MITSUBISHI ELECTRIC

INVERTER

F800-E

FR-F860-E (600V CLASS SPECIFICATION INVERTER) INSTRUCTION MANUAL (STARTUP)

FR-F860-00027-00450-E-N6
FR-F860-00680-04420-E

Thank you for choosing this Mitsubishi Electric Inverter.
This Instruction Manual and the enclosed CD-ROM give handling information and precautions for use of this product.
Do not use this product until you have a full knowledge of the equipment, safety information and instructions.
Please forward this Instruction Manual and the enclosed CD-ROM to the end user.

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This Instruction Manual provides handling information and precautions for use of this product.
Please forward this Instruction Manual to the end user.

Safety Instructions

Do not attempt to install, operate, maintain or inspect this product until you have read through this Instruction Manual and supplementary documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of this product, safety information and instructions.
Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, qualified personnel means personnel who meets all the conditions below.
- **A person who 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 (e.g. light curtain) connected to the safety control system. A person who has read and familiarized himself/herself with the manuals.**

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 even lead to a serious consequence according to conditions. Be sure to follow the instructions of both levels as they are critical to personal safety.

◆ Electric Shock Prevention

⚠WARNING

- While the inverter power is ON, do not remove the front cover or the wiring cover. Do not run the inverter with the front cover or the wiring cover removed, as accidental contact with exposed high-voltage terminals and internal components may occur, resulting in an electrical shock.
- Even if power is OFF, do not remove the front cover except for wiring or periodic inspection. You may accidentally touch the charged inverter circuits and get an electric shock.
- Before wiring or inspection, the power lamp must be switched OFF. Any person who is involved in wiring or inspection shall wait for at least 10 minutes after the power supply has been switched OFF and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
- This inverter must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 61140 class 1 and other applicable standards).
- Any person who is involved in wiring or inspection of this equipment shall be fully competent to do the work.
- The inverter 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 this product output side and keep it open during wiring and inspection of this product. Otherwise you may get an electric shock.

◆ Fire Prevention

⚠CAUTION

- Inverter must be installed on a nonflammable wall without holes in it so that its components cannot be touched from behind. Mounting it to or near flammable material may cause a fire.
- If the inverter becomes faulty, the inverter power must be switched OFF. A continuous flow of large current may cause a fire.
- Do not connect a resistor directly to the DC terminals P/+ and N/-. Doing so could cause a fire.
- Be sure to perform daily and periodic inspections as specified in the Instruction Manual (Detailed). 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 (Detailed).
- The cables must be connected to the correct terminals. Otherwise an explosion or damage may occur.
- The polarity (+ and -) must be correct. Otherwise burst, damage, etc. may occur.
- While power is ON or for some time after power-OFF, do not touch the inverter as it will be extremely hot. Touching these devices may cause a burn.

◆ 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.
- Do not stand or rest heavy objects on the product.
- Do not stack the boxes containing inverters higher than the number recommended.
- When carrying the inverter, do not hold it by the front cover; it may fall or break.
- During installation, caution must be taken not to drop the inverter as doing so may cause injuries.
- The product must be installed on a surface that withstands the weight of the inverter.
- Do not install the product on a hot surface.
- Ensure the mounting orientation of this product is correct.
- Ensure this product is mounted securely in its enclosure.
- Do not install or operate the inverter if it is damaged or has parts missing.
- Foreign conductive objects must be prevented from entering the inverter. That includes screws and metal fragments or other flammable substance such as oil.
- As the inverter is a precision instrument, do not drop or subject it to impact.
- For the FR-F860-00090 or lower, the surrounding air temperature must be -10 to +30°C for the SLD rating (-10 to +40°C for the LD rating) (non-freezing). Otherwise the inverter may be damaged.
- For the FR-F860-00170 to 01080, the surrounding air temperature must be -10 to +40°C (non-freezing). Otherwise the inverter may be damaged.
- For the FR-F860-01440 or higher, the surrounding air temperature must be -10 to +40°C for the SLD rating (-10 to +50°C for the LD rating) (non-freezing). Otherwise the inverter may be damaged.
- The ambient humidity must be 95%RH or less (non-condensing). Otherwise the inverter may be damaged. (Refer to page 5 for details.)
- The storage temperature (applicable for a short time, e.g. during transit) must be between -20 and +65°C. Otherwise the inverter may be damaged.
- The inverter must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.) Otherwise the inverter may be damaged.
- Do not use this product at an altitude above 2500 m. Vibration should not exceed 5.9 m/s^2 at 10 to 55 Hz in X, Y, and Z directions. (For installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.) Otherwise the inverter may be damaged.
- 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.
- To prevent a failure, do not use the inverter with a part or material containing halogen flame retardant including bromine.

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.
- 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 connected with the output terminals (U, V, W) of the inverter.

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

*1 2.9 m/s^2 or less for the FR-F860-02890 or higher.

⚠ WARNING

Usage

- Stay away from the equipment when the retry function is set as it will restart suddenly after a trip.
- Since pressing the STOP/RESET key may not stop output depending on the function setting status, separate circuit and switch that make an emergency stop (power OFF, mechanical brake operation for emergency stop, etc.) must be provided.
- 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 where the PM motor is driven by its load and runs at a speed higher than the maximum motor speed.
- Use this inverter only with three-phase induction motors or with a PM motor. Connection of any other electrical equipment to the inverter output may damage the equipment.
- Do not modify the equipment.
- Do not remove any part which is not instructed to be removed in the Instruction Manual (Detailed). Doing so may lead to fault or damage of the product.

⚠ CAUTION

Usage

- The electronic thermal relay function does not guarantee protection of the motor from overheating. It is recommended to install both an external thermal and PTC thermistor for overheat protection.
- Do not repeatedly start or stop this product with a magnetic contactor on its input side.
- The effect of electromagnetic interference must be reduced by using a noise filter or by other means. Otherwise nearby electronic equipment may be affected.
- Appropriate precautions must be taken to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power factor correction capacitor and generator.
- To drive a 600 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 parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations because all parameters return to their initial values.
- The inverter can be easily set for high-speed operation. Before changing its setting, the performances of the motor and machine must be fully examined.
- This product's brake function cannot be used as a mechanical brake. Use a separate device instead.
- Perform an inspection and test operation of this product if it has been stored for a long period of time.
- Static electricity in your body must be discharged before you touch the product.
- Only one PM motor can be connected to an inverter.
- A PM motor must be used under PM motor 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.
- In the system with a PM motor, the inverter power must be turned ON before closing the contacts of the contactor at the output side.
- When the emergency drive operation is performed, the operation is continued or the retry is repeated even when a fault occurs, which may damage or burn the inverter and motor. Before restarting the normal operation after using the emergency drive function, make sure that the inverter and motor have no fault.
- In order to protect the inverter and the system against unauthorized access by external systems via network, take security measures including firewall settings.
- Depending on the network environment, the inverter may not operate as intended due to delays or disconnection in communication. Carefully consider the conditions and safety for the inverter on site.
- 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.
- When the emergency drive function is enabled, the operation is continued or the retry operation (automatic reset and restart) is repeated even if a fault occurs, which may damage or burn the inverter, the converter unit, or the motor. Before restarting the normal operation after the operation using the emergency drive function, make sure that the inverter, the converter unit, and the motor have no fault.

Emergency stop

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

Maintenance, inspection and parts replacement

- Do not carry out a megger (insulation resistance) test on the control circuit of the inverter. It will cause a failure.

Disposal

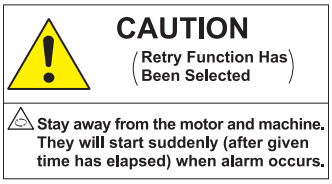
- The inverter must be treated as industrial waste.

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

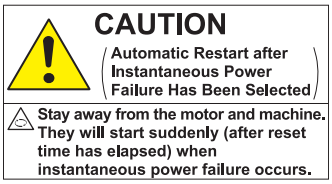
Application of caution labels

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

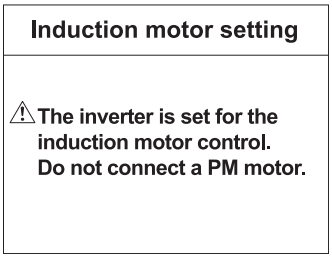


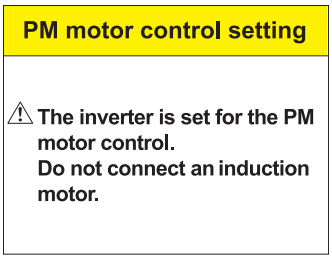
- For automatic restart after instantaneous power failure



Application of motor control labels

Apply the following labels to the inverter to avoid connecting motors not intended for a particular motor control setting.





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.

MEMO

1 INVERTER INSTALLATION AND PRECAUTIONS

◆ Inverter model

- FR-F860-00450 or lower

FR - F8 60 - 00027 - E3 - N6

Symbol	Voltage class
6	600 V class

Symbol	Description
00027 to 00450	Inverter SLD rated current (A)

Symbol	Type	Communication type
E3	CA3	Ethernet*1

Symbol	Circuit board coating (conforming to IEC60721-3-3:1994 3C2/3S2)	Plated conductor	UL Type 1 certification
N6	With	Without	With

- FR-F860-00680 or higher

FR - F8 60 - 00680 - E3 - 60

Symbol	Voltage class
6	600 V class

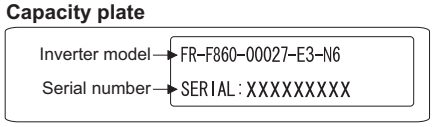
Symbol	Description
00680 to 04420	Inverter SLD rated current (A)

Symbol	Type	Communication type
E3	CA3	Ethernet*1

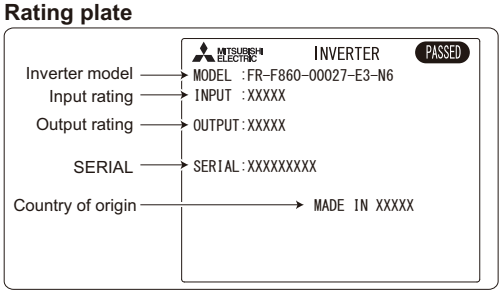
Symbol	Circuit board coating (conforming to IEC60721-3-3:1994 3C2/3S2)	Plated conductor
60	With	Without
06	With	With

*1 Inverter equipped with a built-in Ethernet board (FR-A8ETH).

Capacity plate

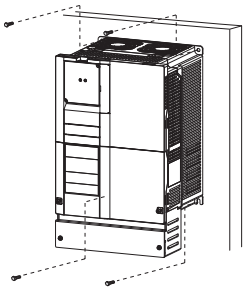


Rating plate



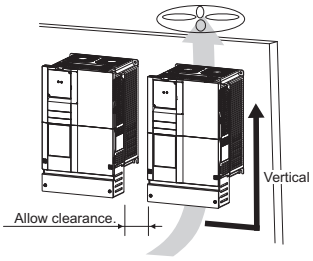
◆ Inverter placement

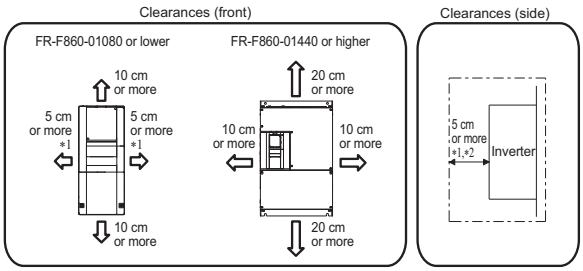
Installation on the enclosure



Fix six positions for the FR-F860-02890 or higher.

- 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, install them in parallel as a cooling measure.
- 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.



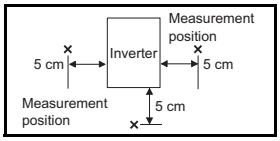


*1 For the FR-F860-00090 or lower, allow 1 cm or more clearance.

*2 For replacing the cooling fan of the FR-F860-02890 or higher, 30 cm of space is necessary in front of the inverter. Refer to the FR-F860 Instruction Manual (Detailed) for fan replacement.

◆ Installation environment

Before installation, confirm that the following environment conditions are met.

Item	Description		
Surrounding air temperature*4	FR-F860-00090 or lower	-10°C to +30°C (non-freezing) (SLD rating) -10°C to +40°C (non-freezing) (LD rating)	Enclosure*5 
	FR-F860-00170 to 01080	-10°C to +40°C (non-freezing)	
	FR-F860-01440 or higher	-10°C to +40°C (non-freezing) (SLD rating) -10°C to +50°C (non-freezing) (LD rating)	
Ambient humidity	95% RH or less (non-condensing)		
Storage temperature	-20 to +65°C*1		
Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)		
Altitude	Maximum 2500 m*2		
Vibration	5.9 m/s^2 *3 or less at 10 to 55 Hz (directions of X, Y, Z axes)		

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

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

*3 2.9 m/s^2 or less for the FR-F860-02890 or higher.

*4 Surrounding air temperature is a temperature measured at a measurement position in an enclosure. Ambient temperature is a temperature outside an enclosure.

*5 The FR-F860-00680 or higher inverter is intended for installation in an enclosure.

◆ Accessory

- Eyebolt for hanging the inverter

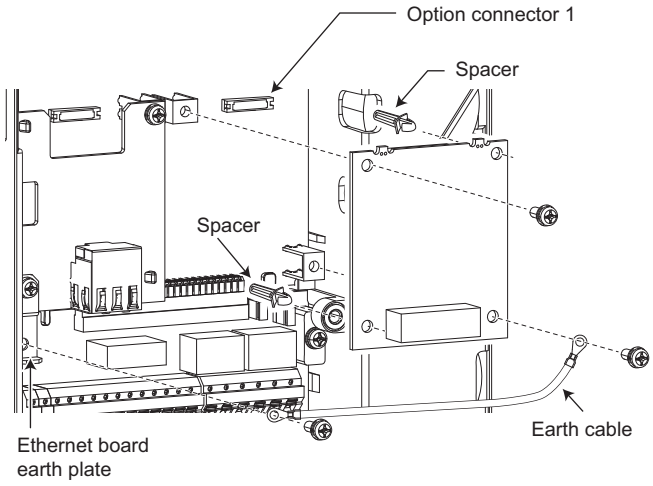
Capacity	Eyebolt size	Quantity
FR-F860-02890, 03360	M10	2
FR-F860-04420	M12	2

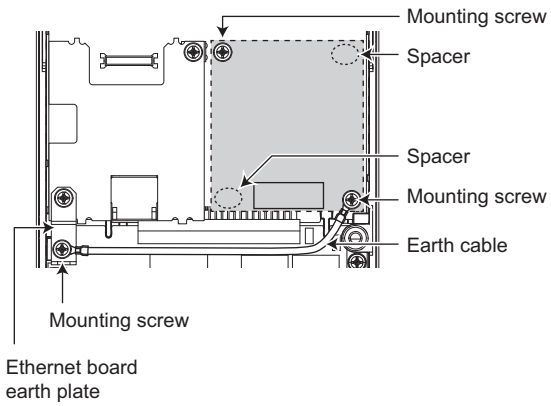
- Earthing (grounding) cable (1): For connection with a communication option
- CD-ROM (1): Including the Instruction Manual (Detailed) and other documents

◆ Installing a communication option

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

No.	Installation procedure
1	Insert spacers into the mounting holes that will not be tightened with the option mounting screws.
2	Fit the connector of the communication option to the guide of the connector of the inverter, and insert the option as far as it goes. (Insert it to the inverter option connector 1.)
3	Remove the mounting screw (lower) of the Ethernet board earth plate. Fit the one terminal of the earthing (grounding) cable on the Ethernet board earth plate and fix it securely to the inverter with the mounting screw. (tightening torque 0.33 N•m to 0.40 N•m)
4	Fix the left part of the communication option securely with the option mounting screw, and place another terminal of the earthing (grounding) cable on the right part of the option and fix the cable terminal and the option with the option mounting screw. (tightening torque 0.33 N•m to 0.40 N•m) If the screws are not tightened properly, the connector may not be inserted deep enough. Check the connector.





