
1.5kW



2.2kW

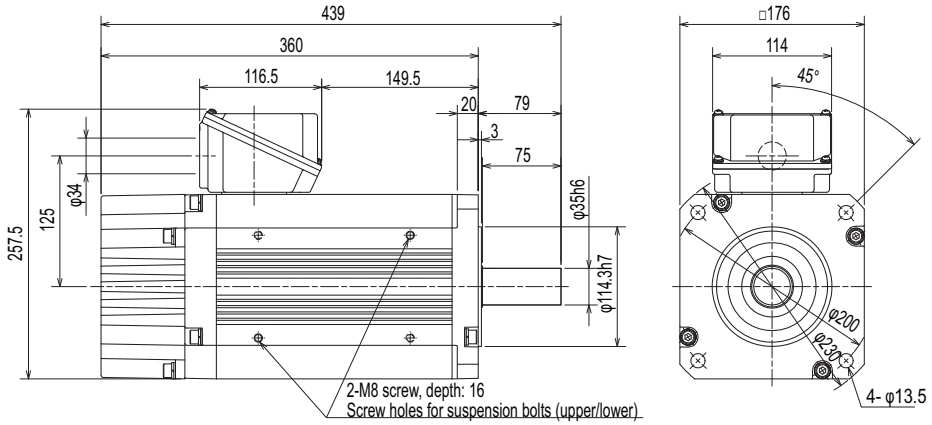


3.7kW

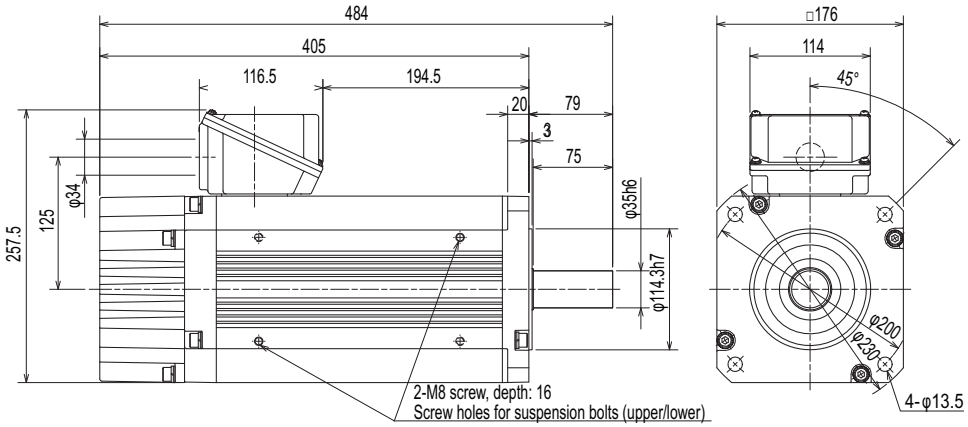


(Unit: mm)

5.5kW



7.5kW



(Unit: mm)

CHAPTER 5 Appendix

5 Appendix

5.1 Differences from the standard inverter

The following functions/specifications of the FR-E800 standard model are changed in the FR-E800-HVC inverters.

Item	Description
PU/EXT key on the operation panel	Changed to the HAND/AUTO key.
Plug-in option	Cannot be used.
Optional operation panel	Cannot be used.
Terminal PR	Not provided. Brake resistors, high-duty brake resistors, brake units, resistor units, discharging resistors, multifunction regeneration converters, and high-duty brake resistors cannot be used.
Terminals MRS and FU	Not provided.
Terminal RES	Not provided. The initial value of **Pr.184** is changed to "9999". Refer to the FR-E800 Instruction Manual (Function).
Terminals S1, S2, SO, and SOC	Not provided. "80, 81, 180, and 181" cannot be set in **Pr.190 to Pr.192**. Refer to the FR-E800 Instruction Manual (Function).
Terminal 4	Not provided. **Pr.126** cannot be set. "20 and 21" cannot be set in **Pr.128**. "4" cannot be set in **Pr.178 to Pr.182, and Pr.185 to Pr.189**. "4, 5, 7, 10, 12, 16, 25, 62, 65 to 67" cannot be set in **Pr.183** and **Pr.184**. **Pr.267** cannot be set. "3" cannot be set in **Pr.609**. "3" cannot be set in **Pr.610**, and the initial value is changed to "4". The initial value and the setting range of **Pr.804** are changed to "1". "1" cannot be set in **Pr.810**. "1 to 3" cannot be set in **Pr.840**. **Pr.846 to Pr.848, and Pr.858** cannot be set. **Pr.904, Pr.905, Pr.932, and Pr.933** cannot be set. Refer to the FR-E800 Instruction Manual (Function).
Terminal FM	Not provided. **Pr.54 and Pr.900** cannot be set. Refer to the FR-E800 Instruction Manual (Function).
PU connector	Not provided. (The RS-485 terminals (connector) are added.) The setting range of **Pr.550** is changed to "2 and 9999". Refer to the FR-E800 Instruction Manual (Communication).
Multiple rating	LD rating only. **Pr.570** cannot be set. Refer to the FR-E800 Instruction Manual (Function).
Load pattern selection	The initial value of **Pr.14** is changed to "1". Refer to the FR-E800 Instruction Manual (Function).
Estimated lifespan of parts	8 years for cooling fan, main circuit smoothing capacitor, and on-board smoothing capacitor

