MITSUBISHI ELECTRIC

700 series

# INVERTER FR-A700 INSTRUCTION MANUAL (BASIC)

## FR-A720-0.4K to 90K
## FR-A740-0.4K to 500K

Thank you for choosing this Mitsubishi Inverter.
This Instruction Manual (Basic) is intended for users who "just want to run the inverter".

**CONTENTS**





## To obtain the Instruction Manual (Applied)

If you are going to utilize functions and performance, refer to the *Instruction Manual (Applied)* [IB-0600226ENG].
The *Instruction Manual (Applied)* is separately available from where you purchased the inverter or your Mitsubishi sales representative.

The PDF version of this manual is also available for download at "MELFANS Web," the Mitsubishi Electric FA network service on the world wide web (URL: http://www.MitsubishiElectric.co.jp/melfansweb)

This Instruction Manual (Basic) provides handling information and precautions for use of the equipment.
Please forward this Instruction Manual (Basic) to the end user.

## This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect the inverter until you have read through this Instruction Manual (Basic) and appended documents carefully and can use the equipment correctly. Do not use the inverter until you have a full knowledge of the equipment, safety information and instructions. In this Instruction Manual (Basic), 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.

The **⚠CAUTION** level may even lead to a serious consequence according to conditions. Both instruction levels must be followed because these are important to personal safety.

### 1. Electric Shock Prevention

**⚠WARNING**

- While the inverter power is ON, do not open the front cover or the wiring cover. Do not run the inverter with the front cover or the wiring cover removed. Otherwise you may access the exposed high voltage terminals or the charging part of the circuitry and get an electric 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, inspection or switching EMC filter ON/OFF connector, power must be switched OFF. To confirm that, LED indication of the operation panel must be checked. (It must be OFF.) Any person who is involved in wiring, inspection or switching EMC filter ON/OFF connector 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 536 class 1 and other applicable standards).
  A neutral-point earthed (grounded) power supply for 400V class inverter in compliance with EN standard must be used.
- 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.
- Setting dial and key operations must be performed with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching.
- Do not replace the cooling fan while power is on. It is dangerous to replace the cooling fan while power is on.
- Do not touch the printed circuit board or handle the cables with wet hands. Otherwise you may get an electric shock.
- When measuring the main circuit capacitor capacity (*Pr. 259 Main circuit capacitor life measuring* = "1"), the DC voltage is applied to the motor for 1s at powering OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.
- IPM motor is a synchronous motor with high-performance magnets embedded in the rotor. Motor terminals hold high-voltage while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. When the motor is driven by the load in applications such as fan and blower, 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.

### 2. Fire Prevention

**⚠CAUTION**

- Inverter must be installed on a nonflammable wall without holes (so that nobody touches the inverter heatsink on the rear side, etc.). Mounting it to or near flammable material can cause a fire.
- If the inverter has become faulty, the inverter power must be switched OFF. A continuous flow of large current could cause a fire.
- When using a brake resistor, a sequence that will turn OFF power when a fault signal is output must be configured.
  Otherwise the brake resistor may overheat due to damage of the brake transistor and possibly cause a fire.
- Do not connect a resistor directly to the DC terminals P/+ and N/-. Doing so could cause a fire.
- Daily and periodic inspections must be performed as instructed in the Instruction Manual. If the product is used without receiving any inspection, it may cause a burst, break, or fire.

### 3. Injury Prevention

**⚠CAUTION**

- The voltage applied to each terminal must be the ones specified in the Instruction Manual. Otherwise burst, damage, etc. may occur.
- The cables must be connected to the correct terminals. Otherwise burst, damage, etc. may occur.
- Polarity 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 since the inverter will be extremely hot. Doing so can cause burns.

### 4. Additional Instructions

Also the following points must be noted to prevent an accidental failure, injury, electric shock, etc.

**(1) Transportation and installation**

**⚠CAUTION**

- The product must be transported in correct method that corresponds to the weight. Failure to do so may lead to injuries.
- Do not stack the boxes containing inverters higher than the number recommended.
- The product must be installed to the position where withstands the weight of the product according to the information in the Instruction Manual.
- Do not install or operate the inverter if it is damaged or has parts missing. This can result in breakdowns.
- When carrying the inverter, do not hold it by the front cover or setting dial; it may fall off or fail.
- Do not stand or rest heavy objects on the product.
- The inverter mounting orientation must be correct.
- 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.
- The inverter must be used under the following environment: Otherwise the inverter may be damaged.

| | | |
|---|---|---|
| Environment | Surrounding air temperature | -10°C to +50°C (non-freezing) |
| | Ambient humidity | 90% RH or less (non-condensing) |
| | Storage temperature | -20°C to +65°C *1 |
| | Atmosphere | Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt) |
| | Altitude, vibration | Maximum 1000m above sea level for standard operation. 5.9m/s$^2$ *2 or less at 10 to 55Hz (directions of X, Y, Z axes) |

*1 Temperature applicable for a short time, e.g. in transit.
*2 2.9m/s$^2$ or less for the 160K or higher.

- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.) infiltrate into a Mitsubishi product, the product will be damaged. Halogen-based materials are often included in fumigant, which is used to sterilize or disinfest wooden packages. When packaging, prevent residual fumigant components from being infiltrated into Mitsubishi products, or use an alternative sterilization or disinfection method (heat disinfection, etc.) for packaging. Sterilization of disinfection of wooden package should also be performed before packaging the product.

**(2) Wiring** ⚠ CAUTION

- Do not install a power factor correction capacitor, surge suppressor or radio noise filter on the inverter output side. These devices on the inverter output side may be overheated or burn out.
- The connection orientation of the output cables U, V, W to the motor affects the rotation direction of the motor.
- IPM motor terminals (U, V, W) hold high-voltage while the IPM motor is running even after the power is turned OFF. Before wiring, the IPM motor must be confirmed to be stopped. Otherwise you may get an electric shock.
- Never connect an IPM motor to the commercial power supply. Applying the commercial power supply to input terminals (U, V, W) of an IPM motor will burn the IPM motor. The IPM motor must be connected with the output terminals (U, V, W) of the inverter.

**(3) Test operation and adjustment**

⚠ CAUTION

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

**(4) Operation** ⚠ WARNING

- The IPM motor capacity must be the same or the one rank lower than the inverter capacity.
- Do not use multiple IPM motors with one inverter.
- Any person must stay away from the equipment when the retry function is set as it will restart suddenly after trip.
- Since pressing 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.
- OFF status of the start signal must be confirmed before resetting the inverter fault. Resetting inverter alarm with the start signal ON restarts the motor suddenly.
- Do not use an IPM motor in an application where a motor is driven by its load and runs at a speed higher than the maximum motor speed.
- An IPM motor must be used under PM sensorless vector control. Do not use a synchronous motor, induction motor, or synchronous induction motor under PM sensorless vector control.
- The inverter must be used for three-phase induction motors or IPM motors.
  Connection of any other electrical equipment to the inverter output may damage the equipment.
- Performing pre-excitation (LX signal and X13 signal) under torque control (Real sensorless vector control) may start the motor running at a low speed even when the start command (STF or STR) is not input. The motor may also run at a low speed when the speed limit value = 0 with a start command input. It must be confirmed that the motor running will not cause any safety problem before performing pre-excitation.
- Do not modify the equipment.
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the inverter.