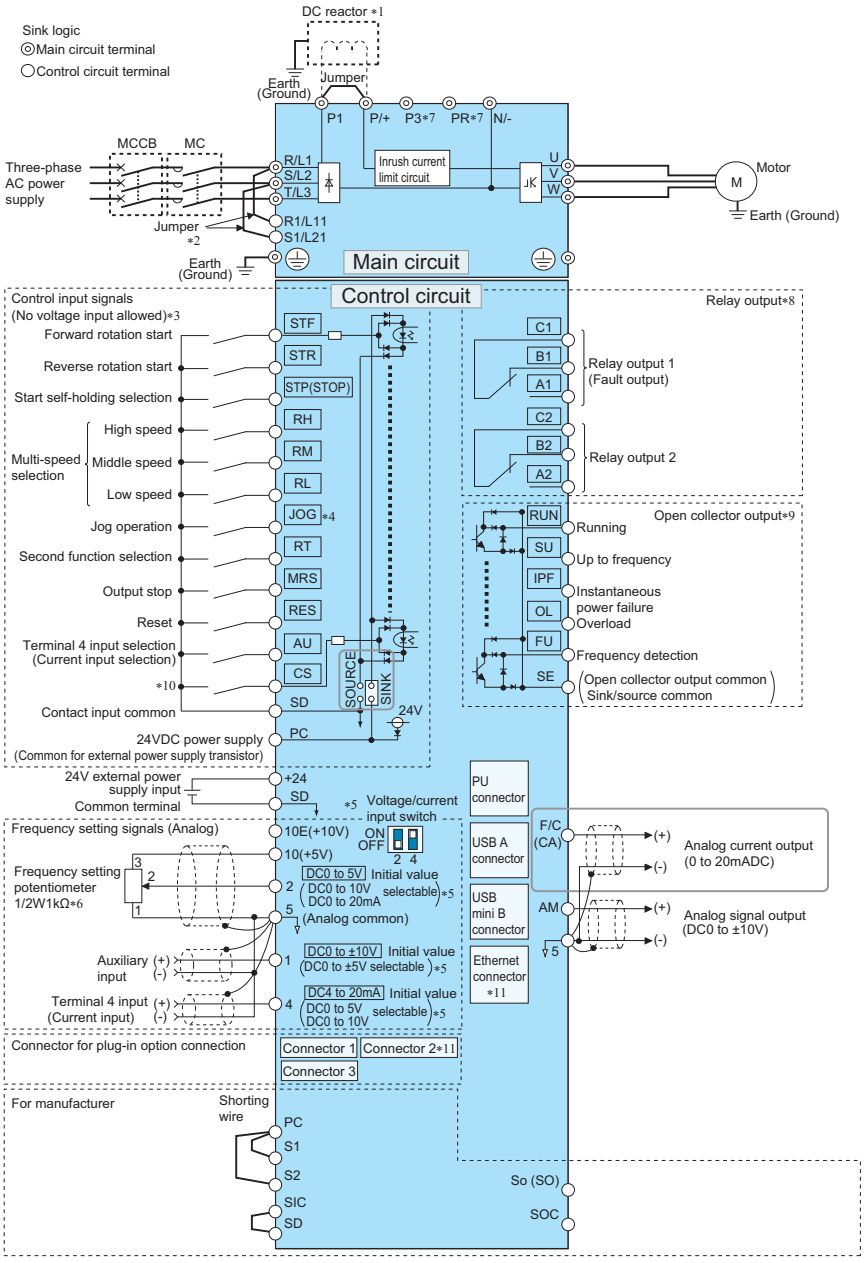
Example of FR-A8NC

NOTE

- The number and shape of the spacers used differ depending on the communication option type. Refer to the Instruction Manual of each communication option for details.
- The earth plate enclosed with a communication option is not used.

2 WIRING

2.1 Terminal connection diagrams



*1 For the FR-F860-01080 or higher, or whenever a 75 kW or higher motor is used, always connect a DC reactor, which is available as an option. (To select a DC reactor, refer to page 24, and select one according to the applicable motor capacity.)
When connecting a DC reactor, if a jumper is installed across terminals P1 and P/+, remove the jumper before installing the DC reactor. (The jumper is not installed for the FR-F860-01440 or higher.)

*2 When using separate power supply for the control circuit, remove the jumper between R1/L11 and S1/L21.

*3 The function of these terminals can be changed with the input terminal assignment **(Pr.178 to Pr.189)**. (Refer to page 17.)

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

*5 Terminal input specifications can be changed by analog input specification switchover **(Pr.73, Pr.267)**. To input a voltage, set the voltage/current input switch OFF. To input a current, set the voltage/current input switch ON. Terminals 10 and 2 are also used as a PTC input terminal. **(Pr.561)** (Refer to the FR-F860 Instruction Manual (Detailed).)

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

*7 Do not use terminals PR and P3. (Terminals PR and P3 are equipped in FR-F860-01080 or lower.)

*8 The function of these terminals can be changed with the output terminal assignment **(Pr.195, Pr.196)**. (Refer to page 17.)

*9 The function of these terminals can be changed with the output terminal assignment **(Pr.190 to Pr.194)**. (Refer to page 17.)

*10 No function is assigned in the initial status. Assign the function using **Pr.186 CS terminal function selection**. (Refer to page 17.)

*11 The option connector 2 cannot be used because the Ethernet board is installed in the initial status. The Ethernet board must be removed to install a plug-in option to the option connector 2. (However, Ethernet communication is disabled in that case.)

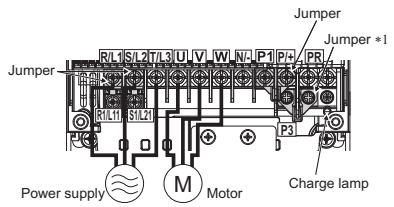
NOTE

- To prevent a malfunction due to noise, keep the signal cables 10 cm or more away from the power cables. Also, separate the main circuit cables at the input side from the main circuit cables at the output side.
- After wiring, wire offcuts must not be left in the inverter. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch correctly. Incorrect setting may cause a fault, failure or malfunction.
- Terminals S1, S2, SIC, So (SO), and SOC are for manufacturer setting. Do not connect anything to these. Doing so may cause an inverter failure.
  Do not remove the shorting wires across the terminals S1 and PC, terminals S2 and PC, and the terminals SIC and SD. Removing either shorting wire disables the inverter operation.

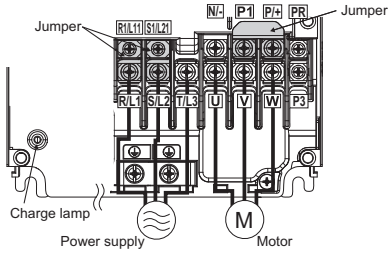
2.2 Main circuit terminals

◆ Terminal arrangement and wiring

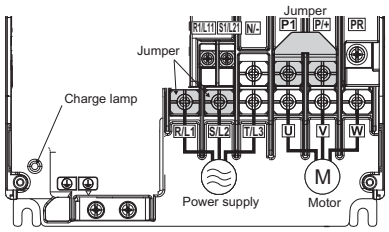
FR-F860-00027 to 00090



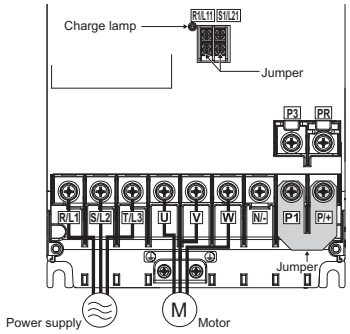
FR-F860-00170



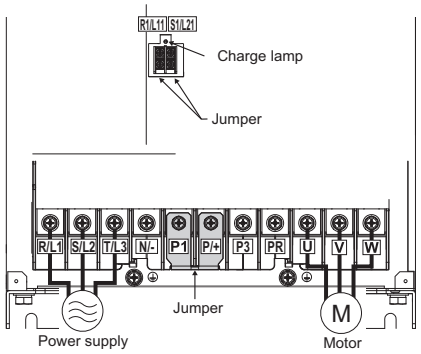
FR-F860-00320



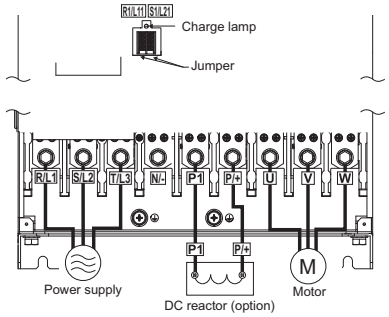
FR-F860-00450



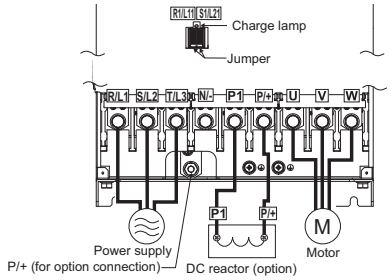
FR-F860-00680, 01080*2



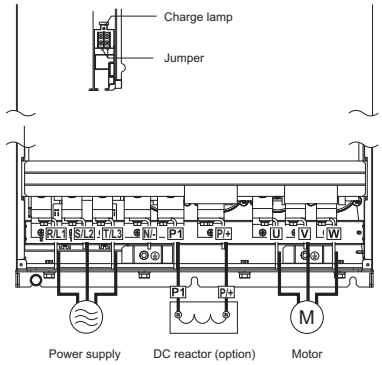
FR-F860-01440 to 02430



FR-F860-02890, 03360



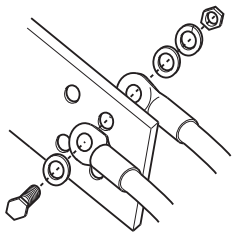
FR-F860-04420



*1 Do not remove the jumper from terminal P3.
*2 For the FR-F860-01080, a jumper is not installed across terminals P1 and P/+. Always connect a DC reactor (FR-HEL), which is available as an option, across terminals P1 and P/+.
*3 When an option other than the DC reactor must be connected to terminal P/+, use terminal P/+ (for option connection).

NOTE

- Make sure the power cables are connected to the R/L1, S/L2, T/L3. (Phase need not be matched.) Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter.
- Connect the motor to U, V, and W. Turning ON the forward rotation switch (signal) at this time rotates the motor counterclockwise when viewed from the load shaft. (The phase sequence must be matched.)
- The charge lamp will turn ON when the power is supplied to the main circuit.
- When wiring the inverter main circuit conductor of the FR-F860-04420, tighten a nut from the right side of the conductor. When wiring two wires, place wires on both sides of the conductor. (Refer to the drawing on the right.) For wiring, use bolts (nuts) provided with the inverter.

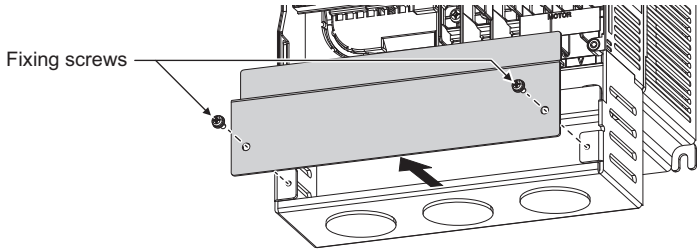


◆ Wiring cover and handling (FR-F860-00450 or lower)

• Removal of the wiring cover

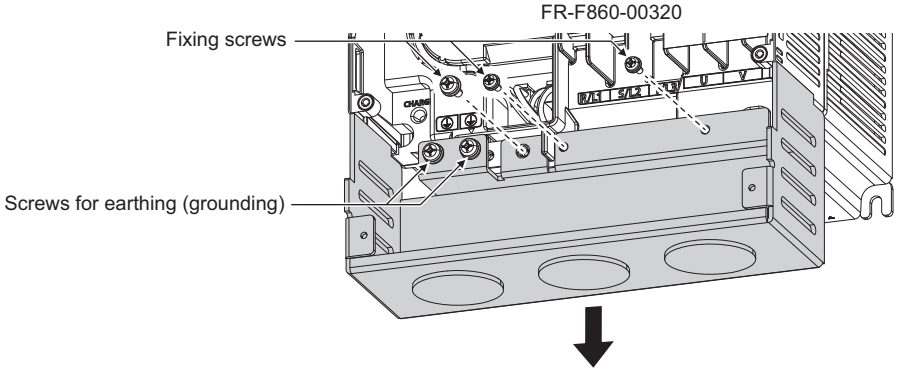
(1) Remove the inverter front cover (lower side). (For the details on how to remove the front cover (lower side), refer to the Instruction Manual (Detailed).)
(2) Loosen the fixing screws, and remove the front lid of the wiring cover.

FR-F860-00320



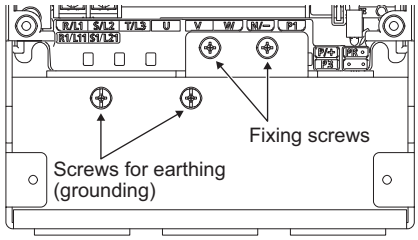
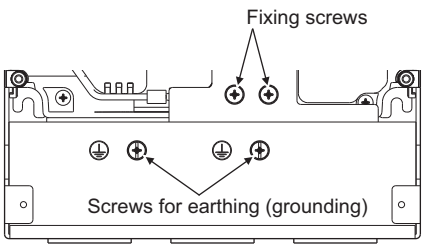
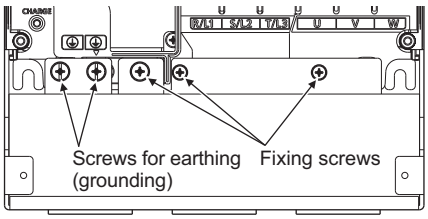
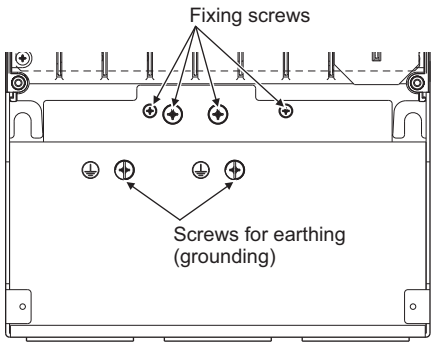
(3) Loosen the fixing screws that fix the wiring cover to the inverter, and remove the wiring cover.

FR-F860-00320



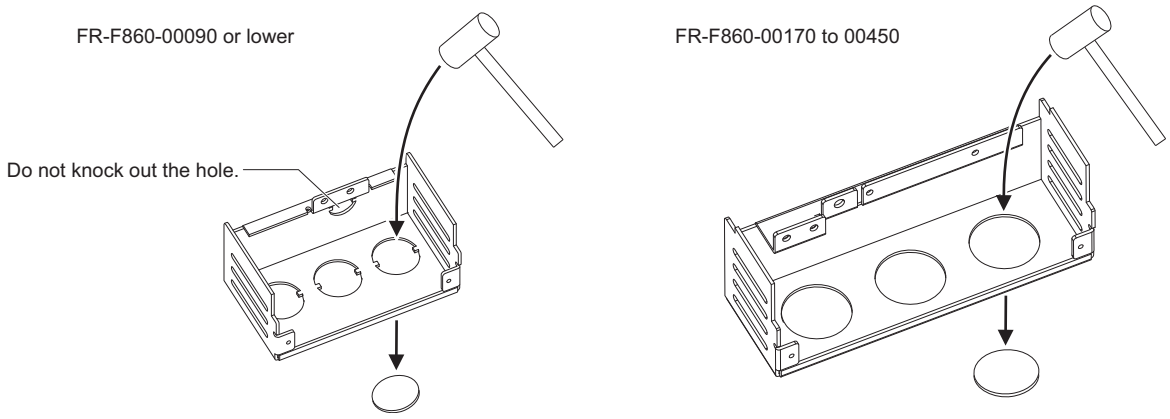
NOTE

• Always use fixing screws when attaching the wiring cover to the inverter. Otherwise, the inverter may be damaged.
The table below shows the locations of the fixing screws and the screws for earthing (grounding). Locations are shown for each capacity.

FR-F860-00027 to 00090	FR-F860-00170
	
FR-F860-00320	**FR-F860-00450**
	

• Punching out the knockout holes

(1) Punch out the knockout holes by firmly tapping it with an object, such as a hammer. Remove any sharp edges and burrs from knockout holes of the wiring cover.



(2) Conduit hubs must always be used to connect conduit to the enclosure knockout. The hub shall be assembled to the conduit before it is installed in the conduit box knockout opening.

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 to enter the inverter, conduits must be installed to the all knockout holes.

• Wiring cover hole diameters

Inverter capacity	Hole diameter (mm)	Number of holes	Applicable conduit size (Nominal diameter)
FR-F860-00027 to 00090	ϕ35	3	1
FR-F860-00170, 00320	ϕ44	3	1•1/4
FR-F860-00450	ϕ63	3	2

WARNING

● 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.

◆ Cable gauge of main circuit terminals and earth (ground) terminals

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, the voltage drop in the main circuit will cause the motor torque to decrease especially at a low speed. The following table indicates a selection example for the wiring length of 20 m.