5.2 Supported options

Describes the options available in the FR-E800-HVC inverters.

Name		Type	Remarks
Stand-alonetype	USB cable	MR-J3USBCBL3M Cable length: 3 m	–
	AC reactor	FR-HAL	The option's model varies with the inverter's model.
	DC reactor	FR-HEL	
	EMC Directive compliant noise filter	SF, FR-E5NF, FR-S5NFSA	
	EMC filter installation attachment	FR-A5AT03 FR-AAT02 FR-E5T(-02)	Installation to the rear panel of the inverter is not available.
	Radio noise filter	FR-BIF(H)	
	Line noise filter	FR-BSF01, FR-BLF	–
	Filterpack	FR-BFP2	The option's model varies with the inverter's model.
	Surge voltage suppression filter	FR-ASF	400 V only. The option's model varies with the inverter's model.
		FR-BMF	FR-E840-0149 to 0349 only. The option's model varies with the inverter's model.
Others	Pilot generator	QVAH-10	–
	Multiple rating	YVGC-500WNS	–
	FR Configurator2 (Inverter setup software)	SW1DND-FRC2	Supported by Ver.1.30G or later.

5.3 Restricted Use of Hazardous Substances in Electronic and Electrical Products

The mark of restricted use of hazardous substances in electronic and electrical products is described as follows based on the "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products" of the People's Republic of China.

电器电子产品有害物质限制使用标识要求

本产品中所含有的有害物质的名称、含量、含有部件如下表所示。

• 产品中所含有害物质的名称及含量

部件名称 *2	有害物质 *1					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
电路板组件（包括印刷电路板及其构成的零部件，如电阻、电容、集成电路、连接器等）、电子部件	×	○	×	○	○	○
金属壳体、金属部件	×	○	○	○	○	○
树脂壳体、树脂部件	○	○	○	○	○	○
螺丝、电线	○	○	○	○	○	○

上表依据 SJ/T11364 的规定编制。

○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T26572 规定的限量要求以下。

×：表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 规定的限量要求。

*1 即使表中记载为 ×，根据产品型号，也可能会有有害物质的含量为限制值以下的情况。

*2 根据产品型号，一部分部件可能不包含在产品中。

Warranty

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

1. **Warranty period and coverage**

We will repair any failure or defect (hereinafter referred to as "failure") in our FA equipment (hereinafter referred to as the "Product") arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

The term of warranty for Product is twelve months after your purchase or delivery of the Product to a place designated by you or eighteen months from the date of manufacture whichever comes first ("Warranty Period"). Warranty period for repaired Product cannot exceed beyond the original warranty period before any repair work.

[Limitations]

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

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.

(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;

- a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
- a failure caused by any alteration, etc. to the Product made on your side without our approval
- a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
- a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
- any replacement of consumable parts (condenser, cooling fan, etc.)
- a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
- a failure caused by using the emergency drive function
- a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
- any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. **Term of warranty after the stop of production**

(1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.

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

3. **Service in overseas**

Our regional FA Center in overseas countries will accept the repair work of the Product; however, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

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

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

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

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

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

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

5. **Change of Product specifications**

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

6. **Application and use of the Product**

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

(2) Our product is designed and manufactured as a general purpose product for use at general industries.
Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used.
In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used.
We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

Revisions

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

Revision date	*Manual number	Revision
Jul. 2021	IB(NA)-0600950ENG-A	First edition
Jun. 2022	IB(NA)-0600950ENG-B	Edited • Wiring cover shape • EM-A motors (200 V class 1.5 kW to 3.7 kW, and 400 V class 3.7 kW and 5.5 kW)
Jul. 2023	IB(NA)-0600950ENG-C	Added • FR-E820-0011(0.2K)-HVC to FR-E820-0051(1.1K)-HVC, FR-E820-0748(22K)-HVC, FR-E820-0978(30K)-HVC, FR-E840-0383(22K)-HVC, FR-E840-0510(30K)-HVC, FR-E820S-0011(0.2K)-HVC to FR-E820S-0082(2.2K)-HVC

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BUILDING 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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