⚠ CAUTION

- 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 use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter. Otherwise the life of the inverter decreases.
- The effect of electromagnetic interference must be reduced by using a noise filter or by other means. Otherwise nearby electronic equipment may be affected.
- Appropriate measures must be taken to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power factor correction capacitor and generator.
- When driving a 400V class motor by the inverter, the motor must be an insulation-enhanced motor or measures must be taken to suppress surge voltage. Surge voltage attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations because all parameters return to the initial value.
- 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.
- Stop status cannot be held by the inverter's brake function. In addition to the inverter's brake function, a holding device must be installed to ensure safety.
- Before running an inverter which had been stored for a long period, inspection and test operation must be performed.
- Static electricity in your body must be discharged before you touch the product. Otherwise the product may be damaged.
- Do not connect an IPM motor under the induction motor control settings (initial settings). Do not use an induction motor under the PM sensorless vector control settings. Doing so will cause a failure.
- In the system with an IPM motor, the inverter power must be turned ON before closing the contacts of the contactor at the output side.

**(5) Emergency stop** ⚠ CAUTION

- A safety backup such as an emergency brake must be provided to prevent hazardous condition to the machine and equipment in case of inverter failure.
- When the breaker on the inverter input side trips, the wiring must be checked for fault (short circuit), and internal parts of the inverter for a damage, etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.
- When any protective function is activated, appropriate corrective action must be taken, and the inverter must be reset before resuming operation.

**(6) Maintenance, inspection and parts replacement**

⚠ CAUTION

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

**(7) Disposing of the inverter**

⚠ CAUTION

- The inverter must be treated as industrial waste.

General instructions

Many of the diagrams and drawings in this Instruction Manual (Basic) show the inverter without a cover or partially open for explanation. Never operate the inverter in this manner. The cover must be always reinstalled and the instruction in this Instruction Manual (Basic) must be followed when operating the inverter.
For more details on an IPM motor, refer to the Instruction Manual of the IPM motor.

# — CONTENTS —

<Abbreviations>
- DU: Operation panel (FR-DU07)
- PU: Operation panel(FR-DU07) and parameter unit (FR-PU04, FR-PU07)
- Inverter: Mitsubishi inverter FR-A700 series
- FR-A700: Mitsubishi inverter FR-A700 series
- Pr.: Parameter Number (Number assigned to function)
- PU operation: Operation using the PU (FR-DU07/FR-PU04/FR-PU07).
- External operation: Operation using the control circuit signals
- Combined operation: Combined operation using the PU (FR-DU07/FR-PU04/FR-PU07) and external operation
- Standard motor: SF-JR
- Constant-torque motor: SF-HRCA
- Vector control dedicated motor: SF-V5RU

The following marks are used to indicate the controls as below.
(Parameters without any mark are valid for all control)

| Mark | Control method | Applied motor |
|---|---|---|
| V/F | V/F control | Three-phase induction motor |
| Magnetic flux | Advanced magnetic flux vector control | |
| Sensorless | Real sensorless vector control | |
| Vector | Vector control | |
| P M | PM sensorless vector control | IPM motor |

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- Company and product names herein are the trademarks and registered trademarks of their respective owners.

<Notes on descriptions in this Instruction Manual>
- Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to *page 22*.)

Harmonic Suppression Guideline

All models of general-purpose inverters used by specific consumers are covered by the "Harmonic Suppression Guideline for Consumers Who Receive High Voltage or Special High Voltage". (*For further details, refer to Chapter 3 of the Instruction Manual (Applied)*)

# 1 OUTLINE

## 1.1 Product checking and parts identification

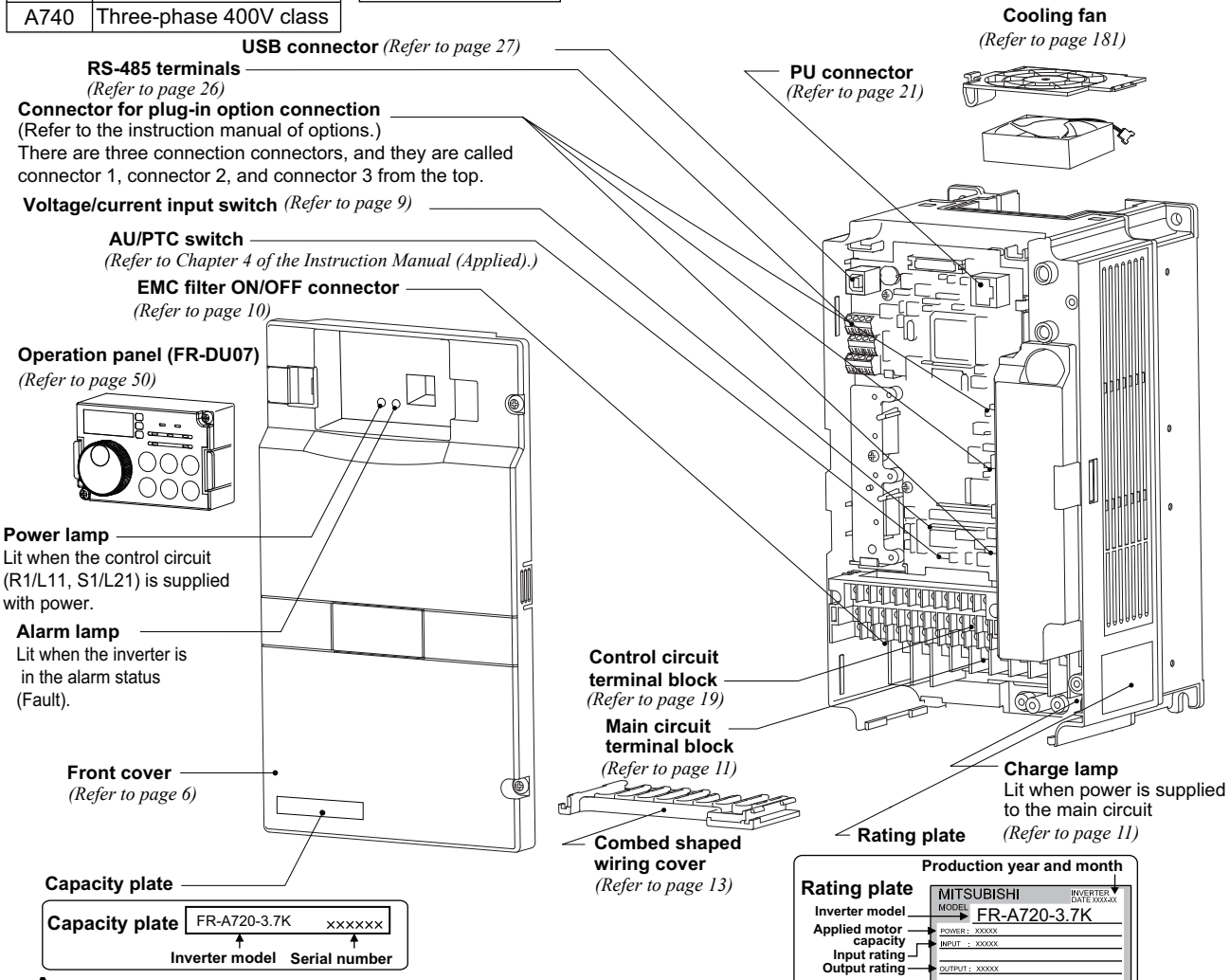
Unpack the inverter and check the capacity plate on the front cover and the rating plate on the inverter side face to ensure that the product agrees with your order and the inverter is intact.