◆ SLD rating (Pr.570 Multiple rating setting = "0")

• 600 V class (575 V input power supply)

Applicable inverter model	Terminal screw size *2	Tightening torque N•m	Crimp terminal				Cable gauge *1							
							HIV cables, etc. (mm^2)				AWG/MCM			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
FR-F860-00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2	14	14	14	14
FR-F860-00170	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2	14	14	14	14
FR-F860-00320	M5	2.5	5.5-5	5.5-5	8-5	5.5-5	5.5	5.5	8	5.5	10	10	8	10
FR-F860-00450	M6	4.4	14-6	14-6	14-6	14-6	14	14	14	14	6	6	4	6
FR-F860-00680	M8	7.8	22-8	22-8	22-8	22-8	22	22	22	22	4	4	2	4
FR-F860-01080	M8	7.8	38-8	38-8	38-8	22-8	38	38	38	22	1	1	1/0	4
FR-F860-01440	M10	14.7	60-10	60-10	60-10	38-10	60	60	60	38	1/0	1/0	1/0	1
FR-F860-01670	M10	14.7	60-10	60-10	60-10	38-10	60	60	60	38	2/0	2/0	2/0	1
FR-F860-02430	M10	14.7	80-10	80-10	80-10	38-10	80	80	80	38	4/0	250	4/0	1
FR-F860-02890	M12 (M10)	24.5	100-12	100-12	100-12	38-10	100	100	100	38	250	300	250	1
FR-F860-03360	M12 (M10)	24.5	125-12	125-12	125-12	38-10	125	125	125	38	2×2/0	2×2/0	2×2/0	1
FR-F860-04420	M12 (M10)	46	2×80-12	2×80-12	2×80-12	60-10	2×80	2×80	2×80	60	2×4/0	2×250	2×4/0	1/0

*1 The cables used should be 75°C copper cables. (For the use in the United States or Canada, refer to page 27.)

*2 The terminal screw size indicates the size of terminal screw for R/L1, S/L2, T/L3, U, V, W, PR, P/+, N/-, P1, P3, and the screw for earthing (grounding), and P/+ for option connection. A screw for earthing (grounding) of the FR-F860-02890 or higher is indicated in ( ).

◆ LD rating (Pr.570 Multiple rating setting = "1")

- 600 V class (575 V input power supply)

Applicable inverter model	Terminal screw size *2	Tightening torque N•m	Crimp terminal				Cable gauge *1							
							HIV cables, etc. (mm^2)				AWG/MCM			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
FR-F860-00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2	14	14	14	14
FR-F860-00170	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2	14	14	14	14
FR-F860-00320	M5	2.5	5.5-5	5.5-5	8-5	5.5-5	5.5	5.5	8	5.5	10	10	8	10
FR-F860-00450	M6	4.4	8-6	14-6	8-6	5.5-6	8	14	8	5.5	8	6	8	10
FR-F860-00680	M8	7.8	22-8	22-8	22-8	22-8	22	22	22	22	4	4	2	4
FR-F860-01080	M8	7.8	38-8	38-8	38-8	22-8	38	38	38	22	2	2	1/0	4
FR-F860-01440	M10	14.7	60-10	60-10	60-10	38-10	60	60	60	38	1/0	1/0	1/0	1
FR-F860-01670	M10	14.7	60-10	60-10	60-10	38-10	60	60	60	38	2/0	2/0	2/0	1
FR-F860-02430	M10	14.7	80-10	80-10	80-10	38-10	80	80	80	38	4/0	250	4/0	1
FR-F860-02890	M12 (M10)	24.5	100-12	100-12	100-12	38-10	100	100	100	38	250	300	250	1
FR-F860-03360	M12 (M10)	24.5	125-12	125-12	125-12	38-10	125	125	125	38	2×2/0	2×3/0	2×2/0	1
FR-F860-04420	M12 (M10)	46	2×80-12	2×80-12	2×80-12	60-10	2×80	2×80	2×80	60	2×4/0	2×250	2×4/0	1/0

*1 The cables used should be 75°C copper cables. (For the use in the United States or Canada, refer to page 27.)
*2 The terminal screw size indicates the size of terminal screw for R/L1, S/L2, T/L3, U, V, W, PR, P/+, N/-, P1, P3, and the screw for earthing (grounding), and P/+ for option connection. A screw for earthing (grounding) of the FR-F860-02890 or higher is indicated in ( ).

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

Line voltage drop [V] = $\sqrt{3}$ × wire resistance [mΩ/m] × wiring distance [m] × current [A] / 1000
Use a larger diameter cable when the wiring distance is long or when it is desired to decrease the voltage drop (torque reduction) in the low speed range.

NOTE

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

◆ Total wiring length

◆ With general-purpose motor

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

- When fast response current limit is enabled (**Pr.156** = "0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, or 30"), the wiring length should be within the value in the table below.

Pr.72 setting (carrier frequency)	FR-F860-00027	FR-F860-00061	FR-F860-00090	FR-F860-00170	FR-F860-00320 or higher
2 (2 kHz) or less	100 m	200 m	300 m	500 m	500 m
3 (3 kHz) or more	100 m	100 m	200 m	400 m	500 m

- When fast response current limit is disabled (**Pr.156** = "1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, or 31"), the wiring length should be within the value in the table below.

FR-F860-00027	FR-F860-00061	FR-F860-00090	FR-F860-00170 or higher
100 m	300 m	500 m	500 m

- Use a "600 V class inverter-driven insulation-enhanced motor" and set frequency in **Pr.72 PWM frequency selection** according to wiring length.

Wiring length 50 m or shorter	Wiring length 50 to 100 m	Wiring length longer than 100 m
15 (14.5 kHz) or lower	9 (9 kHz) or lower	4 (4 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 600 V class motor driven by an inverter under PM motor control, set "9" (6 kHz) or less in **Pr.72 PWM frequency selection**.

NOTE

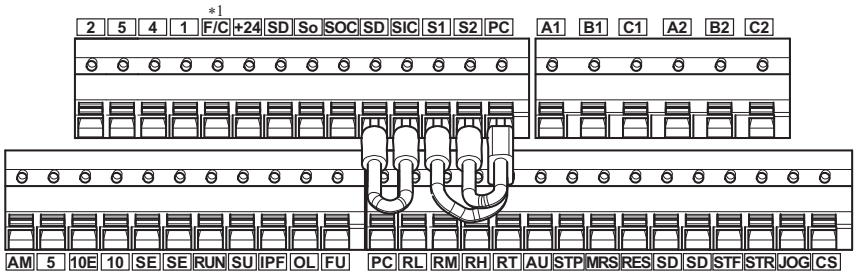
- Especially for long-distance wiring, the inverter may be affected by a charging current caused by stray capacitance of the wiring, leading to an activation of the overcurrent protection, malfunction of the fast-response current limit operation, or even to an inverter failure. If the fast-response current limit function malfunctions, disable this function.
  (**Pr.156 Stall prevention operation selection** Refer to Chapter 5 of the FR-F860 Instruction Manual (Detailed).)
- Refer to Chapter 3 in the FR-F860 Instruction Manual (Detailed) to drive a 600 V class motor by an inverter.

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

- Terminal screw size: M4
- Cable gauge: 0.75 mm^2 to 2 mm^2
- Tightening torque: 1.5 N•m

2.3 Control circuit terminal

◆ Terminal layout



Recommended cable gauge:
0.3 to 0.75 mm^2

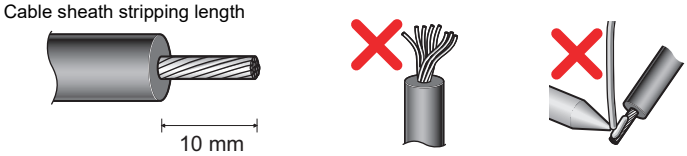
*1 This terminal functions as terminal CA.

◆ Wiring method

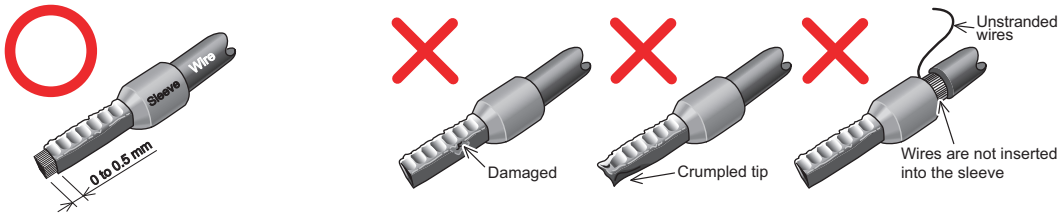
• Power supply connection

For the control circuit wiring, strip off the sheath of a cable, and use it with a crimp terminal. For a single wire, strip off the sheath of the wire and apply directly. Insert the crimp terminal or the single wire into a socket of the terminal.

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



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



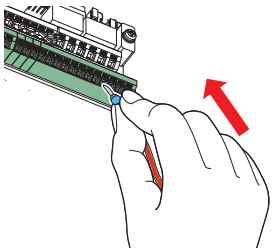
• Crimp terminals commercially available (as of October 2020)

Cable gauge (mm^2)	Ferrule terminal model			Manufacturer	Crimping tool name
	With insulation sleeve	Without insulation sleeve	For UL wire*1		
0.3	AI 0,34-10TQ	—	—	Phoenix Contact Co., Ltd.	CRIMPFOX 6
0.5	AI 0,5-10WH	—	AI 0,5-10WH-GB		
0.75	AI 0,75-10GY	A 0,75-10	AI 0,75-10GY-GB		
1	AI 1-10RD	A 1-10	AI 1-10RD/1000GB		
1.25, 1.5	AI 1,5-10BK	A 1,5-10	AI 1,5-10BK/1000GB*2		
0.75 (for two wires)	AI-TWIN 2×0,75-10GY	—	—		

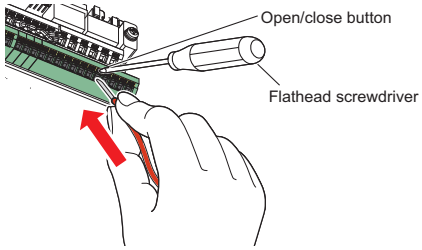
*1 A ferrule terminal with an insulation sleeve compatible with the MTW wire which has a thick wire insulation.
*2 Applicable to terminals A1, B1, C1, A2, B2, and C2.

Cable gauge (mm^2)	Blade terminal product number	Insulation cap product number	Manufacturer	Crimping tool product number
0.3 to 0.75	BT 0.75-11	VC 0.75	NICHIFU Co., Ltd.	NH 69

(3) Insert the wires into a socket.

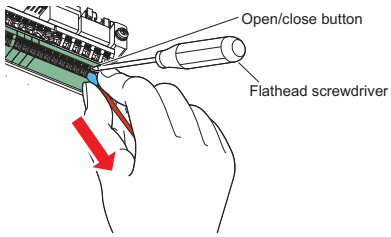


When using a single wire or stranded wires without a crimp terminal, push the open/close button all the way down with a flathead screwdriver, and insert the wire.



• Wire removal

Pull the wire while pressing down the open/close button firmly with a flathead screwdriver.



NOTE

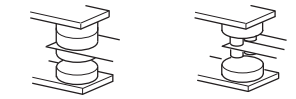
- When using stranded wires without a crimp terminal, twist enough to avoid short circuit with a nearby terminals or wires.
- During wiring, pulling out the wire forcefully without pushing the open/close button all the way down may damage the terminal block.
- Use a small flathead screwdriver (tip thickness: 0.4 mm, tip width: 2.5 mm).
  If a flathead screwdriver with a narrow tip is used, terminal block may be damaged.
  Commercially available products (as of October 2020) .

Name	Model	Manufacturer
Screwdriver	SZF 0- 0,4 x 2,5	Phoenix Contact Co., Ltd.

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

◆ Wiring precautions

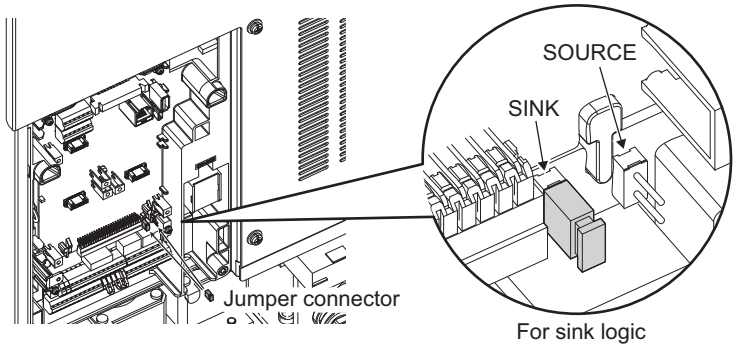
- It is recommended to use a cable of 0.3 to 0.75 mm^2 for connection to the control circuit terminals.
- The wiring length should be 30 m at the maximum.
- Use two or more parallel micro-signal contacts or twin contacts to prevent contact faults when using contact inputs since the control circuit input signals are micro-currents.



- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200 V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A1, B1, C1, A2, B2, and C2) via a relay coil, lamp, etc.
- When using an external power supply for transistor output, note the following points to prevent a malfunction caused by undesirable current.
  Do not connect any terminal SD on the inverter and the 0 V terminal of the external power supply (when the sink logic is selected).
  Do not connect terminal PC on the inverter and the +24 V terminal of the external power supply (when the source logic is selected).
  Do not install an external power source in parallel with the internal 24 VDC power source (connected to terminals PC and SD) to use them together.
  Refer to Chapter 2 of the Instruction Manual (Detailed) for the detail.

◆ Control logic (sink/source) change

Change the control logic of input signals as necessary.
To change the control logic, change the jumper connector position on the control circuit board.
Connect the jumper connector to the connector pin of the desired control logic.
The control logic of input signals is initially set to the sink logic (SINK).
(The output signals may be used in either the sink or source logic independently of the jumper connector position.)



For sink logic

◆ When supplying 24 V external power to the control circuit

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

◆ Applied 24 V external power specification

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

3 FAILSAFE SYSTEM WHICH USES THE INVERTER

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

◆ 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.

Interlock method	Check method	Used signals	Refer to
Inverter protective function operation	Operation check of an alarm contact. Circuit error detection by negative logic.	Fault (ALM) signal	Chapter 5 of the FR-F860 Instruction Manual (Detailed).
Inverter operating status	Operation ready signal check.	Inverter operation ready (RY) signal	Chapter 5 of the FR-F860 Instruction Manual (Detailed).
Inverter running status	Logic check of the start signal and running signal.	Start signal (STF signal, STR signal) Inverter running (RUN) signal	Chapter 5 of the FR-F860 Instruction Manual (Detailed).
Inverter running status	Logic check of the start signal and output current.	Start signal (STF signal, STR signal) Output current detection (Y12) signal	Chapter 5 of the FR-F860 Instruction Manual (Detailed).

◆ Backup method outside the inverter

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

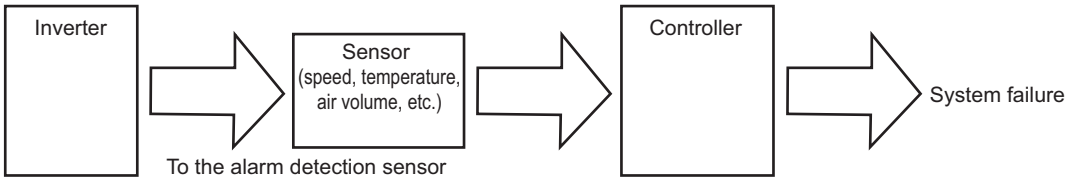
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as performing a check as below according to the level of importance of the system.

- 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.



4 PRECAUTIONS FOR USE OF THE INVERTER

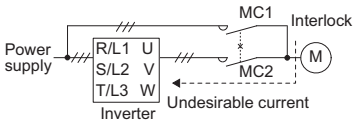
The FR-F800 series inverter is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product. Before starting operation, always recheck the following points.

- **Use crimp terminal with insulation sleeves to wire the power supply and the motor.**
- **Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.**
- **After wiring, wire offcuts must not be left in the inverter.**
  Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
  When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
- **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.
  Refer to page 11 for the recommended cable gauge.
- **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. (Refer to page 11.)
- **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. In such case, install a noise filter.

- **Electrical corrosion of the bearing**
  When a motor is driven by the inverter, axial voltage is generated on the motor bearing, which may cause electrical corrosion of the bearing in rare cases depending on: condition of the grease used for the bearing, 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 on the output side of the inverter.*1

    *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.