### · Inverter Model

FR - A720 - 3.7 K

| Symbol | Voltage Class |
|---|---|
| A720 | Three-phase 200V class |
| A740 | Three-phase 400V class |

Represents inverter capacity (kW)




### • Accessory

· **Fan cover fixing screws (22K or lower) (*Refer to page 213*)**
These screws are necessary for compliance with the EU Directive.

| Capacity | | Screw Size (mm) | Quantity |
|---|---|---|---|
| 200V | 1.5K to 3.7K | M3 × 35 | 1 |
| | 5.5K to 11K | M4 × 40 | 2 |
| | 15K to 22K | M4 × 50 | 1 |
| 400V | 2.2K, 3.7K | M3 × 35 | 1 |
| | 5.5K to 15K | M4 × 40 | 2 |
| | 18.5K, 22K | M4 × 50 | 1 |

· **DC reactor supplied (75K or higher)**

· **Eyebolt for hanging the inverter (30K to 280K)**

| Capacity | Eyebolt Size | Quantity |
|---|---|---|
| 30K | M8 | 2 |
| 37K to 132K | M10 | 2 |
| 160K to 280K | M12 | 2 |

**REMARKS**

· For removal and reinstallation of covers, *refer to page 6*.

### • How to read SERIAL

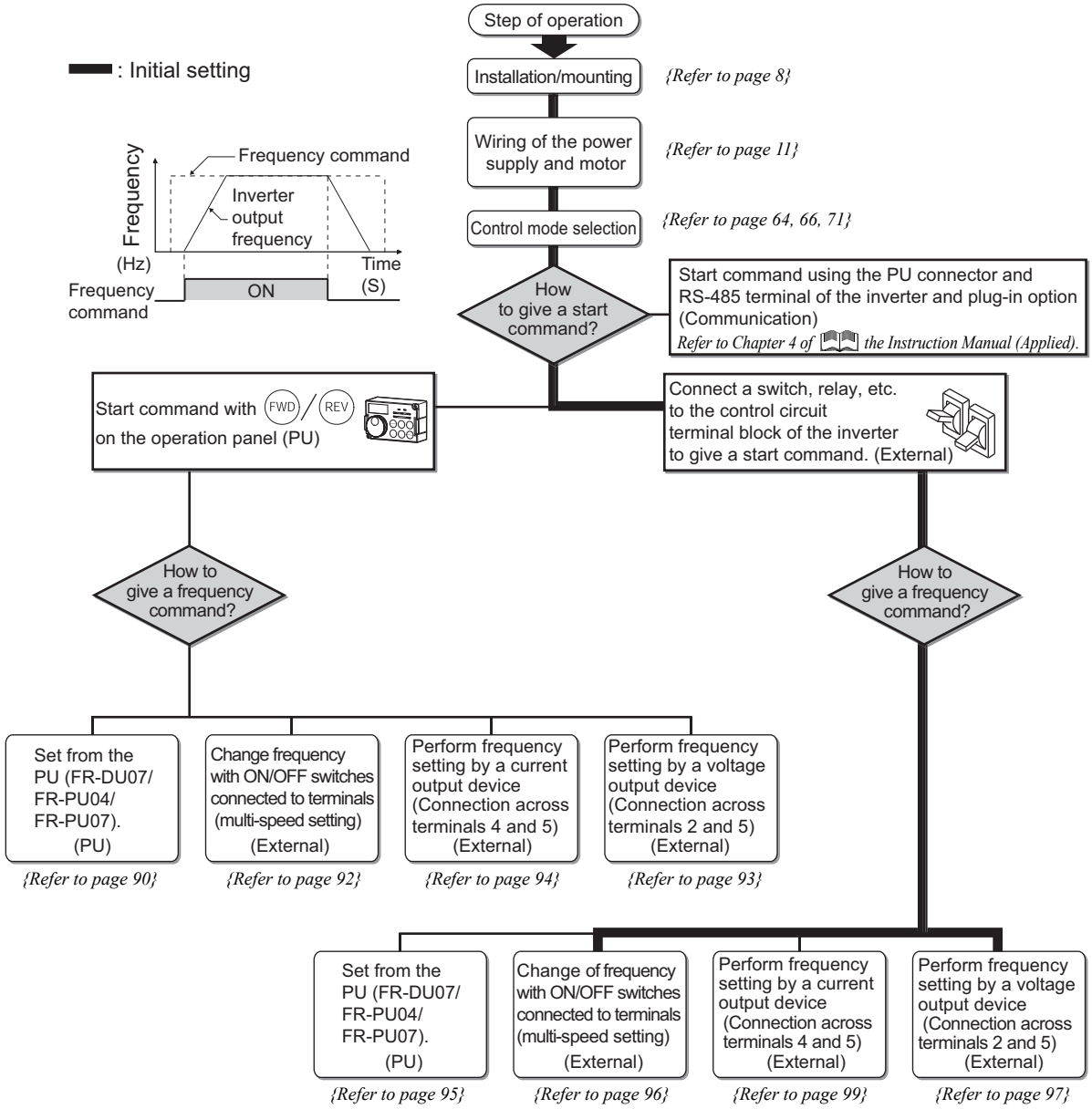
**Rating plate example**

□ ○ ○ ○○○○○○
Symbol Year Month Control number
SERIAL

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

# 1.2 Step of operation

The inverter needs frequency command and start command. Frequency command (set frequency) determines the rotation speed of the motor. Turning ON the start command starts the motor to rotate.
Refer to the flow chart below to perform setting.




**CAUTION**

Check the following items before powering on the inverter.