- **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 to trip or the capacitor and surge suppressor to be damaged. If any of the above devices is connected, immediately remove it.
- **For some short time after the power-OFF, a high voltage remains in the smoothing capacitor, and it is dangerous.**
  A smoothing capacitor holds high voltage some time after power-OFF. When accessing the inverter for inspection, wait for at least 10 minutes after the power supply has been switched OFF, and then make sure that the voltage across the main circuit terminals P/+ and N/- of the inverter is low enough using a tester, etc.
- **If the alarm lamp blinks, turn OFF the 24 V external power supply before performing wiring.**
- **A short circuit or earth (ground) fault on the inverter's output side may damage the inverter module.**
  - Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits caused by peripheral circuit inadequacy or an earth (ground) fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter module.
  - Fully check the to-earth (ground) insulation and phase-to-phase insulation of the inverter's output side before power-ON.
    Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance, etc.
- **Do not use the magnetic contactor (MC) on the inverter's input side to start/stop the inverter.**
  Since repeated inrush currents at power ON will shorten the life of the converter circuit (1,000,000 times for others), frequent starts and stops of the input side MC must be avoided. Turn ON/OFF the inverter's start signals (STF, STR) to run/stop the inverter. (Refer to **page 7**.)
- **Do not apply a voltage higher than the permissible voltage to the inverter I/O signal circuits.**
  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. Especially check the wiring to prevent the speed setting potentiometer from being connected incorrectly to short circuit terminals 10E and 5.
- **To use the commercial power supply during general-purpose motor operation, be sure to provide electrical and mechanical interlocks between the electronic bypass contactors MC1 and MC2.**
  When using a switching circuit as shown right, chattering due to mis-configured sequence or arc generated at switching may allow undesirable current to flow in and damage the inverter. Mis-wiring may also damage the inverter.
  (The commercial power supply operation is not available with PM motors.)



- **If the machine must not be restarted when power is restored after a power failure, provide an MC in 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.
- **MC on the inverter's input side**
  On the inverter's input side, connect an MC for the following purposes. (For the selection, refer to Chapter 2 of the FR-F860 Instruction Manual (Detailed).)
  - To disconnect the inverter from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.).
  - To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure.
  - To separate the inverter from the power supply to ensure safe maintenance and inspection work.

  If using an MC for emergency stop during operation, select an MC regarding the inverter input side current as JEM 1038-AC-3 class rated current.
- **Handling of the magnetic contactor on the inverter's output side**
  Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned ON while the inverter is operating, overcurrent protection of the inverter and such will activate. When providing MCs to use the commercial power supply during general-purpose motor operation, switch the MCs after both the inverter and motor stop.
  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. Before wiring or inspection, confirm that the 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.
- **Countermeasures against inverter-generated EMI**
  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 signal cables as far away as possible from power cables (inverter I/O cables).
  - Use shielded cables.
  - Install a ferrite core on the signal cable.
- **Instructions for 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 a general-purpose motor, use an inverter of a higher capacity (up to 2 ranks). For an IPM motor, use an inverter and IPM motor of higher capacities.
- **Make sure that the specifications and rating match the system requirements.**

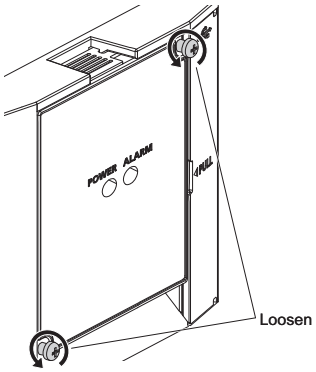
5 INVERTER FUNCTION SETTING

5.1 Operation panel (FR-LU08)

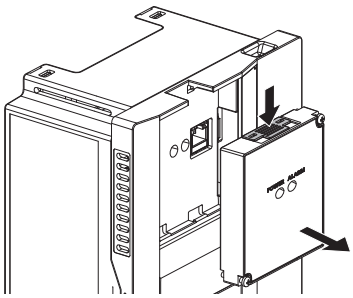
The operation panel can be used for setting the inverter parameters, monitoring various items, and checking fault indications.

◆ Removal and installation of the accessory cover

- Loosen the two fixing screws on the accessory cover. (These screws cannot be removed.)



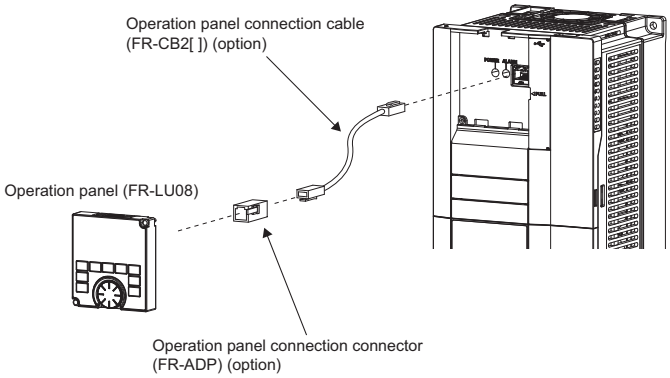
- Push the upper edge of the accessory cover and pull the accessory cover to remove.



- To install the accessory cover, fit it securely and tighten the screws. (Tightening torque: 0.40 to 0.45 N•m)

◆ Installing the operation panel on the enclosure surface

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



NOTE

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

Name	Model	Manufacturer
Communication cable	SGLPEV-T (Cat5e/300 m) 24AWG × 4P	Mitsubishi Cable Industries, Ltd.
RJ-45 connector	5-554720-3	Tyco Electronics

- For the details of the FR-LU08, refer to the FR-LU08 Instruction Manual.

5.2 Parameter list

For simple variable-speed operation of the inverter, the initial values of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be performed from the operation panel.

Pr.	Name	Setting range	Initial value
0*8	Torque boost	0 to 30%	3%/2%/1%*1
1*8	Maximum frequency	0 to 120Hz	120Hz*2
			60Hz*3
2*8	Minimum frequency	0 to 120Hz	0Hz
3*8	Base frequency	0 to 590Hz	60Hz
4*8	Multi-speed setting (high speed)	0 to 590Hz	60Hz
5*8	Multi-speed setting (middle speed)	0 to 590Hz	30Hz
6*8	Multi-speed setting (low speed)	0 to 590Hz	10Hz
7*8	Acceleration time	0 to 3600s	5s*4
			15s*5
8*8	Deceleration time	0 to 3600s	10s*4
			30s*5
9*8	Electronic thermal O/L relay	0 to 500A*2	Inverter rated current
		0 to 3600A*3	
10	DC injection brake operation frequency	0 to 120Hz, 9999	3Hz
11	DC injection brake operation time	0 to 10s, 8888	0.5s
12	DC injection brake operation voltage	0 to 30%	1%
13	Starting frequency	0 to 60Hz	0.5Hz
14	Load pattern selection	0, 1, 12 to 15	1
15*8	Jog frequency	0 to 590Hz	5Hz
16*8	Jog acceleration/ deceleration time	0 to 3600s	0.5s
17	MRS input selection	0, 2, 4	0
18	High speed maximum frequency	0 to 590Hz	120Hz*2
			60Hz*3
19	Base frequency voltage	0 to 1000V, 8888, 9999	9999
20	Acceleration/ deceleration reference frequency	1 to 590Hz	60Hz
21	Acceleration/ deceleration time increments	0, 1	0
22	Stall prevention operation level (Torque limit level)	0 to 400%	110%
23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	9999
24 to 27	Multi-speed setting (4 speed to 7 speed)	0 to 590Hz, 9999	9999
28	Multi-speed input compensation selection	0, 1	0
29	Acceleration/ deceleration pattern selection	0 to 3, 6	0
30	Regenerative function selection	0 to 2, 10, 11, 20, 21, 100 to 102, 110, 111, 120, 121	0
31	Frequency jump 1A	0 to 590Hz, 9999	9999
32	Frequency jump 1B		9999
33	Frequency jump 2A		9999
34	Frequency jump 2B		9999
35	Frequency jump 3A		9999
36	Frequency jump 3B		9999
37	Speed display	0, 1 to 9998	0
41	Up-to-frequency sensitivity	0 to 100%	10%
42	Output frequency detection	0 to 590Hz	6Hz
43	Output frequency detection for reverse rotation	0 to 590Hz, 9999	9999
44	Second acceleration/ deceleration time	0 to 3600s	5s
45	Second deceleration time	0 to 3600s, 9999	9999
46	Second torque boost	0 to 30%, 9999	9999
47	Second V/F (base frequency)	0 to 590Hz, 9999	9999
48	Second stall prevention operation level	0 to 400%	110%
49	Second stall prevention operation frequency	0 to 590Hz, 9999	0Hz
50	Second output frequency detection	0 to 590Hz	30Hz

Pr.	Name	Setting range	Initial value
51	Second electronic thermal O/L relay	0 to 500A, 9999*2	9999
		0 to 3600A, 9999*3	
52	Operation panel main monitor selection	0, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100	0
54	CA terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52, 53, 61, 62, 67, 69, 70, 85, 87 to 90, 92, 93, 95, 98	1
55	Frequency monitoring reference	0 to 590Hz	60Hz
56	Current monitoring reference	0 to 500A*2	Inverter rated current
		0 to 3600A*3	
57	Restart coasting time	0, 0.1 to 30s, 9999	9999
58	Restart cushion time	0 to 60s	1s
59	Remote function selection	0 to 3, 11 to 13	0
60	Energy saving control selection	0, 4, 9	0
65	Retry selection	0 to 5	0
66	Stall prevention operation reduction starting frequency	0 to 590Hz	60Hz
67	Number of retries at fault occurrence	0 to 10, 101 to 110	0
68	Retry waiting time	0.1 to 600s	1s
69	Retry count display erase	0	0
70	Parameter for manufacturer setting. Do not set.		
71	Applied motor	0 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094	0
72	PWM frequency selection	0 to 15*2	2
		0 to 6, 25*3	
73	Analog input selection	0 to 7, 10 to 17	1
74	Input filter time constant	0 to 8	1
75	Reset selection/ disconnected PU detection/PU stop selection	0 to 3, 14 to 17, 1000 to 1003, 1014 to 1017*2	14
		0 to 3, 14 to 17, 100 to 103, 114 to 117, 1000 to 1003, 1014 to 1017, 1100 to 1103, 1114 to 1117*3	
76	Fault code output selection	0 to 2	0
77	Parameter write selection	0 to 2	0
78	Reverse rotation prevention selection	0 to 2	0
79*8	Operation mode selection	0 to 4, 6, 7	0
80	Motor capacity	0.4 to 55kW, 9999*2	9999
		0 to 3600kW, 9999*3	
81	Number of motor poles	2, 4, 6, 8, 10, 12, 9999	9999
82	Motor excitation current	0 to 500A, 9999*2	9999
		0 to 3600A, 9999*3	
83	Rated motor voltage	0 to 1000V	575V
84	Rated motor frequency	10 to 400Hz, 9999	9999
85	Excitation current break point	0 to 400Hz, 9999	9999
86	Excitation current low-speed scaling factor	0 to 300%, 9999	9999
89	Speed control gain (Advanced magnetic flux vector)	0 to 200%, 9999	9999
90	Motor constant (R1)	0 to 50Ω, 9999 *2	9999
		0 to 400mΩ, 9999*3	

Pr.	Name	Setting range	Initial value
91	Motor constant (R2)	0 to 50Ω, 9999*2	9999
		0 to 400mΩ, 9999*3	
92	Motor constant (L1)/d-axis inductance (Ld)	0 to 6000mH, 9999*2	9999
		0 to 400mH, 9999*3	
93	Motor constant (L2)/q-axis inductance (Lq)	0 to 6000mH, 9999*2	9999
		0 to 400mH, 9999*3	
94	Motor constant (X)	0 to 100%, 9999	9999
95	Online auto tuning selection	0, 1	0
96	Auto tuning setting/status	0, 1, 11, 101	0
100	V/F1 (first frequency)	0 to 590Hz, 9999	9999
101	V/F1 (first frequency voltage)	0 to 1000V	0V
102	V/F2 (second frequency)	0 to 590Hz, 9999	9999
103	V/F2 (second frequency voltage)	0 to 1000V	0V
104	V/F3 (third frequency)	0 to 590Hz, 9999	9999
105	V/F3 (third frequency voltage)	0 to 1000V	0V
106	V/F4 (fourth frequency)	0 to 590Hz, 9999	9999
107	V/F4 (fourth frequency voltage)	0 to 1000V	0V
108	V/F5 (fifth frequency)	0 to 590Hz, 9999	9999
109	V/F5 (fifth frequency voltage)	0 to 1000V	0V
111	Check valve deceleration time	0 to 3600s, 9999	9999
117	PU communication station number	0 to 31	0
118	PU communication speed	48, 96, 192, 384, 576, 768, 1152	192
119	PU communication stop bit length / data length	0, 1, 10, 11	1
120	PU communication parity check	0 to 2	2
121	Number of PU communication retries	0 to 10, 9999	1
122	PU communication check time interval	0, 0.1 to 999.8s, 9999	9999
123	PU communication waiting time setting	0 to 150ms, 9999	9999
124	PU communication CR/ LF selection	0 to 2	1
125*8	Terminal 2 frequency setting gain frequency	0 to 590Hz	60Hz
126*8	Terminal 4 frequency setting gain frequency	0 to 590Hz	60Hz
127	PID control automatic switchover frequency	0 to 590Hz, 9999	9999
128	PID action selection	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	0
129	PID proportional band	0.1 to 1000%, 9999	100%
130	PID integral time	0.1 to 3600s, 9999	1s
131	PID upper limit	0 to 100%, 9999	9999
132	PID lower limit	0 to 100%, 9999	9999
133	PID action set point	0 to 100%, 9999	9999
134	PID differential time	0.01 to 10s, 9999	9999
135	Electronic bypass sequence selection	0, 1	0
136	MC switchover interlock time	0 to 100s	1s
137	Start waiting time	0 to 100s	0.5s
138	Bypass selection at a fault	0, 1	0
139	Automatic switchover frequency from inverter to bypass operation	0 to 60Hz, 9999	9999
140	Backlash acceleration stopping frequency	0 to 590Hz	1Hz
141	Backlash acceleration stopping time	0 to 360s	0.5s
142	Backlash deceleration stopping frequency	0 to 590Hz	1Hz
143	Backlash deceleration stopping time	0 to 360s	0.5s

Parameter list

Pr.	Name	Setting range	Initial value
144	Speed setting switchover	0, 2, 4, 6, 8, 10, 12, 102, 104, 106, 108, 110, 112	4
145	PU display language selection	0 to 7	—
147	Acceleration/ deceleration time switching frequency	0 to 590Hz, 9999	9999
148	Stall prevention level at 0 V input	0 to 400%	110%
149	Stall prevention level at 10 V input	0 to 400%	120%
150	Output current detection level	0 to 400%	110%
151	Output current detection signal delay time	0 to 10s	0s
152	Zero current detection level	0 to 400%	5%
153	Zero current detection time	0 to 10s	0.5s
154	Voltage reduction selection during stall prevention operation	0, 1, 10, 11	1
155	RT signal function validity condition selection	0, 10	0
156	Stall prevention operation selection	0 to 31, 100, 101	0
157	OL signal output timer	0 to 25s, 9999	0s
158	AM terminal function selection	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52 to 54, 61, 62, 67, 69, 70, 86 to 96, 98	1
159	Automatic switchover frequency range from bypass to inverter operation	0 to 10Hz, 9999	9999
160*8	User group read selection	0, 1, 9999	0
161	Parameter for manufacturer setting. Do not set.		
162	Automatic restart after instantaneous power failure selection	0 to 3, 10 to 13, 1000 to 1003, 1010 to 1013	0
163	First cushion time for restart	0 to 20s	0s
164	First cushion voltage for restart	0 to 100%	0%
165	Stall prevention operation level for restart	0 to 400%	110%
166	Output current detection signal retention time	0 to 10s, 9999	0.1s
167	Output current detection operation selection	0, 1, 10, 11	0
168	Parameter for manufacturer setting. Do not set.		
169			
170	Watt-hour meter clear	0, 10, 9999	9999
171	Operation hour meter clear	0, 9999	9999
172	User group registered display/batch clear	9999, (0 to 16)	0
173	User group registration	0 to 1999, 9999	9999
174	User group clear	0 to 1999, 9999	9999
178	STF terminal function selection	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 33, 37, 46 to 48, 50, 51, 57, 58, 60 to 62, 64 to 67, 70 to 73, 77 to 81, 84, 94 to 98, 128, 129, 9999*6	60
179	STR terminal function selection		61
180	RL terminal function selection		0
181	RM terminal function selection		1
182	RH terminal function selection		2
183	RT terminal function selection		3
184	AU terminal function selection		4
185	JOG terminal function selection		5
186	CS terminal function selection		9999
187	MRS terminal function selection		24
188	STOP terminal function selection		25
189	RES terminal function selection		62