- Check that the inverter is installed correctly in a correct place. *(Refer to page 8)*
- Check that wiring is correct. *(Refer to page 9)*
- Check that no load is connected to the motor.

- *When protecting the motor from overheat by the inverter, set Pr.9 Electronic thermal O/L relay (Refer to page 59)*
- *When the rated motor frequency under V/F control is 50Hz, set the Pr.3 Base frequency. (Refer to page 59)*

# 2 INSTALLATION AND WIRING

**Three-phase AC power supply**
Use within the permissible power supply specifications of the inverter.
*(Refer to page 185)*

**Moulded case circuit breaker (MCCB) or earth leakage current breaker (ELB), fuse**
The breaker must be selected carefully since an inrush current flows in the inverter at power on.
*(Refer to page 5)*

**Magnetic contactor (MC)**
Install the magnetic contactor to ensure safety. Do not use the magnetic contactor for frequent starting/stopping of the inverter. Doing so will cause the inverter life to be shortened.
*(Refer to page 46)*

**Reactor (FR-HAL, FR-HEL option)**
Install reactors to suppress harmonics and to improve the power factor. An AC reactor (FR-HAL) (option) is required when installing the inverter near a large power supply system (1000kVA or more).
The inverter may be damaged if you do not use a reactor. Select a reactor according to the model. Remove the jumpers across terminals P/+ and P1 to connect the DC reactor to the 55K or lower.
*(Refer to Chapter 2 of the Instruction Manual (Applied))*

**USB connector** *(Refer to page 27)*
A personal computer and an inverter can be connected with a USB (Ver1. 1) cable.

**Inverter (FR-A700)**
The life of the inverter is influenced by surrounding air temperature. The surrounding air temperature should be as low as possible within the permissible range. This must be noted especially when the inverter is installed in an enclosure. *(Refer to page 8)*
Wrong wiring might lead to damage of the inverter. The control signal lines must be kept fully away from the main circuit to protect them from noise.*(Refer to page 9)*
Refer to *page 10* for the built-in noise filter.

**High-duty brake resistor (FR-ABR*4)**
Braking capability of the inverter built-in brake can be improved.
Remove the jumper across terminal PR-PX when connecting the high-duty brake resistor. (7.5K or lower)
Always install a thermal relay when using a brake resistor whose capacity is 11K or higher.
*(Refer to page 35)*
*4 Compatible with the 22K or lower.

**AC reactor (FR-HAL)**

**DC reactor (FR-HEL)**
For the 75K or higher, a DC reactor is supplied. Always install the reactor.

**Line noise filter (FR-BLF)**
The 55K or lower has a built-in common mode choke.

P/+ P1 R/L1 S/L2 T/L3 P/+ N/-

IM connection

U V W

Earth (Ground)

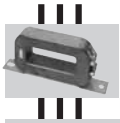
Induction motor

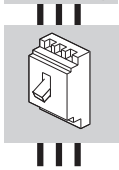
Earth (Ground)

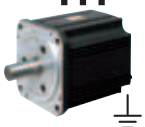
P/+ PR

IPM connection

U V W







Earth (Ground)

**EMC filter (ferrite core) (FR-BSF01, FR-BLF)**
Install an EMC filter (ferrite core) to reduce the electromagnetic noise generated from the inverter. Effective in the range from about 0.5MHz to 5MHz.
A wire should be wound four turns at a maximum.
*(Refer to Chapter 3 of the Instruction Manual (Applied))*

**Contactor**
**Example) No-fuse switch (DSN type)**
Install a contactor in an application where the IPM motor is driven by the load even at power-OFF of the inverter. Do not open or close the contactor while the inverter is running (outputting).

**IPM motor (MM-CF)**
Use the specified motor. IPM motors cannot be driven by the commercial power supply.
For the use of an IPM motor other than MM-CF, contact your sales representative.
*(Refer to page 189)*

**High power factor converter (FR-HC2*3)**
Power supply harmonics can be greatly suppressed.
Install this as required.

**Power regeneration common converter (FR-CV*1)**
**Power regeneration converter (MT-RC*2)**
Great braking capability is obtained.
Install this as required.

**Brake unit (FR-BU2*3, FR-BU*1, MT-BU5*2)**

P/+ PR
P/+
PR

**Resistor unit (FR-BR*1, MT-BR5*2)**
The regenerative braking capability of the inverter can be exhibited fully.
Install this as required.

**Devices connected to the output**
Do not install a power factor correction capacitor, surge suppressor or radio noise filter on the output side of the inverter. When installing a moulded case circuit breaker on the output side of the inverter, contact each manufacturer for selection of the moulded case circuit breaker.

**Earth (Ground)**
To prevent an electric shock, always earth (ground) the motor and inverter.

*1 Compatible with the 55K or lower.
*2 Compatible with the 75K or higher.
*3 Compatible with all capacities.

: Install these options as required.

## CAUTION

- Do not install a power factor correction capacitor, surge suppressor or radio noise filter on the inverter output side. This will cause the inverter to trip or the capacitor, and surge suppressor to be damaged. If any of the above devices are connected, immediately remove them.
- 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 this case, set the EMC filter valid to minimize interference.
  *(Refer to Chapter 2 of the Instruction Manual (Applied))*
- Refer to the instruction manual of each option and peripheral devices for details of peripheral devices.
- An IPM motor cannot be driven by the commercial power supply.
- An IPM motor is a motor with permanent magnets embedded inside. High-voltage is generated at motor terminals while the motor is running even after the inverter power is turned OFF. Before closing the contactor at the output side, make sure that the inverter power is ON and the motor is stopped.

# 2.1 Peripheral devices

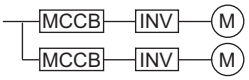
Check the inverter model of the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the following list and prepare appropriate peripheral devices:

**200V class**

| Motor Output (kW) *1 | Applicable Inverter Model | Moulded Case Circuit Breaker (MCCB) *2 or Earth Leakage Circuit Breaker (ELB) (NF or NV type) | | Input Side Magnetic Contactor*3 | |
|---|---|---|---|---|---|
| | | Power factor improving (AC or DC) reactor | | Power factor improving (AC or DC) reactor | |
| | | without | with | without | with |
| 0.4 | FR-A720-0.4K | 5A | 5A | S-T10 | S-T10 |
| 0.75 | FR-A720-0.75K | 10A | 10A | S-T10 | S-T10 |
| 1.5 | FR-A720-1.5K | 15A | 15A | S-T10 | S-T10 |
| 2.2 | FR-A720-2.2K | 20A | 15A | S-T10 | S-T10 |
| 3.7 | FR-A720-3.7K | 30A | 30A | S-T21 | S-T10 |
| 5.5 | FR-A720-5.5K | 50A | 40A | S-N25 | S-T21 |
| 7.5 | FR-A720-7.5K | 60A | 50A | S-N25 | S-N25 |
| 11 | FR-A720-11K | 75A | 75A | S-N35 | S-N35 |
| 15 | FR-A720-15K | 125A | 100A | S-N50 | S-N50 |
| 18.5 | FR-A720-18.5K | 150A | 125A | S-N65 | S-N50 |
| 22 | FR-A720-22K | 175A | 150A | S-N80 | S-N65 |
| 30 | FR-A720-30K | 225A | 175A | S-N95 | S-N80 |
| 37 | FR-A720-37K | 250A | 225A | S-N150 | S-N125 |
| 45 | FR-A720-45K | 300A | 300A | S-N180 | S-N150 |
| 55 | FR-A720-55K | 400A | 350A | S-N220 | S-N180 |
| 75 | FR-A720-75K | — | 400A | — | S-N300 |
| 90 | FR-A720-90K | — | 400A | — | S-N300 |

*1 Motor Output (kW) in the above table indicates values when using the IPM motor MM-CF or the Mitsubishi 4-pole standard motor with power supply voltage of 200VAC 50Hz.

*2 Select the MCCB according to the power supply capacity. Install one MCCB per inverter.
For installation in the United States or Canada, select a fuse in accordance with UL, cUL, the National Electrical Code and any applicable local codes, or use UL 489 Molded Case Circuit Breaker (MCCB).
*(Refer to page 210.)*




*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stop during motor driving, the electrical durability is 25 times.
If using an MC for emergency stop during motor driving, select an MC regarding the inverter input side current as JEM1038-AC-3 class rated current. When using an MC on the inverter output side for commercial-power supply operation switching using a general-purpose motor, select an MC regarding the rated motor current as JEM1038-AC-3 class rated current.

**CAUTION**

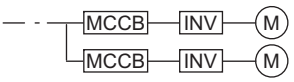
- When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter model and cable and reactor according to the motor output.
- When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.

## 400V class

| Motor Output (kW) *1 | Applicable Inverter Model | Moulded Case Circuit Breaker (MCCB) *2 or Earth Leakage Circuit Breaker (ELB) (NF or NV type) | | Input Side Magnetic Contactor*3 | |
|---|---|---|---|---|---|
| | | Power factor improving (AC or DC) reactor | | Power factor improving (AC or DC) reactor | |
| | | without | with | without | with |
| 0.4 | FR-A740-0.4K | 5A | 5A | S-T10 | S-T10 |
| 0.75 | FR-A740-0.75K | 5A | 5A | S-T10 | S-T10 |
| 1.5 | FR-A740-1.5K | 10A | 10A | S-T10 | S-T10 |
| 2.2 | FR-A740-2.2K | 10A | 10A | S-T10 | S-T10 |
| 3.7 | FR-A740-3.7K | 20A | 15A | S-T10 | S-T10 |
| 5.5 | FR-A740-5.5K | 30A | 20A | S-T21 | S-T12 |
| 7.5 | FR-A740-7.5K | 30A | 30A | S-T21 | S-T21 |
| 11 | FR-A740-11K | 50A | 40A | S-T21 | S-T21 |
| 15 | FR-A740-15K | 60A | 50A | S-N25 | S-T21 |
| 18.5 | FR-A740-18.5K | 75A | 60A | S-N25 | S-N25 |
| 22 | FR-A740-22K | 100A | 75A | S-N35 | S-N25 |
| 30 | FR-A740-30K | 125A | 100A | S-N50 | S-N50 |
| 37 | FR-A740-37K | 150A | 125A | S-N65 | S-N50 |
| 45 | FR-A740-45K | 175A | 150A | S-N80 | S-N65 |
| 55 | FR-A740-55K | 200A | 175A | S-N80 | S-N80 |
| 75 | FR-A740-75K | — | 225A | — | S-N95 |
| 90 | FR-A740-90K | — | 225A | — | S-N150 |
| 110 | FR-A740-110K | — | 225A | — | S-N180 |
| 132 | FR-A740-132K | — | 400A | — | S-N220 |
| 160 | FR-A740-160K | — | 400A | — | S-N300 |
| 185 | FR-A740-185K | — | 400A | — | S-N300 |
| 220 | FR-A740-220K | — | 500A | — | S-N400 |
| 250 | FR-A740-250K | — | 600A | — | S-N600 |
| 280 | FR-A740-280K | — | 600A | — | S-N600 |
| 315 | FR-A740-315K | — | 700A | — | S-N600 |
| 355 | FR-A740-355K | — | 800A | — | S-N600 |
| 400 | FR-A740-400K | — | 900A | — | S-N800 |
| 450 | FR-A740-450K | — | 1000A | — | 1000A Rated product |
| 500 | FR-A740-500K | — | 1200A | — | 1000A Rated product |

*1 Motor Output (kW) in the above table indicates values when using the Mitsubishi 4-pole standard motor with power supply voltage of 400VAC 50Hz.

*2 Select the MCCB according to the power supply capacity. Install one MCCB per inverter.
For installation in the United States or Canada, select a fuse in accordance with UL, cUL, the National Electrical Code and any applicable local codes, or use UL 489 Molded Case Circuit Breaker (MCCB).
*(Refer to page 210.)*




*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stop during motor driving, the electrical durability is 25 times.
If using an MC for emergency stop during motor driving, select an MC regarding the inverter input side current as JEM1038-AC-3 class rated current. When using an MC on the inverter output side for commercial-power supply operation switching using a general-purpose motor, select an MC regarding the rated motor current as JEM1038-AC-3 class rated current.

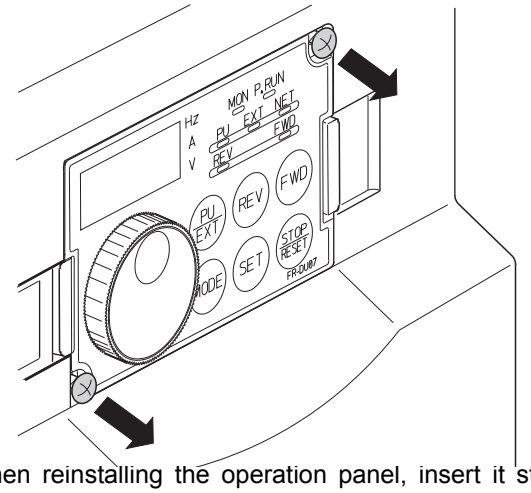
**CAUTION**

- When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter model, and select cable and reactor according to the motor output.
- When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.