Pr.	Name	Setting range	Initial value
190	RUN terminal function selection	0 to 5, 7, 8, 10 to 19, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 68, 70 to 80, 82, 85, 90 to 96, 98 to 105, 107, 108, 110 to 116, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 168, 170 to 180, 182, 185, 190 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 242, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 342, 9999*7	0
191	SU terminal function selection		1
192	IPF terminal function selection		2
193	OL terminal function selection		3
194	FU terminal function selection		4
195	ABC1 terminal function selection		99
196	ABC2 terminal function selection		9999
232 to 239	Multi-speed setting (8 speed to 15 speed)	0 to 590Hz, 9999	9999
240	Soft-PWM operation selection	0, 1	1
241	Analog input display unit switchover	0, 1	0
242	Terminal 1 added compensation amount (terminal 2)	0 to 100%	100%
243	Terminal 1 added compensation amount (terminal 4)	0 to 100%	75%
244	Cooling fan operation selection	0, 1, 101 to 105, 1000, 1001, 1101 to 1105	1
245	Rated slip	0 to 50%, 9999	9999
246	Slip compensation time constant	0.01 to 10s	0.5s
247	Constant-power range slip compensation selection	0, 9999	9999
248	Self power management selection	0 to 2	0
249	Earth (ground) fault detection at start	0, 1	0
250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	9999
251	Output phase loss protection selection	0, 1	1
252	Override bias	0 to 200%	50%
253	Override gain	0 to 200%	150%
254	Main circuit power OFF waiting time	1 to 3600s, 9999	600s
255	Life alarm status display	(0 to 255)	0
256	Inrush current limit circuit life display	(0 to 100%)	100%
257	Control circuit capacitor life display	(0 to 100%)	100%
258	Main circuit capacitor life display	(0 to 100%)	100%
259	Main circuit capacitor life measuring	0, 1, 11	0
260	PWM frequency automatic switchover	0, 1	1
261	Power failure stop selection	0 to 2, 11, 12, 21, 22	0
262	Subtracted frequency at deceleration start	0 to 20Hz	3Hz
263	Subtraction starting frequency	0 to 590Hz, 9999	60Hz
264	Power-failure deceleration time 1	0 to 3600s	5s
265	Power-failure deceleration time 2	0 to 3600s, 9999	9999
266	Power failure deceleration time switchover frequency	0 to 590Hz	60Hz
267	Terminal 4 input selection	0 to 2	0
268	Monitor decimal digits selection	0, 1, 9999	9999
269	Parameter for manufacturer setting. Do not set.		
289	Inverter output terminal filter	5 to 50ms, 9999	9999
290	Monitor negative output selection	0 to 7	0
291	Pulse train I/O selection	0, 1	0
294	UV avoidance voltage gain	0 to 200%	100%
295	Parameter for manufacturer setting. Do not set.		
296	Password lock level	0 to 6, 99, 100 to 106, 199, 9999	9999
297	Password lock/unlock	(0 to 5), 1000 to 9998, 9999	9999

Pr.	Name	Setting range	Initial value
298	Frequency search gain	0 to 32767, 9999	9999
299	Rotation direction detection selection at restarting	0, 1, 9999	9999
313*9	DO0 output selection	0 to 5, 7, 8, 10 to 19, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 96, 98 to 105, 107, 108, 110 to 116, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 166, 168,170 to 180, 185 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 242, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 342, 9999	9999
314*9	DO1 output selection		9999
315*9	DO2 output selection		9999
316*9	DO3 output selection		9999
317*9	DO4 output selection		9999
318*9	DO5 output selection		9999
319*9	DO6 output selection		9999
320*9	RA1 output selection	0 to 5, 7, 8, 10 to 19, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 91, 94 to 96, 98, 99, 200 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 9999	0
321*9	RA2 output selection		1
322*9	RA3 output selection		2
338	Communication operation command source	0, 1	0
339	Communication speed command source	0 to 2	0
340	Communication startup mode selection	0 to 2, 10, 12	0
342	Communication EEPROM write selection	0, 1	0
349	Communication reset selection/Ready bit status selection/Reset selection after inverter faults are cleared/ DriveControl writing restriction selection	0, 1, 100, 101	0
374	Overspeed detection level	0 to 590Hz, 9999	9999
384	Input pulse division scaling factor	0 to 250	0
385	Frequency for zero input pulse	0 to 590Hz	0
386	Frequency for maximum input pulse	0 to 590Hz	60Hz
390	% setting reference frequency	1 to 590Hz	60Hz
414	PLC function operation selection	0 to 2, 11, 12	0
415	Inverter operation lock mode setting	0, 1	0
416	Pre-scale function selection	0 to 5	0
417	Pre-scale setting value	0 to 32767	1
450	Second applied motor	0, 1, 3 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094, 9999	9999
453	Second motor capacity	0.4 to 55kW, 9999*2	9999
		0 to 3600kW, 9999*3	
454	Number of second motor poles	2, 4, 6, 8, 10, 12, 9999	9999
455	Second motor excitation current	0 to 500A, 9999*2	9999
		0 to 3600A, 9999*3	
456	Rated second motor voltage	0 to 1000V	575V
457	Rated second motor frequency	10 to 400Hz, 9999	9999

Pr.	Name	Setting range	Initial value
458	Second motor constant (R1)	0 to 50Ω, 9999*2 0 to 400mΩ, 9999*3	9999
459	Second motor constant (R2)	0 to 50Ω, 9999*2 0 to 400mΩ, 9999*3	9999
460	Second motor constant (L1) / d-axis inductance (Ld)	0 to 6000mH, 9999*2 0 to 400mH, 9999*3	9999
461	Second motor constant (L2) / q-axis inductance (Lq)	0 to 6000mH, 9999*2 0 to 400mH, 9999*3	9999
462	Second motor constant (X)	0 to 100%, 9999	9999
463	Second motor auto tuning setting/status	0, 1, 11, 101	0
495	Remote output selection	0, 1, 10, 11	0
496	Remote output data 1	0 to 4095	0
497	Remote output data 2	0 to 4095	0
498	PLC function flash memory clear	0, 9696 (0 to 9999)	0
502	Stop mode selection at communication error	0 to 4	0
503	Maintenance timer 1	0(1 to 9998)	0
504	Maintenance timer 1 warning output set time	0 to 9998, 9999	9999
505	Speed setting reference	1 to 590Hz	60Hz
506	Display estimated main circuit capacitor residual life	(0 to 100%)	100%
507	Display/reset ABC1 relay contact life	(0 to 100%)	100%
508	Display/reset ABC2 relay contact life	(0 to 100%)	100%
514	Emergency drive dedicated retry waiting time	0.1 to 600s, 9999	9999
515	Emergency drive dedicated retry count	1 to 200, 9999	1
522	Output stop frequency	0 to 590Hz, 9999	9999
523	Emergency drive mode selection	100, 111, 112, 121, 122, 123, 124, 200, 211, 212, 221, 222, 223, 224, 300, 311, 312, 321, 322, 323, 324, 400, 411, 412, 421, 422, 423, 424, 9999	9999
524	Emergency drive running speed	0 to 590Hz/ 0 to 100%, 9999	9999
541	Frequency command sign selection	0, 1	0
544	CC-Link extended setting	0, 1, 12, 14, 18, 24, 28, 100, 112, 114, 118, 128	0
547	USB communication station number	0 to 31	0
548	USB communication check time interval	0 to 999.8s, 9999	9999
550	NET mode operation command source selection	0, 1, 5, 9999	9999
551	PU mode operation command source selection	1 to 3, 5, 9999	9999
552	Frequency jump range	0 to 30Hz, 9999	9999
553	PID deviation limit	0 to 100%, 9999	9999
554	PID signal operation selection	0 to 7, 10 to 17	0
555	Current average time	0.1 to 1.0s	1s
556	Data output mask time	0 to 20s	0s
557	Current average value monitor signal output reference current	0 to 500A*2 0 to 3600A*3	Inverter rated current
560	Second frequency search gain	0 to 32767, 9999	9999
561	PTC thermistor protection level	0.5 to 30kΩ, 9999	9999
563	Energization time carrying-over times	(0 to 65535)	0
564	Operating time carrying-over times	(0 to 65535)	0
565	Second motor excitation current break point	0 to 400Hz, 9999	9999
566	Second motor excitation current low-speed scaling factor	0 to 300%, 9999	9999
569	Second motor speed control gain	0 to 200%, 9999	9999
570	Multiple rating setting	0, 1	0
571	Holding time at a start	0 to 10s, 9999	9999

Pr.	Name	Setting range	Initial value
573	4 mA input check selection	1 to 4, 11 to 14, 21 to 24, 9999	9999
574	Second motor online auto tuning	0, 1	0
575	Output interruption detection time	0 to 3600s, 9999	1s
576	Output interruption detection level	0 to 590Hz	0Hz
577	Output interruption cancel level	900 to 1100%	1000%
578	Auxiliary motor operation selection	0 to 3	0
579	Motor connection function selection	0 to 3	0
580	MC switching interlock time (multi-pump)	0 to 100s	1s
581	Start waiting time (multi-pump)	0 to 100s	1s
582	Auxiliary motor connection-time deceleration time	0 to 3600s, 9999	1s
583	Auxiliary motor disconnection-time acceleration time	0 to 3600s, 9999	1s
584	Auxiliary motor 1 starting frequency	0 to 590Hz	60Hz
585	Auxiliary motor 2 starting frequency	0 to 590Hz	60Hz
586	Auxiliary motor 3 starting frequency	0 to 590Hz	60Hz
587	Auxiliary motor 1 stopping frequency	0 to 590Hz	0Hz
588	Auxiliary motor 2 stopping frequency	0 to 590Hz	0Hz
589	Auxiliary motor 3 stopping frequency	0 to 590Hz	0Hz
590	Auxiliary motor start detection time	0 to 3600s	5s
591	Auxiliary motor stop detection time	0 to 3600s	5s
592	Traverse function selection	0 to 2	0
593	Maximum amplitude amount	0 to 25%	10%
594	Amplitude compensation amount during deceleration	0 to 50%	10%
595	Amplitude compensation amount during acceleration	0 to 50%	10%
596	Amplitude acceleration time	0.1 to 3600s	5s
597	Amplitude deceleration time	0.1 to 3600s	5s
599	X10 terminal input selection	0,1	0
600	First free thermal reduction frequency 1	0 to 590Hz, 9999	9999
601	First free thermal reduction ratio 1	1 to 100%	100%
602	First free thermal reduction frequency 2	0 to 590Hz, 9999	9999
603	First free thermal reduction ratio 2	1 to 100%	100%
604	First free thermal reduction frequency 3	0 to 590Hz, 9999	9999
606	Power failure stop external signal input selection	0, 1	1
607	Motor permissible load level	110 to 250%	150%
608	Second motor permissible load level	110 to 250%, 9999	9999
609	PID set point/deviation input selection	1 to 5	2
610	PID measured value input selection	1 to 5, 101 to 105	3
611	Acceleration time at a restart	0 to 3600s, 9999	9999
617	Reverse rotation excitation current low-speed scaling factor	0 to 300%, 9999	9999
653	Speed smoothing control	0 to 200%	0
654	Speed smoothing cutoff frequency	0 to 120Hz	20Hz
655	Analog remote output selection	0, 1, 10, 11	0
656	Analog remote output 1	800 to 1200%	1000%
657	Analog remote output 2		1000%
658	Analog remote output 3		1000%
659	Analog remote output 4		1000%
660	Increased magnetic excitation deceleration operation selection	0, 1	0
661	Magnetic excitation increase rate	0 to 40%, 9999	9999

Pr.	Name	Setting range	Initial value
662	Increased magnetic excitation current level	0 to 300%	100%
663	Control circuit temperature signal output level	0 to 100°C	0°C
665	Regeneration avoidance frequency gain	0 to 200%	100%
668	Power failure stop frequency gain	0 to 200%	100%
675	User parameter auto storage function selection	1, 9999	9999
684	Tuning data unit switchover	0, 1	0
686	Maintenance timer 2	0 (1 to 9998)	0
687	Maintenance timer 2 warning output set time	0 to 9998, 9999	9999
688	Maintenance timer 3	0 (1 to 9998)	0
689	Maintenance timer 3 warning output set time	0 to 9998, 9999	9999
692	Second free thermal reduction frequency 1	0 to 590Hz, 9999	9999
693	Second free thermal reduction ratio 1	1 to 100%	100%
694	Second free thermal reduction frequency 2	0 to 590Hz, 9999	9999
695	Second free thermal reduction ratio 2	1 to 100%	100%
696	Second free thermal reduction frequency 3	0 to 590Hz, 9999	9999
699	Input terminal filter	5 to 50ms, 9999	9999
702	Maximum motor frequency	0 to 400Hz, 9999	9999
706	Induced voltage constant (phi f)	0 to 5000mV/ (rad/s), 9999	9999
707	Motor inertia (integer)	10 to 999, 9999	9999
711	Motor Ld decay ratio	0 to 100%, 9999	9999
712	Motor Lq decay ratio	0 to 100%, 9999	9999
717	Starting resistance tuning compensation	0 to 200%, 9999	9999
721	Starting magnetic pole position detection pulse width	0 to 6000μs, 10000 to 16000μs, 9999	9999
724	Motor inertia (exponent)	0 to 7, 9999	9999
725	Motor protection current level	100 to 500%, 9999	9999
726	Auto Baudrate/Max Master	0 to 255	255
727	Max Info Frames	1 to 255	1
728	Device instance number (Upper 3 digits)	0 to 419	0
729	Device instance number (Lower 4 digits)	0 to 9999	0
738	Second motor induced voltage constant (phi f)	0 to 5000mV/ (rad/s), 9999	9999
739	Second motor Ld decay ratio	0 to 100%, 9999	9999
740	Second motor Lq decay ratio	0 to 100%, 9999	9999
741	Second starting resistance tuning compensation	0 to 200%, 9999	9999
742	Second motor magnetic pole detection pulse width	0 to 6000μs, 10000 to 16000μs, 9999	9999
743	Second motor maximum frequency	0 to 400Hz, 9999	9999
744	Second motor inertia (integer)	10 to 999, 9999	9999
745	Second motor inertia (exponent)	0 to 7, 9999	9999
746	Second motor protection current level	100 to 500%, 9999	9999
753	Second PID action selection	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	0
754	Second PID control automatic switchover frequency	0 to 590Hz, 9999	9999
755	Second PID action set point	0 to 100%, 9999	9999
756	Second PID proportional band	0.1 to 1000%, 9999	100%
757	Second PID integral time	0.1 to 3600s, 9999	1s
758	Second PID differential time	0.01 to 10.00s, 9999	9999
759	PID unit selection	0 to 43, 9999	9999
760	Pre-charge fault selection	0, 1	0
761	Pre-charge ending level	0 to 100%, 9999	9999
762	Pre-charge ending time	0 to 3600s, 9999	9999

Pr.	Name	Setting range	Initial value
763	Pre-charge upper detection level	0 to 100%, 9999	9999
764	Pre-charge time limit	0 to 3600s, 9999	9999
765	Second pre-charge fault selection	0, 1	0
766	Second pre-charge ending level	0 to 100%, 9999	9999
767	Second pre-charge ending time	0 to 3600s, 9999	9999
768	Second pre-charge upper detection level	0 to 100%, 9999	9999
769	Second pre-charge time limit	0 to 3600s, 9999	9999
774	Operation panel monitor selection 1	1 to 3, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98,100, 9999	9999
775	Operation panel monitor selection 2		9999
776	Operation panel monitor selection 3		9999
777	4 mA input check operation frequency	0 to 590Hz, 9999	9999
778	4 mA input check filter	0 to 10s	0s
779	Operation frequency during communication error	0 to 590Hz, 9999	9999
791	Acceleration time in low-speed range	0 to 3600s, 9999	9999
792	Deceleration time in low-speed range	0 to 3600s, 9999	9999
799	Pulse increment setting for output power	0.1, 1, 10, 100, 1000kWh	1kWh
800	Control method selection	9, 20, 109, 110	20
820	Speed control P gain 1	0 to 1000%	25%
821	Speed control integral time 1	0 to 20s	0.333s
822	Speed setting filter 1	0 to 5s, 9999	9999
824	Torque control P gain 1 (current loop proportional gain)	0 to 500%	50%
825	Torque control integral time 1 (current loop integral time)	0 to 500ms	40ms
827	Torque detection filter 1	0 to 0.1s	0s
828	Parameter for manufacturer setting. Do not set.		
830	Speed control P gain 2	0 to 1000%, 9999	9999
831	Speed control integral time 2	0 to 20s, 9999	9999
832	Speed setting filter 2	0 to 5s, 9999	9999
834	Torque control P gain 2	0 to 500%, 9999	9999
835	Torque control integral time 2	0 to 500ms, 9999	9999
837	Torque detection filter 2	0 to 0.1s, 9999	9999
849	Analog input offset adjustment	0 to 200%	100%
858	Terminal 4 function assignment	0, 4, 9999	0
859	Torque current/Rated PM motor current	0 to 500A, 9999*2 0 to 3600A, 9999*3	9999
860	Second motor torque current/Rated PM motor current	0 to 500A, 9999*2 0 to 3600A, 9999*3	9999
864	Torque detection	0 to 400%	150%
866	Torque monitoring reference	0 to 400%	150%
867	AM output filter	0 to 5s	0.01s
868	Terminal 1 function assignment	0, 4, 9999	0
869	Current output filter	0 to 5s	0.02s
870	Speed detection hysteresis	0 to 5Hz	0Hz
872	Input phase loss protection selection	0, 1	0
874	OLT level setting	0 to 400%	110%
882	Regeneration avoidance operation selection	0 to 2	0
883	Regeneration avoidance operation level	300 to 1200V	940VDC
884	Regeneration avoidance at deceleration detection sensitivity	0 to 5	0
885	Regeneration avoidance compensation frequency limit value	0 to 590Hz, 9999	6Hz
886	Regeneration avoidance voltage gain	0 to 200%	100%
888	Free parameter 1	0 to 9999	9999
889	Free parameter 2	0 to 9999	9999