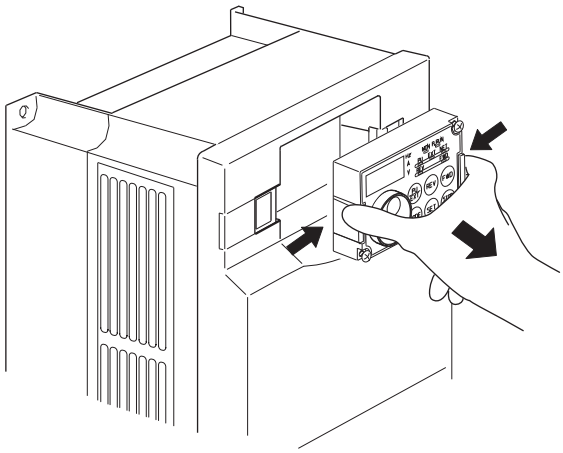
## 2.2 Method of removal and reinstallation of the front cover

**•Removal of the operation panel**

1) Loosen the two screws on the operation panel. (These screws cannot be removed.)




2) Push the left and right hooks of the operation panel and pull the operation panel toward you to remove.



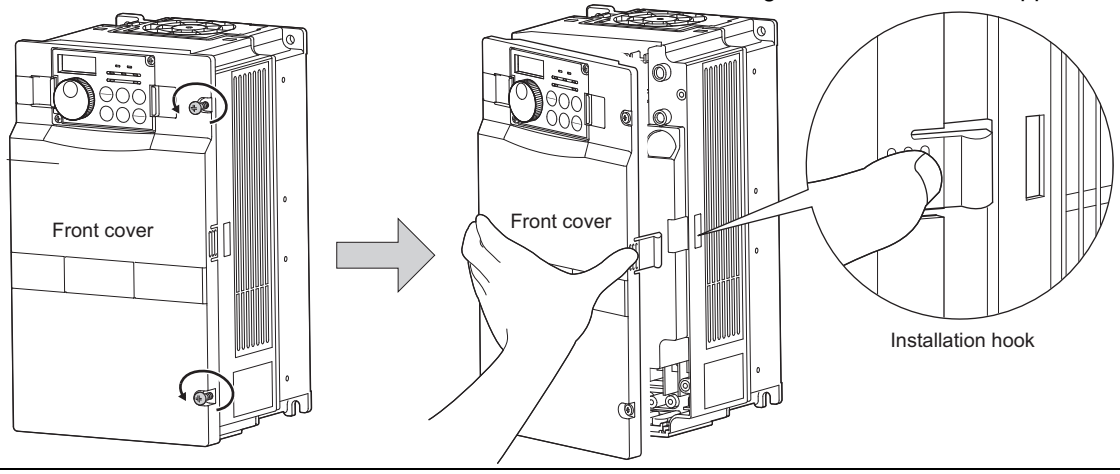
When reinstalling the operation panel, insert it straight to reinstall securely and tighten the fixed screws of the operation panel. (Tightening torque: 0.40N·m to 0.45N·m)

**22K or lower**

**•Removal**

1) Loosen the mounting screws of the front cover.

2) Pull the front cover toward you to remove by pushing an installation hook using left fixed hooks as supports.

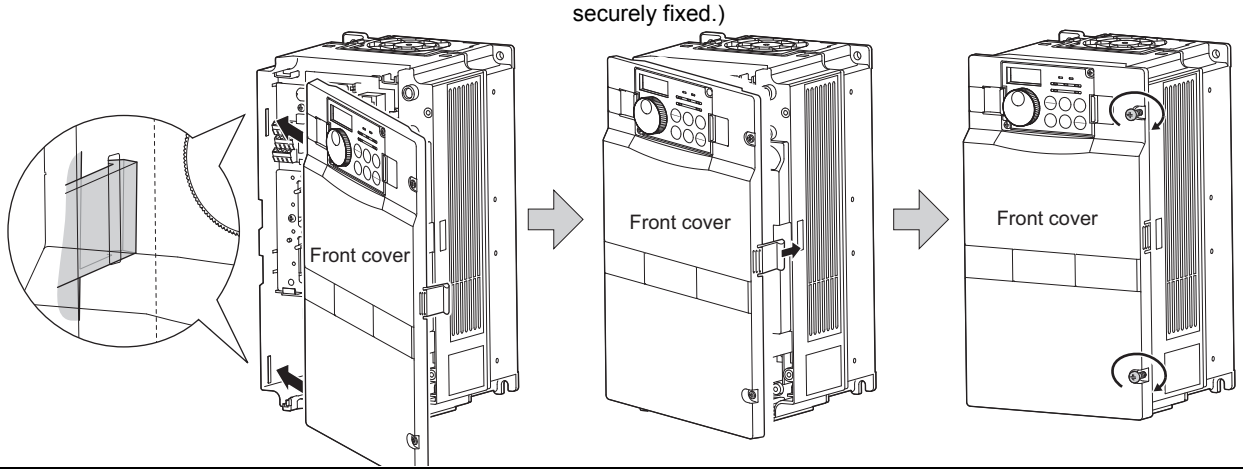



**•Reinstallation**

1) Insert the two fixed hooks on the left side of the front cover into the sockets of the inverter.

2) Using the fixed hooks as supports, securely press the front cover against the inverter. (Although installation can be done with the operation panel mounted, make sure that a connector is securely fixed.)

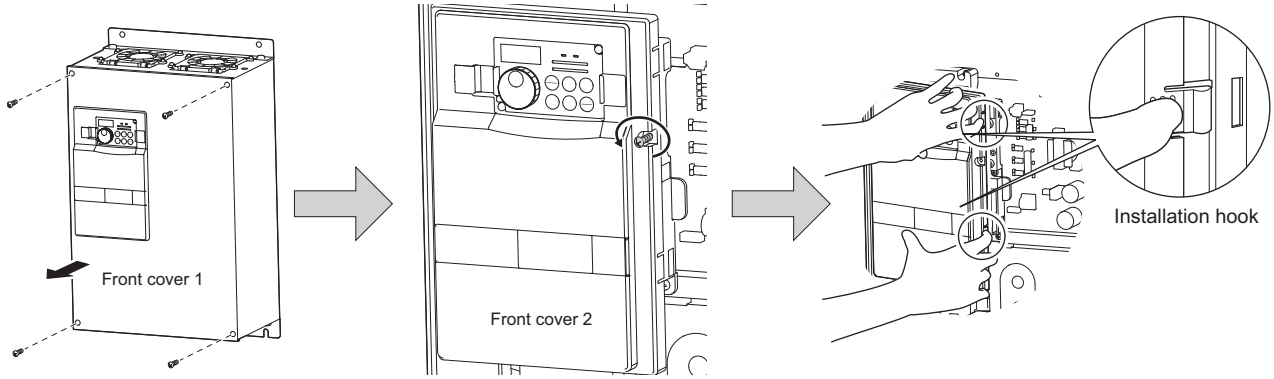
3) Tighten the mounting screws and fix the front cover.