Pr.	Name	Setting range	Initial value
890	Internal storage device status indication	(0 to 9999)	0
891	Cumulative power monitor digit shifted times	0 to 4, 9999	9999
892	Load factor	30 to 150%	100%
893	Energy saving monitor reference (motor capacity)	0.1 to 55kW*2 0 to 3600kW*3	Inverter capacity
894	Control selection during commercial power-supply operation	0 to 3	0
895	Power saving rate reference value	0, 1, 9999	9999
896	Power unit cost	0 to 500, 9999	9999
897	Power saving monitor average time	0, 1 to 1000h, 9999	9999
898	Power saving cumulative monitor clear	0, 1, 10, 9999	9999
899	Operation time rate (estimated value)	0 to 100%, 9999	9999
900	CA terminal calibration	—	—
901	AM terminal calibration	—	—
902	Terminal 2 frequency setting bias frequency	0 to 590Hz	0Hz
902	Terminal 2 frequency setting bias	0 to 300%	0%
903 (125)	Terminal 2 frequency setting gain frequency	0 to 590Hz	60Hz
903	Terminal 2 frequency setting gain	0 to 300%	100%
904	Terminal 4 frequency setting bias frequency	0 to 590Hz	0Hz
904	Terminal 4 frequency setting bias	0 to 300%	20%
905 (126)	Terminal 4 frequency setting gain frequency	0 to 590Hz	60Hz
905	Terminal 4 frequency setting gain	0 to 300%	100%
917	Terminal 1 bias frequency (speed)	0 to 590Hz	0Hz
917	Terminal 1 bias (speed)	0 to 300%	0%
918	Terminal 1 gain frequency (speed)	0 to 590Hz	60Hz
918	Terminal 1 gain (speed)	0 to 300%	100%
919	Terminal 1 bias command (torque)	0 to 400%	0%
919	Terminal 1 bias (torque)	0 to 300%	0%
920	Terminal 1 gain command (torque)	0 to 400%	150%
920	Terminal 1 gain (torque)	0 to 300%	100%
930	Current output bias signal	0 to 100%	0%
930	Current output bias current	0 to 100%	0%
931	Current output gain signal	0 to 100%	100%
931	Current output gain current	0 to 100%	100%
932	Terminal 4 bias command (torque)	0 to 400%	0%
932	Terminal 4 bias (torque)	0 to 300%	20%
933	Terminal 4 gain command (torque)	0 to 400%	150%
933	Terminal 4 gain (torque)	0 to 300%	100%
934	PID display bias coefficient	0 to 500.00, 9999	9999
934*8	PID display bias analog value	0 to 300%	20%
935*8	PID display gain coefficient	0 to 500.00, 9999	9999
935	PID display gain analog value	0 to 300%	100%
989	Parameter copy alarm release	10*2 100*3	10*2 100*3
990	PU buzzer control	0, 1	1
991*8	PU contrast adjustment	0 to 63	58
992	Parameter for manufacturer setting. Do not set.		
997	Fault initiation	0 to 255, 9999	9999
998*8	PM parameter initialization	0, 8009, 8109, 9009, 9109	0
999*8	Automatic parameter setting	1, 2,10 to 13, 20, 21, 9999	9999
1000	Direct setting selection	0 to 2	0
1002	Lq tuning target current adjustment coefficient	50 to 150%, 9999	9999
1006	Clock (year)	2000 to 2099	2000

Pr.	Name	Setting range	Initial value
1007	Clock (month, day)	101 to 131, 201 to 229, 301 to 331, 401 to 430, 501 to 531, 601 to 630, 701 to 731, 801 to 831, 901 to 930, 1001 to 1031, 1101 to 1130, 1201 to 1231	101
1008	Clock (hour, minute)	0 to 59, 100 to 159, 200 to 259, 300 to 359, 400 to 459, 500 to 559, 600 to 659, 700 to 759, 800 to 859, 900 to 959, 1000 to 1059, 1100 to 1159, 1200 to 1259, 1300 to 1359, 1400 to 1459, 1500 to 1559, 1600 to 1659, 1700 to 1759, 1800 to 1859, 1900 to 1959, 2000 to 2059, 2100 to 2159, 2200 to 2259, 2300 to 2359	0
1013	Running speed after emergency drive retry reset	0 to 590Hz	60Hz
1015	Integral stop selection at limited frequency	0 to 2, 10 to 12	0
1016	PTC thermistor protection detection time	0 to 60s	0s
1018	Monitor with sign selection	0, 1, 9999	9999
1020	Trace operation selection	0 to 4	0
1021	Trace mode selection	0 to 2	0
1022	Sampling cycle	0 to 9	2
1023	Number of analog channels	1 to 8	4
1024	Sampling auto start	0, 1	0
1025	Trigger mode selection	0 to 4	0
1026	Number of sampling before trigger	0 to 100%	90%
1027	Analog source selection (1ch)	1 to 3, 5 to 14, 17, 18, 20, 23, 24, 34, 40 to 42, 52 to 54, 61, 62, 64, 67, 68, 81 to 96, 98, 201 to 213, 230 to 232, 237, 238	201
1028	Analog source selection (2ch)		202
1029	Analog source selection (3ch)		203
1030	Analog source selection (4ch)		204
1031	Analog source selection (5ch)		205
1032	Analog source selection (6ch)		206
1033	Analog source selection (7ch)		207
1034	Analog source selection (8ch)		208
1035	Analog trigger channel	1 to 8	1
1036	Analog trigger operation selection	0, 1	0
1037	Analog trigger level	600 to 1400	1000
1038	Digital source selection (1ch)	1 to 255	1
1039	Digital source selection (2ch)		2
1040	Digital source selection (3ch)		3
1041	Digital source selection (4ch)		4
1042	Digital source selection (5ch)		5
1043	Digital source selection (6ch)		6
1044	Digital source selection (7ch)		7
1045	Digital source selection (8ch)		8
1046	Digital trigger channel	1 to 8	1
1047	Digital trigger operation selection	0, 1	0
1048	Parameter for manufacturer setting. Do not set.		
1049	USB host reset	0, 1	0
1106	Torque monitor filter	0 to 5s, 9999	9999
1107	Running speed monitor filter	0 to 5s, 9999	9999
1108	Excitation current monitor filter	0 to 5s, 9999	9999
1124	Station number in inverter-to-inverter link	0 to 5, 9999	9999

Pr.	Name	Setting range	Initial value
1125	Number of inverters in inverter-to-inverter link system	2 to 6	2
1132	Pre-charge change increment amount	0 to 100%, 9999	9999
1133	Second pre-charge change increment amount	0 to 100%, 9999	9999
1136*8	Second PID display bias coefficient	0 to 500, 9999	9999
1137*8	Second PID display bias analog value	0 to 300%	20%
1138*8	Second PID display gain coefficient	0 to 500, 9999	9999
1139*8	Second PID display gain analog value	0 to 300%	100%
1140	Second PID set point/ deviation input selection	1 to 5	2
1141	Second PID measured value input selection	1 to 5, 101 to 105	3
1142	Second PID unit selection	0 to 43, 9999	9999
1143	Second PID upper limit	0 to 100%, 9999	9999
1144	Second PID lower limit	0 to 100%, 9999	9999
1145	Second PID deviation limit	0.0 to 100.0%, 9999	9999
1146	Second PID signal operation selection	0 to 7, 10 to 17	0
1147	Second output interruption detection time	0 to 3600s, 9999	1s
1148	Second output interruption detection level	0 to 590Hz	0Hz
1149	Second output interruption cancel level	900 to 1100%	1000%
1150 to 1199	User parameters 1 to 50	0 to 65535	0
1211	PID gain tuning timeout time	1 to 9999s	100s
1212	Step manipulated amount	900 to 1100%	1000%
1213	Step response sampling cycle	0.01 to 600s	1s
1214	Timeout time after the maximum slope	1 to 9999s	10s
1215	Limit cycle output upper limit	900 to 1100%	1100%
1216	Limit cycle output lower limit	900 to 1100%	1000%
1217	Limit cycle hysteresis	0.1 to 10%	1%
1218	PID gain tuning setting	0, 100 to 102, 111, 112, 121, 122, 200 to 202, 211, 212, 221, 222	0
1219	PID gain tuning start/ status	(0), 1, 8, (9, 90 to 96)	0
1300 to 1343	Communication option parameters		
1346	PID lower limit operation detection time	0 to 900 s, 9999	9999
1350 to 1359	Communication option parameters		
1361	Detection time for PID output hold	0 to 900s	5s
1362	PID output hold range	0 to 50%, 9999	9999
1363	PID priming time	0 to 360s, 9999	9999
1364	Stirring time during sleep	0 to 3600s	15s
1365	Stirring interval time	0 to 1000h	0h
1366	Sleep boost level	0 to 100%, 9999	9999
1367	Sleep boost waiting time	0 to 360s	0s
1368	Output interruption cancel time	0 to 360s	0s
1369	Check valve closing completion frequency	0 to 120Hz, 9999	9999
1370	Detection time for PID limiting operation	0 to 900s	0s
1371	PID upper/lower limit pre-warning level range	0 to 50%, 9999	9999
1372	PID measured value control set point change amount	0 to 50%	5%
1373	PID measured value control set point change rate	0 to 100%	0%
1374	Auxiliary pressure pump operation starting level	900 to 1100%	1000%
1375	Auxiliary pressure pump operation stopping level	900 to 1100%	1000%
1376	Auxiliary motor stopping level	0 to 100%, 9999	9999
1377	PID input pressure selection	1 to 3, 9999	9999
1378	PID input pressure warning level	0 to 100%	20%
1379	PID input pressure fault level	0 to 100%, 9999	9999
1380	PID input pressure warning set point change amount	0 to 100%	5%
1381	PID input pressure fault operation selection	0, 1	0
1410	Starting times lower 4 digits	0 to 9999	0
1411	Starting times upper 4 digits	0 to 9999	0
1412	Motor induced voltage constant (phi f) exponent	0 to 2, 9999	9999
1413	Second motor induced voltage constant (phi f) exponent	0 to 2, 9999	9999
1424	Ethernet communication station number	1 to 239	1
1425	Ethernet communication network number	1 to 120	1
1426	Link speed and duplex mode selection	0 to 4	0
1427	Ethernet function selection 1	502, 5000 to 5002, 5006 to 5008, 5010 to 5013, 9999, 45237, 47808, 61450	5001
1428	Ethernet function selection 2		45237
1429	Ethernet function selection 3		9999
1431	Ethernet signal loss detection function selection	0 to 3	0
1432	Ethernet communication check time interval	0 to 999.8s, 9999	9999
1434	IP address 1 (Ethernet)	0 to 255	192
1435	IP address 2 (Ethernet)	0 to 255	168
1436	IP address 3 (Ethernet)	0 to 255	50
1437	IP address 4 (Ethernet)	0 to 255	1
1438	Subnet mask 1	0 to 255	255
1439	Subnet mask 2	0 to 255	255
1440	Subnet mask 3	0 to 255	255
1441	Subnet mask 4	0 to 255	0
1442	IP filter address 1 (Ethernet)	0 to 255	0
1443	IP filter address 2 (Ethernet)	0 to 255	0
1444	IP filter address 3 (Ethernet)	0 to 255	0
1445	IP filter address 4 (Ethernet)	0 to 255	0
1446	IP filter address 2 range specification (Ethernet)	0 to 255, 9999	9999
1447	IP filter address 3 range specification (Ethernet)	0 to 255, 9999	9999
1448	IP filter address 4 range specification (Ethernet)	0 to 255, 9999	9999
1449	Ethernet command source selection IP address 1	0 to 255	0
1450	Ethernet command source selection IP address 2	0 to 255	0
1451	Ethernet command source selection IP address 3	0 to 255	0
1452	Ethernet command source selection IP address 4	0 to 255	0
1453	Ethernet command source selection IP address 3 range specification	0 to 255, 9999	9999
1454	Ethernet command source selection IP address 4 range selection	0 to 255, 9999	9999
1455	Keepalive time	1 to 7200s	3600s
1460	PID multistage set point 1	0 to 100%, 9999	9999
1461	PID multistage set point 2		9999
1462	PID multistage set point 3		9999
1463	PID multistage set point 4		9999
1464	PID multistage set point 5		9999
1465	PID multistage set point 6		9999
1466	PID multistage set point 7		9999
1469	Number of cleaning times monitor	0 to 255	0
1470	Number of cleaning times setting	0 to 255	0
1471	Cleaning trigger selection	0 to 15	0
1472	Cleaning reverse rotation frequency	0 to 590Hz	30Hz
1473	Cleaning reverse rotation operation time	0 to 3600s	5s
1474	Cleaning forward rotation frequency	0 to 590Hz, 9999	9999
1475	Cleaning forward rotation operation time	0 to 3600s, 9999	9999
1476	Cleaning stop time	0 to 3600s	5s
1477	Cleaning acceleration time	0 to 3600s, 9999	9999
1478	Cleaning deceleration time	0 to 3600s, 9999	9999
1479	Cleaning time trigger	0 to 6000hr	0
1480	Load characteristics measurement mode	0, 1, (2, 3, 4, 5, 81, 82, 83, 84, 85)	0
1481	Load characteristics load reference 1	0 to 400%, 8888, 9999	9999
1482	Load characteristics load reference 2	0 to 400%, 8888, 9999	9999
1483	Load characteristics load reference 3	0 to 400%, 8888, 9999	9999
1484	Load characteristics load reference 4	0 to 400%, 8888, 9999	9999
1485	Load characteristics load reference 5	0 to 400%, 8888, 9999	9999
1486	Load characteristics maximum frequency	0 to 590Hz	60Hz
1487	Load characteristics minimum frequency	0 to 590Hz	6Hz
1488	Upper limit warning detection width	0 to 400%, 9999	20%
1489	Lower limit warning detection width	0 to 400%, 9999	20%
1490	Upper limit fault detection width	0 to 400%, 9999	9999
1491	Lower limit fault detection width	0 to 400%, 9999	9999
1492	Load status detection signal delay time / load reference measurement waiting time	0 to 60s	1s
1499	Parameter for manufacturer setting. Do not set.		

*1 Differs according to capacities.
- 3%: FR-F860-00027
- 2%: FR-F860-00061 and FR-F860-00090
- 1%: FR-F860-00170 or higher

*2 For FR-F860-00680 or lower
*3 For FR-F860-01080 or higher
*4 For FR-F860-00090 or lower
*5 For FR-F860-00170 or higher
*6 The setting value "60" is only available for **Pr.178**, and "61" is only for **Pr.179**.
*7 The setting values "92, 93, 192, 193" are only available for **Pr.190 to Pr.194**.
*8 These are the simple mode parameters when the FR-LU08 is installed. (Initially set to the extended mode.)
*9 The setting is available when the PLC function is enabled.

6 TROUBLESHOOTING

When a fault occurs in the inverter, the protective function is activated, and the operation panel display automatically changes to one of the fault or alarm indications on page 23.
If the fault does not correspond to any of the following faults or if you have any other problem, please contact your sales representative.

- Retention of the fault output signal
  Opening the magnetic contactor (MC) provided on the input side of the inverter at a fault occurrence shuts off the control power to the inverter, therefore, the fault output will not be retained.
- Fault or alarm indication
  When a fault or alarm occurs, the operation panel display automatically switches to a fault or alarm indication.
- Resetting method
  When a fault occurs, the inverter output is kept stopped. Unless reset, the inverter cannot restart. (Refer to page 22.)
- When any fault occurs, take an appropriate corrective action, then reset the inverter, and resume the operation. Not doing so may lead to an inverter fault and damage.

Inverter fault or alarm indications are roughly categorized as below.

- Error message
  A message regarding operational fault and setting fault by the operation panel is displayed. The inverter output is not shut off.
- Warning
  The inverter output is not shut off even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.
- Alarm
  The inverter output is not shut off. An alarm can also be output with a parameter setting.
- Fault
  When a protective function is activated, the inverter output is shut off and a fault signal is output.

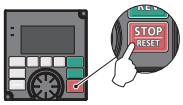
NOTE

- For the details of fault displays and other troubles, also refer to the FR-F860 Instruction Manual (Detailed).
- The past eight faults can be displayed using the operation panel. (Refer to the FR-LU08 Instruction Manual.)

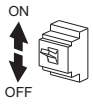
6.1 Reset method for the protective functions

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

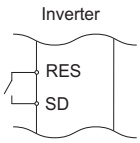
- On the operation panel, press the STOP/RESET key to reset the inverter.
  (This may only be performed when a fault occurs.)



- Switch power OFF once, then switch it ON again.



- Turn ON the Reset (RES) signal for 0.1 seconds or more. (If the RES signal is kept ON, "Err" appears (blinks) to indicate that the inverter is in a reset status.)



NOTE

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

6.2 List of fault displays

	Abbreviation	Name
Error message	LOCD	Password locked
	Er1 to Er4 Er8	Parameter write error
	rE1 to rE8	Copy operation error
	Err.	RES signal ON or communication circuit fault
Warning	OL	Stall prevention (overcurrent)
	oL	Stall prevention (overvoltage)
	TH	Electronic thermal relay function pre-alarm
	PS	PU stop
	MT1 to MT3	Maintenance signal output
	CP	Parameter copy
	CF	Continuous operation during communication fault
	SA	SA
	UF	USB host error
	ED	Emergency drive in operation
	LDF	Load fault warning
	EHR	Ethernet communication fault
Alarm	FN	Fan alarm
Fault	E.OC1	Overcurrent trip during acceleration
	E.OC2	Overcurrent trip during constant speed
	E.OC3	Overcurrent trip during deceleration or stop
	E.OV1	Regenerative overvoltage trip during acceleration
	E.OV2	Regenerative overvoltage trip during constant speed
	E.OV3	Regenerative overvoltage trip during deceleration or stop
	E.THT	Inverter overload trip (electronic thermal relay function)
	E.THM	Motor overload trip (electronic thermal relay function)
	E.FIN	Heat sink overheat
	E.IPF	Instantaneous power failure
	E.UVT	Undervoltage
	E.ILF	Input phase loss
	E.OLT	Stall prevention stop
	E.GF	Output side earth (ground) fault overcurrent
	E.SOT	Loss of synchronism detection
	E.LUP	Upper limit fault detection
	E.LDN	Lower limit fault detection
	E.LF	Output phase loss
	E.OHT	External thermal relay operation
	E.PTC	PTC thermistor operation
	E.OPT	Option fault
	E.OP1	Communication option fault
	E.1 to E.3	Option fault
	E.PE	Parameter storage device fault (control circuit board)
	E.PUE	PU disconnection
	E.RET	Retry count excess
	E.PE2	Parameter storage device fault (main circuit board)
	E.PE6	Internal storage device fault
	E.5 to E.7 E.CPU	CPU fault
	E.CTE	Operation panel power supply short circuit
	E.P24	24 VDC power fault
	E.CDO	Abnormal output current detection
	E.IOH	Inrush current limit circuit fault
	E.AIE	Analog input fault

	Abbreviation	Name
Fault	E.OS	Overspeed occurrence
	E.USB	USB communication fault
	E.13 E.PBT E.BE	Internal circuit fault
	E.SAF	Safety circuit fault
	E.LCI	4 mA input fault
	E.PCH	Pre-charge fault
	E.PID	PID signal fault
	E.EHR	Ethernet communication fault
	E.16 to E.20	User definition error by the PLC function
Others	E.0	No fault history
	RD	Backup in progress
	WR	Restoration in progress

If faults other than the above appear, contact your sales representative.

7 SPECIFICATIONS

7.1 Rating

◆ FR-F860-00450 or lower

Model FR-F860-[ ]-N6				00027	00061	00090	00170	00320	00450
Inverter capacity (kW)				1.5	3.7	5.5	11.0	18.5	30.0
Applicable motor capacity (kW) *1			SLD	1.5	3.7	5.5	11.0	22.0	30.0
			LD	1.12	2.2	3.7	7.5	18.5	30.0
Output	Rated capacity (kVA) *2		SLD	2.7	6.1	9.0	17.0	32.0	45.0
			LD	2.5	5.6	8.2	16.0	27.0	41.0
	Rated current (A) *3		SLD	2.7 (2.3)	6.1 (5.2)	9.0 (7.65)	17.0 (14.4)	32.0 (27.2)	45.0 (38.2)
			LD	2.5 (2.1)	5.6 (4.8)	8.2 (7.0)	16.0 (13.6)	27.0 (22.9)	41.0 (34.8)
	Overload current rating *4		SLD	110% 60 s, 120% 3 s (inverse-time characteristics) at ambient temperature of 30°C			110% 60 s, 120% 3 s (inverse-time characteristics) at ambient temperature of 40°C		
			LD	120% 60 s, 150% 3 s (inverse-time characteristics) at ambient temperature of 40°C					
	Rated voltage *5			Three-phase 525 to 600 V					
Power supply	Rated input AC voltage/frequency			Three-phase 525 to 600 V 60 Hz					
	Permissible AC voltage fluctuation			472 to 660 V 60 Hz					
	Permissible frequency fluctuation			±5%					
	Rated input current (A) *6	Without DC reactor	SLD	4.7	11.0	15.0	27.0	43.0	61.0
			LD	4.4	9.8	14.0	25.0	36.0	55.0
		With DC reactor *3	SLD	2.7 (2.3)	6.1 (5.2)	9.0 (7.65)	17.0 (14.4)	32.0 (27.2)	45.0 (38.2)
			LD	2.5 (2.1)	5.6 (4.8)	8.2 (7.0)	16.0 (13.6)	27.0 (22.9)	41.0 (34.8)
	Power supply capacity (kVA) *7	Without DC reactor	SLD	4.7	10.6	15.0	26.7	42.4	60.6
			LD	4.4	9.8	13.8	25.2	35.8	54.4
		With DC reactor	SLD	2.7	6.1	9.0	17.0	32.0	45.0
			LD	2.5	5.6	8.2	16.0	27.0	41.0
Protective structure (IEC 60529)				Enclosed type (UL type 1 plenum rated) *8					
Cooling system				Self-cooling	Forced air				
Approx. mass (kg)				3.5	4.0	4.0	7.0	9.0	17.0

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

*2 The rated output capacity indicated assumes that the output voltage is 575 V.

*3 When an operation is performed with the carrier frequency set to 3 kHz or more, and the inverter output current reaches the value indicated in the parenthesis, the carries frequency is automatically lowered. The motor noise becomes louder accordingly.

*4 The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the 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. However, the maximum point of the voltage waveform at the inverter output side is the power supply voltage multiplied by about $\sqrt{2}$.

*6 The rated input current indicates a value at a rated output voltage. The impedance at the power supply side (including those of the input reactor and cables) affects the rated input current.

*7 The power supply capacity is the value when at the rated output current. It varies by the impedance at the power supply side (including those of the input reactor and cables).

*8 UL Type 1 Enclosure - Suitable for Installation in a Compartment Handling Conditioned Air (Plenum)

◆ FR-F860-00680 or higher

Model FR-F860-[ ]				00680	01080	01440	01670	02430	02890	03360	04420
Inverter capacity (kW)				45.0	75.0	90.0	110.0	132.0	160.0	220.0	250.0
Applicable motor capacity (kW) *1				SLD	45.0	75.0	110.0	110.0	185.0	220.0	260.0	335.0
				LD	45.0	75.0	90.0	110.0	150.0	185.0	220.0	300.0
Output	Rated capacity (kVA) *2			SLD	68.0	108.0	144.0	167.0	242.0	288.0	335.0	441.0
				LD	62.0	99.0	131.0	152.0	221.0	254.0	303.0	401.0
	Rated current (A) *3			SLD	68.0 (57.8)	108.0 (91.8)	144.0 (122.0)	167.0 (141.0)	243.0 (206.0)	289.0 (245.0)	336.0 (285.0)	442.0 (375.0)
				LD	62.0 (52.7)	99.0 (84.1)	131.0 (122.0)	152.0 (129.0)	221.0 (187.0)	255.0 (216.0)	304.0 (258.0)	402.0 (341.0)
	Overload current rating *4			SLD	110% 60 s, 120% 3 s (inverse-time characteristics) at surrounding air temperature of 40°C							
				LD	120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature of 40°C	120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature of 50°C						
	Rated voltage *5				Three-phase 525 to 600 V							
Power supply	Rated input AC voltage/frequency				Three-phase 525 to 600 V 60 Hz							
	Permissible AC voltage fluctuation				472 to 660 V 60 Hz							
	Permissible frequency fluctuation				±5%							
	Rated input current (A) *6	Without DC reactor		SLD	87.0	—	—	—	—	—	—	—
				LD	79.0	—	—	—	—	—	—	—
		With DC reactor *3		SLD	68.0 (57.8)	108.0 (91.8)	144.0 (122.0)	167.0 (141.0)	243.0 (206.0)	289.0 (245.0)	336.0 (285.0)	442.0 (375.0)
				LD	62.0 (52.7)	99.0 (84.1)	131.0 (122.0)	152.0 (129.0)	221.0 (187.0)	255.0 (216.0)	304.0 (258.0)	402.0 (341.0)
	Power supply capacity (kVA) *7	Without DC reactor		SLD	86.8	—	—	—	—	—	—	—
				LD	79.1	—	—	—	—	—	—	—
		With DC reactor		SLD	68.0	108.0	144.0	167.0	242.0	288.0	335.0	441.0
				LD	62.0	99.0	131.0	152.0	221.0	254.0	303.0	401.0
Protective structure (IEC 60529)					Open type (IP00)							
Cooling system					Forced air							
Approx. mass (kg)					36.0	41.0	52.0	52.0	55.0	112.0	115.0	153.0

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

*2 The rated output capacity indicated assumes that the output voltage is 575 V.

*3 When an operation is performed with the carrier frequency set to 3 kHz or more, and the inverter output current reaches the value indicated in the parenthesis, the carries frequency is automatically lowered. The motor noise becomes louder accordingly.

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

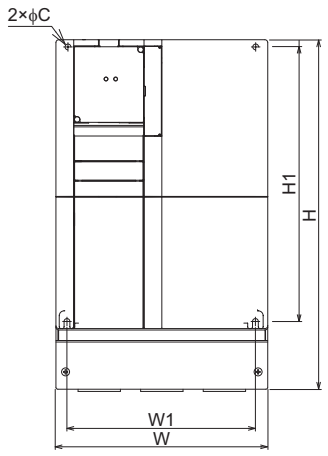
*5 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the maximum point of the voltage waveform at the inverter output side is the power supply voltage multiplied by about $\sqrt{2}$.

*6 The rated input current indicates a value at a rated output voltage. The impedance at the power supply side (including those of the input reactor and cables) affects the rated input current.

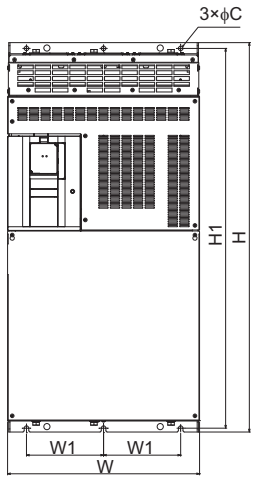
*7 The power supply capacity is the value when at the rated output current. It varies by the impedance at the power supply side (including those of the input reactor and cables).

7.2 Outline dimensions

FR-F860-00027 to 02430



FR-F860-02890 to 04420



(Unit: mm)

Inverter model	W	W1	H	H1	D	C
FR-F860-00027	150	125	318	245	140	6
FR-F860-00061						
FR-F860-00090						
FR-F860-00170	220	195	324		170	
FR-F860-00320			363	285	190	
FR-F860-00450	250	230	517.3	380		10
FR-F860-00680	435	380	550	525	250	12
FR-F860-01080						
FR-F860-01440	465	400	620	595	300	
FR-F860-01670						
FR-F860-02430						
FR-F860-02890	498	200	1010	985	380	
FR-F860-03360						
FR-F860-04420	680	300		984		

Appendix

Appendix 1 Instructions for UL and cUL

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

◆ General precaution

CAUTION - Risk of Electric Shock -
The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P/+ and N/- with a meter etc., to avoid a hazard of electrical shock.
ATTENTION - Risque de choc électrique -
La durée de décharge du condensateur de bus est de 10 minutes. Avant de commencer le câblage ou l'inspection, mettez l'appareil hors tension et attendez plus de 10 minutes.

◆ Installation

- The FR-F860-00450 and lower inverters have been approved as products for a UL type1 enclosure that is suitable for Installation in a Compartment Handling Conditioned Air (Plenum).
  Install the inverter so that the ambient temperature, humidity and ambience of the inverter will satisfy the specifications. (Refer to page 5.)

- The FR-F860-00680 and higher inverters have been approved as products for use in enclosure and approval tests were conducted under the following conditions.
  Design the enclosure so that the surrounding air temperature, humidity and ambience of the inverter will satisfy the specifications. (Refer to page 5.)

◆ Branch circuit protection

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

FR-F860-[]		00027	00061	00090	00170	00320	00450	00680	01080	01440	01670	02430	02890	03360	04420
Rated fuse voltage(V)		600 V or more													
Fuse allowable rating (A)	Without power factor improving reactor	10	20	30	40	80	125	125	175	—	—	—	—	—	—
	With power factor improving reactor	6	10	15	25	40	60	100	150	200	250	300	400	450	600

◆ Wiring to the power supply and the motor

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

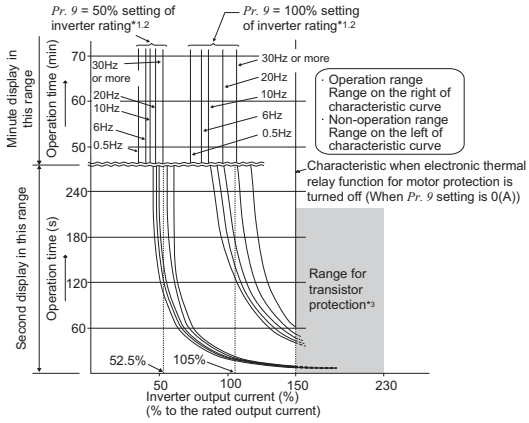
◆ Short circuit ratings

Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 600 V maximum.

◆ Motor overload protection

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

Operation characteristics of electronic thermal relay function



This function detects the overload (overheat) of the motor, stops the operation of the inverter's output transistor, and stops the output. (The operation characteristic is shown on the left.)

*1 When a value 50% of the inverter rated output current (current value) is set in **Pr.9**
*2 The % value denotes the percentage to the inverter rated current. It is not the percentage to the rated motor current.
*3 Transistor protection is activated depending on the temperature of the heat sink. The protection may be activated even with less than 150% depending on the operating conditions.

NOTE

- The internal accumulated heat value of the electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.
- When multiple motors are driven with a single inverter or when a multi-pole motor or a special motor is driven, install an external thermal relay (OCR) between the inverter and motors. Note that the current indicated on the motor rating plate is affected by the line-to-line leakage current (details in the FR-F860 Instruction Manual (Detailed)) when selecting the setting for an external thermal relay.
- The cooling effect of the motor drops during low-speed operation. Use a thermal protector or a motor with built-in thermistor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
- Motor over temperature sensing is not provided by the drive.

Appendix 2 Restricted Use of Hazardous Substances in Electronic and Electrical Products

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

电器电子产品有害物质限制使用标识要求

本产品中所含有的有害物质的名称、含量、含有部件如下表所示。

- 产品中所含有害物质的名称及含量

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.

◆ About the enclosed CD-ROM

- The enclosed CD-ROM contains PDF copies of the manuals related to this product.

◆ Before using the enclosed CD-ROM

- The copyright and other rights of the enclosed CD-ROM all belong to Mitsubishi Electric Corporation.
- No part of the enclosed CD-ROM may be copied or reproduced without the permission of Mitsubishi Electric Corporation.
- Specifications of the enclosed CD-ROM are subject to change for modification without notice.
- We are not responsible for any damages and lost earnings, etc. from use of the enclosed CD-ROM.
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  Other company and product names of companies herein are all trademarks or registered trademarks of those respective companies.
- Warranty
  We do not provide a warranty against defects in the enclosed CD-ROM and related documents.