## 30K or higher

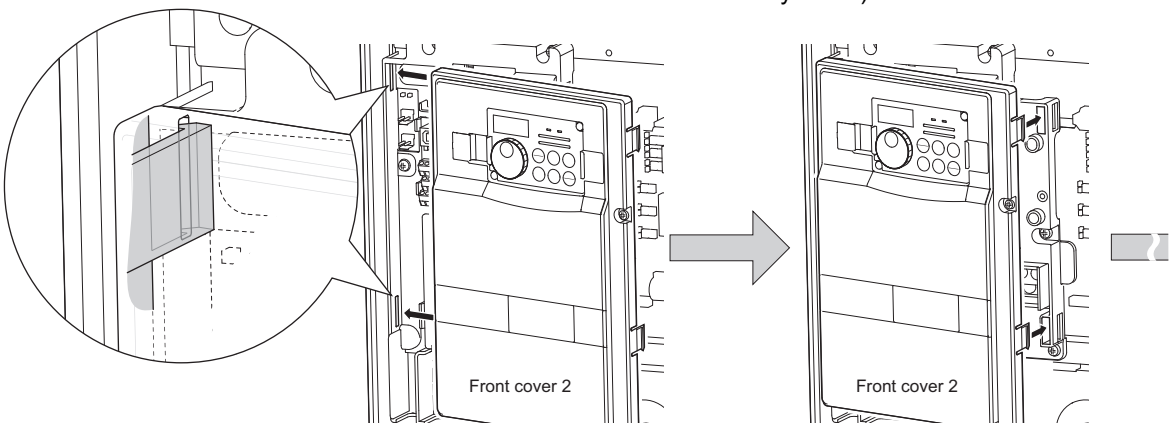
**•Removal**

1) Remove mounting screws on the front cover 1 to remove the front cover 1.
2) Loosen the mounting screws of the front cover 2.
3) Pull the front cover 2 toward you to remove by pushing an installation hook on the right side using left fixed hooks as supports.

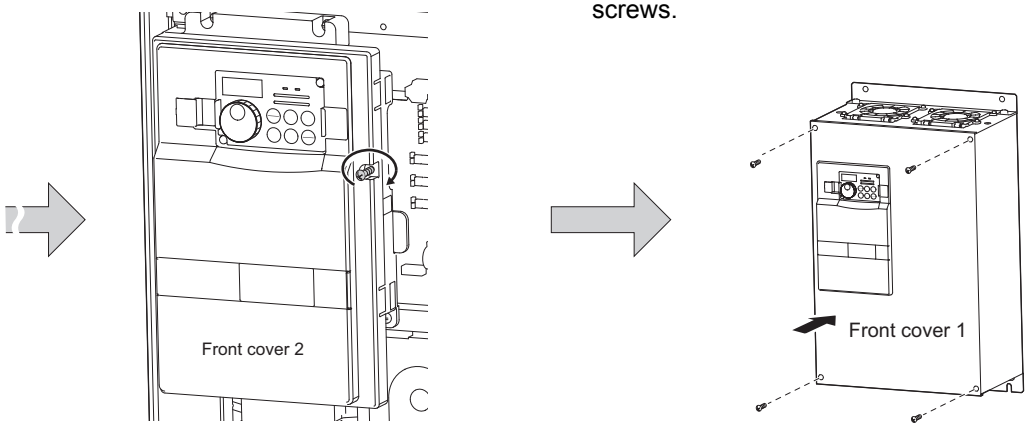



**•Reinstallation**

1) Insert the two fixed hooks on the left side of the front cover 2 into the sockets of the inverter.
2) Using the fixed hooks as supports, securely press the front cover 2 against the inverter.
(Although installation can be done with the operation panel mounted, make sure that a connector is securely fixed.)




3) Fix the front cover 2 with the mounting screws.
4) Fix the front cover 1 with the mounting screws.




**REMARKS**

· For the FR-A720-55K and the FR-A740-160K or higher, the front cover 1 is separated into two parts.

**CAUTION**

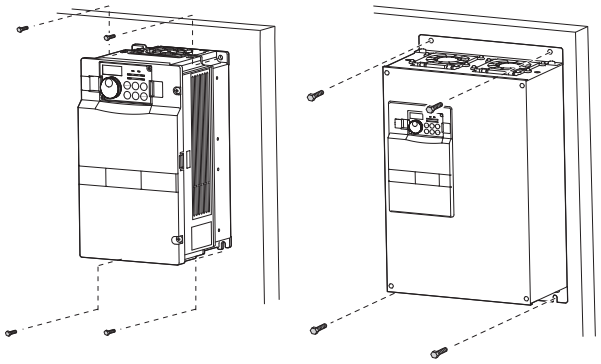
1. Fully make sure that the front cover has been reinstalled securely. Always tighten the mounting screws of the front cover.
2. The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Before reinstalling the front cover, check the serial numbers to ensure that the cover removed is reinstalled to the inverter from where it was removed.

# 2.3 Installation of the inverter and instructions

• Installation of the Inverter

Installation on the enclosure

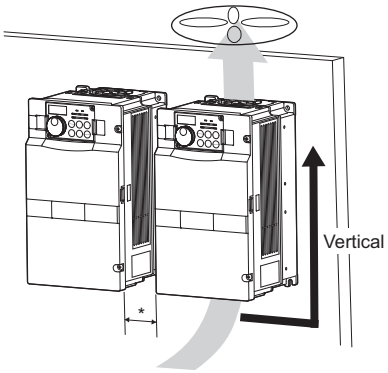
**0.4K to 22K** **30K or higher**



Fix six positions for the FR-A740-160K to 355K and fix eight positions for the FR-A740-400K to 500K.

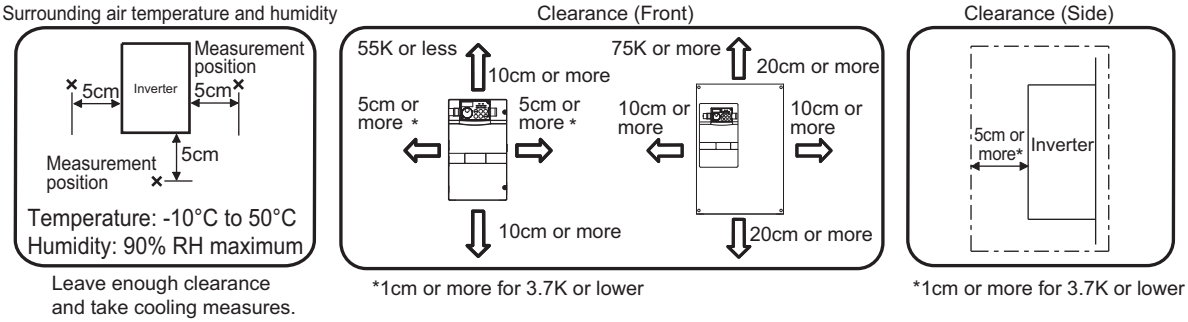
**CAUTION**

- When encasing multiple inverters, install them in parallel as a cooling measure.
- Install the inverter vertically.