NOTE

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

◆ System requirements for the enclosed CD-ROM

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

Item	Specifications
OS	Microsoft® Windows® 10, Windows® 8.1, Windows® 8, Windows® 7, Windows Vista®
CPU	Intel® Pentium® or better processor
Memory	128 MB of RAM
Hard disk	90 MB of available hard-disk space
CD-ROM drive	Double speed or more (more than quadruple speed is recommended)
Monitor	800×600 dots or more
Application	Adobe® Reader® 7.0 or more Internet Explorer® 6.0 or more

◆ Operating method of the enclosed CD-ROM

- How to read instruction manuals
  Step 1. Start a personal computer and place the enclosed CD-ROM in the CD-ROM drive.
  Step 2. The main window automatically opens by the web browser.
  Step 3. Click a manual you want to read in the "INSTRUCTION MANUAL" list.
  Step 4. PDF manual you clicked opens.

- Manual opening of the enclosed CD-ROM
  Step 1. Start a personal computer and place the enclosed CD-ROM in the CD-ROM drive.
  Step 2. Open "index.html" file in the enclosed CD-ROM.
  Step 3. The main window opens by the web browser. Follow the instructions from Step 3 of "How to read instruction manuals".

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

REVISIONS

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

Revision Date	*Manual Number	Revision
Oct. 2016	IB-0600691ENG-A	First edition
Feb. 2019	IB-0600691ENG-B	Added • Application of caution labels • Reset selection/disconnected PU detection/PU stop selection (**Pr.75** = "1000 to 1003, 1014 to 1017, 1100 to 1103, 1114 to 1117") • Automatic restart after instantaneous power failure selection (**Pr.162** = "1000 to 1003, 1010 to 1013") • Communication reset selection (**Pr.349** = "100, 101") • PLC function operation selection (**Pr.414** = "11, 12", **Pr.675**) • Control method selection (**Pr.800** = "109, 110") • Monitor with sign selection (**Pr.1018** = "1") • Ethernet function selection 1 to 3 (**Pr.1427 to Pr.1429** = "47808")
Mar. 2022	IB-0600691ENG-C	Added • Main circuit capacitor life measurement at power OFF (every time) (**Pr.259** = "11") • **Pr.506** Display estimated main circuit capacitor residual life • Current input check terminal selection (**Pr.573** = "11 to 14, 21 to 24") • Low-speed forward rotation command (RLF) signal, Low-speed reverse rotation command (RLR) signal • Cooling fan operation selection during the test operation (**Pr.244** = "1000, 1001, 1101 to 1105") • Display/reset ABC relay contact life (**Pr.507**, **Pr.508**) • **Pr.890** Internal storage device status indication • **Pr.1346** PID lower limit operation detection time • Internal storage device fault (E.PE6)

FR-F800 Series
Instruction Manual Supplement

1 Earth (ground) fault detection at start / restricting reset method for an earth (ground) fault

The reset method for the output side earth (ground) fault overcurrent (E.GF) can be restricted.

- Select whether to enable or disable the earth (ground) fault detection at start. When enabled, the earth (ground) fault detection is performed immediately after a start signal input to the inverter.
- Select whether to restrict the reset method for an earth (ground) fault.

Pr.	Name	Initial value	Setting range	Description	
				Earth (ground) fault	Reset method
249 **H101**	**Earth (ground) fault detection at start**	0	0	Not detected at start	Not restricted
			1	Detected at start	
			2		Restricted

◆ Selecting whether to perform the earth (ground) fault detection at start V/F Magnetic flux

- If an earth (ground) fault is detected at start while **Pr.249** = "1 or 2", the output side earth (ground) fault overcurrent (E.GF) is detected and output is shut off.
- Earth (ground) fault detection at start is enabled under V/F control and Advanced magnetic flux vector control.
- When the **Pr.72 PWM frequency selection** setting is high, enable the earth (ground) fault detection at start.

NOTE

- Because the detection is performed at start, output is delayed for approx. 20 ms every start.
- Use **Pr.249** to enable/disable the earth (ground) fault detection at start. During operation, earth (ground) faults are detected regardless of the **Pr.249** setting.

◆ Restricting reset method for an earth (ground) fault

- The reset method when the output is shut off due to the output side earth (ground) fault overcurrent (E.GF) can be restricted. When E.GF occurs while **Pr.249** = "2", E.GF can be reset only by turning OFF the control circuit power.
- This restriction prevents the inverter from being damaged due to repeated reset operations by the other methods such as entering the RES signal.
- When E.GF occurs while **Pr.249** = "2", the output short-circuit detection (ALM4) signal can be output.
- For the terminal used to output the ALM4 signal, set "23" (positive logic) or "123" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- If **Pr.249** is set to "2" while the retry function is enabled (**Pr.67** is not set to "0"), no retry is performed even when E.GF occurs.
- If **Pr.249** is set to "2" while the automatic bypass switching after inverter fault is enabled (**Pr.138** is not set to "1"), the operation is not switched to the commercial power supply operation even when E.GF occurs.

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.
- E.GF is not cleared by turning ON the Fault clear (X51) signal when **Pr.249** = "2".
- If E.GF occurs during emergency drive operation when **Pr.249** = "2", the output is shut off.

BCN-C22005-998

2 Output short-circuit fault (E.SCF)

Select the reset operation and fault indication for an output short-circuit.

Pr.	Name	Initial value	Setting range	Description	
				Operation after detection	Reset method
521 H194	Output short-circuit detection	0	0	E.OC1 to E.OC3	Not restricted
			1	E.SCF	Restricted

- The fault indication for an output short-circuit (E.OC1 to E.OC3, and E.SCF) can be changed by the **Pr.521** setting.
- When an output short-circuit is detected while **Pr.521** = "1", E.SCF is displayed and the inverter output is shut off.
- When E.SCF occurs while **Pr.521** = "1", E.SCF can be reset only by turning OFF the control circuit power. (E.OC1 to E.OC3 can be reset by any reset method.)
- This restriction prevents the inverter from being damaged due to repeated reset operations by the other methods such as entering the RES signal.
- When E.SCF occurs, the output short-circuit detection (ALM4) signal can be output.
- For the terminal used to output the ALM4 signal, set "23" (positive logic) or "123" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- If the automatic bypass switching after inverter fault is enabled (**Pr.138** is not set to "1"), the operation is not switched to the commercial power supply operation even when E.SCF occurs.

Operation panel indication	E.SCF		FR-LU08 indication	Fault
Name	Output short-circuit fault			
Description	The inverter output is shut off when an output short-circuit is detected while **Pr.521** = "1". When **Pr.521** = "0" (initial value), E.OC1, E.OC2, or E.OC3 appears when an output short-circuit is detected.			
Check point	Check for output short-circuit.			
Corrective action	Check the wiring to make sure that any output short circuit does not occur, then turn OFF the control circuit power to reset the inverter.			

NOTE

- When short-circuit resistance is large, the current does not reach the short-circuit detection level. In such a case, an output short-circuit cannot be detected.
- 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.
- E.SCF does not activate the retry function.
- E.SCF is not cleared by turning ON the Fault clear (X51) signal.
- If E.SCF occurs during emergency drive operation, the output is shut off.
- The communication data code for E.SCF is 20 (H14).

3 Extended detection time of the output current and zero current

The setting range of the **Pr.151 Output current detection signal delay time** and **Pr.153 Zero current detection time** is extended.

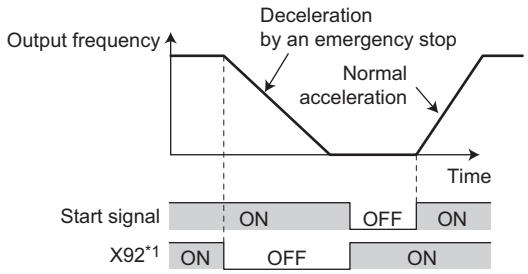
Pr.	Name	Initial value	Setting range	Description
151 **M461**	**Output current detection signal delay time**	0 s	0 to 300 s	Set the output current detection time. Enter the time from when the output current reaches the set current or higher to when the Output current detection (Y12) signal is output.
153 **M463**	**Zero current detection time**	0.5 s	0 to 300 s	Set the time from when the output current drops to the **Pr.152** setting or lower to when the Zero current detection (Y13) signal is output.

4 Emergency stop function (Pr.1103)

When a fault occurs in the superordinate controller, the motor can be decelerated by the signal input via an external terminal.

Pr.	Name	Initial value	Setting range	Description
815 **H710**	**Torque limit level 2**	9999	0 to 400%	Set the torque limit level at a deceleration by turning ON the X92 signal.
			9999	The torque limit set to **Pr.22** is valid.
1103 **F040**	**Deceleration time at emergency stop**	5 s	0 to 3600 s	Set the motor deceleration time at a deceleration by turning ON the X92 signal.

- The motor will decelerate to stop according to the settings of **Pr.1103 Deceleration time at emergency stop** and **Pr.815 Torque limit level 2** when the Emergency stop (X92) signal is turned OFF (when the contact is opened).
- To input the X92 signal, set "92" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to a terminal.
- The X92 signal is a normally closed input (NC contact input).
- "PS" is displayed on the operation panel during activation of the emergency stop function.



*1 ON/OFF indicates the input status of the physical terminal.

NOTE

- The X92 signals can be assigned to an input terminal by setting **Pr.178 to Pr.189 (Input terminal function selection)**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.

FR-F860
Instruction Manual Supplement

1 Instructions for UL and cUL

(Standard to comply with: UL 61800-5-1, CSA C22.2 No. 274)

◆ Applicable models

- FR-F860-00027 to 04420
- The above models are compliant with both UL 508C and UL 61800-5-1, CSA C22.2 No. 274. (The FR-F860-00090 or less is not compliant with UL 508C.)
  For the instructions for UL 61800-5-1, CSA C22.2 No. 274, refer to this Instruction Manual Supplement.
  For the instructions for UL 508C, refer to the FR-F860 (600V CLASS SPECIFICATION INVERTER) INSTRUCTION MANUAL (STARTUP).

◆ Product handling information / Informations sur la manipulation du produit

-WARNING- Operation of this product requires detailed installation and operation instructions provided in the Instruction Manual (Startup) and the Instruction Manual (Detailed) intended for use with this product. Please forward relevant manuals to the end user.

-AVERTISSEMENT-
L'utilisation de ce produit nécessite des instructions détaillées d'installation et d'utilisation fournies dans les manuels d'instructions en anglais (Instruction Manual (Startup) et Instruction Manual (Detailed)) destinés à être utilisés avec ce produit. Veuillez transmettre les manuels correspondants à l'utilisateur final.

◆ Precautions for compliance with CSA C22.2 No.274

Use the inverter under the conditions of overvoltage category III and pollution degree 2 or lower specified in IEC 60664.

◆ Branch circuit protection

For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code and any applicable provincial codes.
For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. Short circuit protection of the inverter cannot be used as branch circuit protection. Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local code.

■ Precautions for opening the branch-circuit protective device / Précautions pour ouvrir le dispositif de protection du circuit de dérivation

-WARNING- If the fuse melts down or the breaker trips on the input side of this product, check for wiring faults (such as short circuits). Identify and remove the cause of melting down or the trip before replacing the fuse or resetting the tripped breaker (or before applying the power to the inverter again).
-AVERTISSEMENT-
Si le fusible fond ou si le disjoncteur se déclenche du côté entrée de ce produit, vérifier les défauts de câblage (tels que les courts-circuits). Identifier et éliminer la cause de la fonte ou du déclenchement avant de remplacer le fusible ou de réinitialiser le disjoncteur déclenché (ou avant de remettre sous tension l'onduleur).

■ Fuse selection

Fuses are selected based on IEC/EN/UL 61800-5-1 and CSA C22.2 No. 274.

For installation in the United States, the following semi-conductor fuses must be provided, in accordance with the National Electrical Code and any applicable local codes. For installation in Canada, the following semi-conductor fuses must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes. Always install the following semiconductor fuses for branch circuit protection.

Inverter Model	Cat. No.	Manufacturer	Rating (A)
FR-F860-00027	BS000GB69V20	Mersen	20
FR-F860-00061	BS000GB69V25	Mersen	25
FR-F860-00090	BS000GB69V32	Mersen	32
FR-F860-00170	BS000GB69V63	Mersen	63
FR-F860-00320	BS000GB69V100	Mersen	100
FR-F860-00450	BS000UB69V125	Mersen	125
FR-F860-00680	BS000UB69V160	Mersen	160
FR-F860-01080	PC30UD69V250TF	Mersen	250
FR-F860-01440	PC30UD69V315TF	Mersen	315
FR-F860-01670	PC30UD69V315TF	Mersen	315
FR-F860-02430	PC31UD69V350TF	Mersen	350
FR-F860-02890	PC31UD69V400TF	Mersen	400
FR-F860-03360	PC31UD69V500TF	Mersen	500
FR-F860-04420	PC33UD69V700TF	Mersen	700

◆ Capacitor discharge time / Temps de décharge du condensateur

CAUTION -Risk of Electric Shock-

Before wiring or inspection, check that the LED indicator turns OFF. Any person who is involved in wiring or inspection shall wait for 10 minutes or longer after power OFF and check that there are no residual voltage using a digital multimeter or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.

ATTENTION -Risque de choc électrique-

Avant le câblage ou l'inspection, vérifier que le témoin LED s'éteint. Toute personne impliquée dans le câblage ou l'inspection doit attendre 10 minutes ou plus après la mise hors tension et vérifier l'absence de tension résiduelle à l'aide d'un multimètre numérique ou similaire. Le condensateur est chargé avec une haute tension pendant un certain temps après la mise hors tension, ce qui est dangereux. Précautions pour ouvrir le dispositif de protection du circuit de dérivation.

◆ Wiring to the power supply and the motor

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

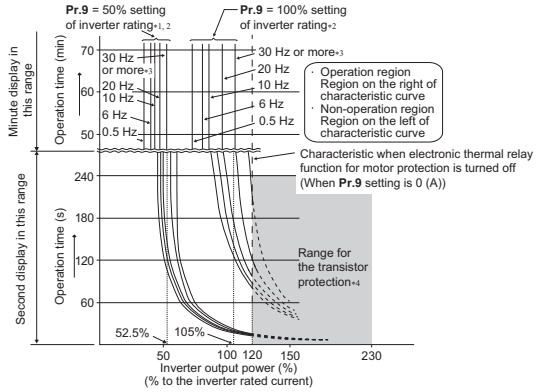
◆ Short circuit ratings

- Suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 600 V maximum.

◆ Motor overload protection

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

Operation characteristics of electronic thermal relay function (LD rating)



This function detects the overload (overheat) of the motor, stops the operation of the inverter's output transistor, and stops the output. (The operation characteristic is shown on the left.)

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

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

*3 Transistor protection is activated depending on the temperature of the heat sink. The protection may be activated even with less than 120% depending on the operating conditions.

NOTE

- The internal accumulated heat value of the electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.
- When multiple motors are driven with a single inverter or when a multi-pole motor or a special motor is driven, install an external thermal relay (OCR) between the inverter and motors. Note that the current indicated on the motor rating plate is affected by the line-to-line leakage current (details in the Instruction Manual (Detailed)) when selecting the setting for an external thermal relay.
- The cooling effect of the motor drops during low-speed operation. Use a thermal protector or a motor with built-in thermistor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
- Motor over temperature sensing is not provided by the drive.

◆ Applicable power supply

For use at an altitude above 2000 m (maximum 2500 m), only a neutral-point earthed (grounded) power supply can be used.

2 Instructions for motor overload protection

Some descriptions about motor overload protection are incorrect in APPENDIX of the Instruction Manual. The descriptions are corrected as follows.

◆ Motor overload protection

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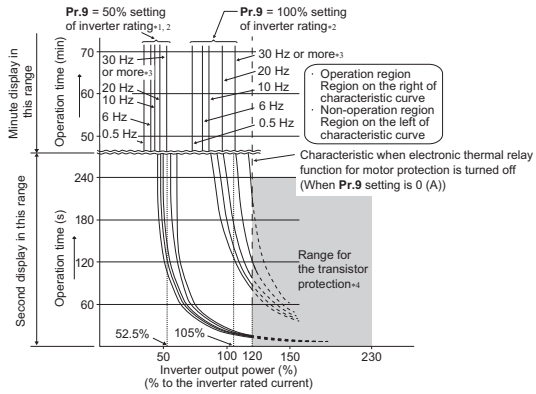
Operation characteristics of electronic thermal relay function (LD rating)



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- A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
- Motor over temperature sensing is not provided by the drive.

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IB-0600691ENG-C(2203)MEE Printed in Japan