* Refer to the clearance below.

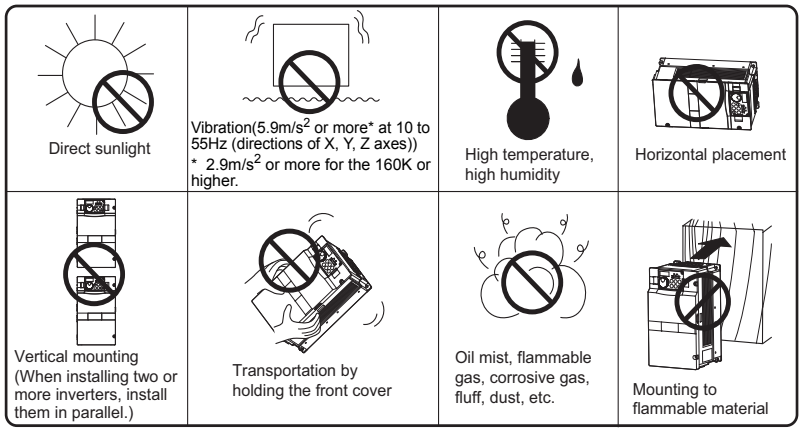
• Install the inverter under the following conditions.




**REMARKS**

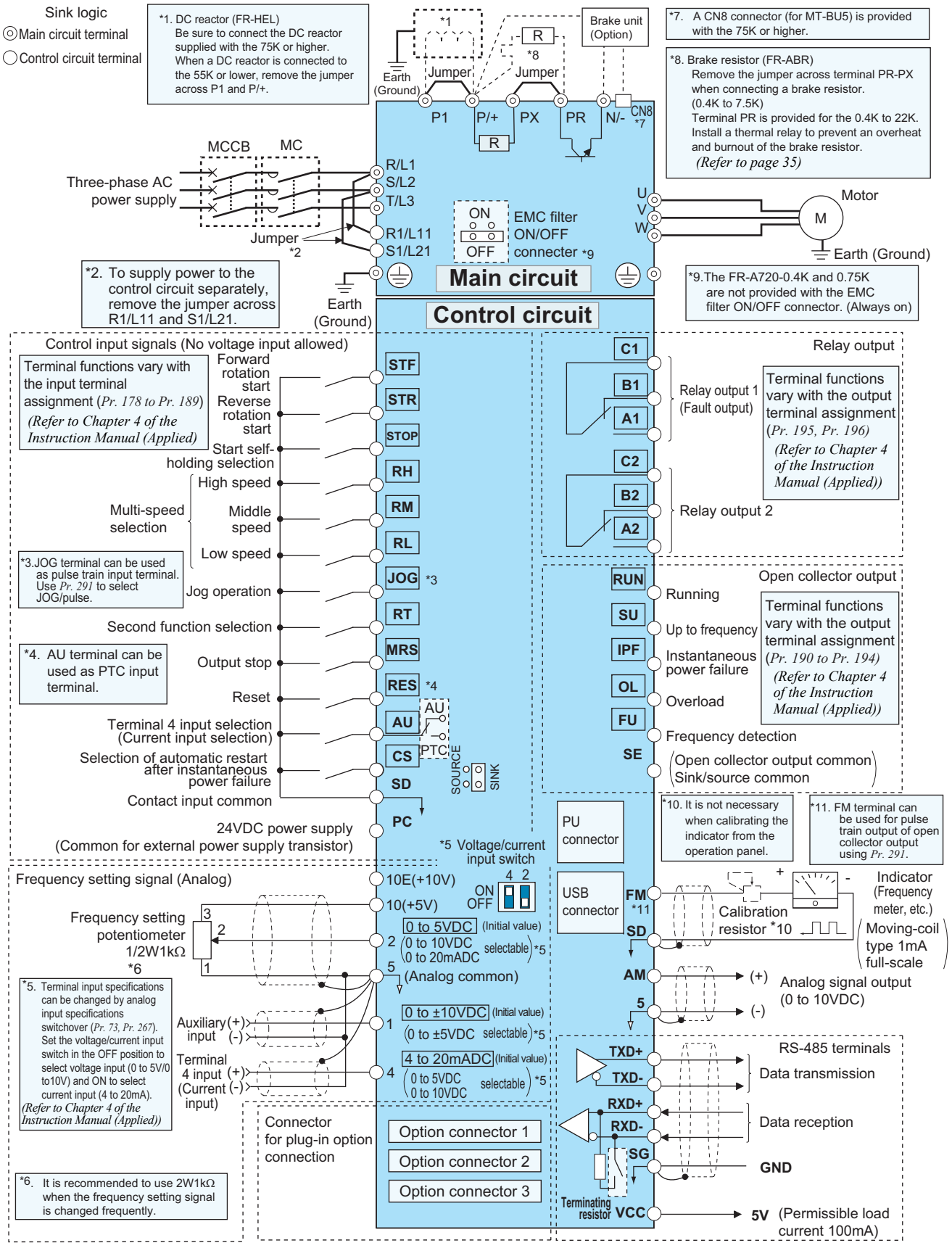
For replacing the cooling fan of the FR-A740-160K or higher, 30cm of space is necessary in front of the inverter.
Refer to *page 181* for fan replacement.

• The inverter consists of precision mechanical and electronic parts. Never install or handle it in any of the following conditions as doing so could cause an operation fault or failure.



# 2.4 Wiring

## 2.4.1 Terminal connection diagram

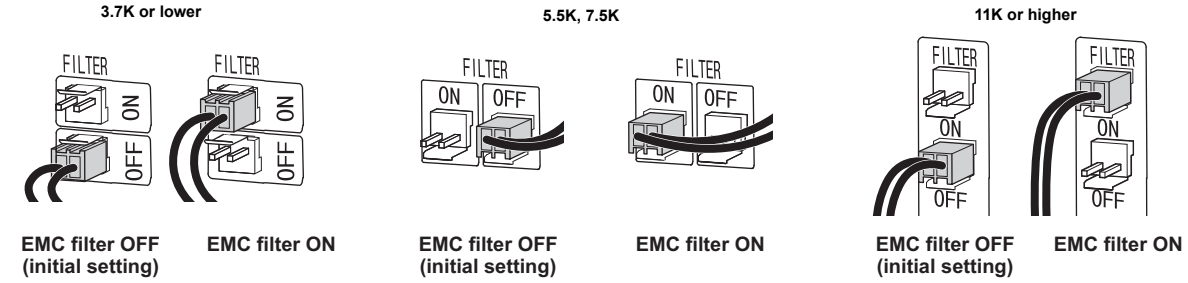


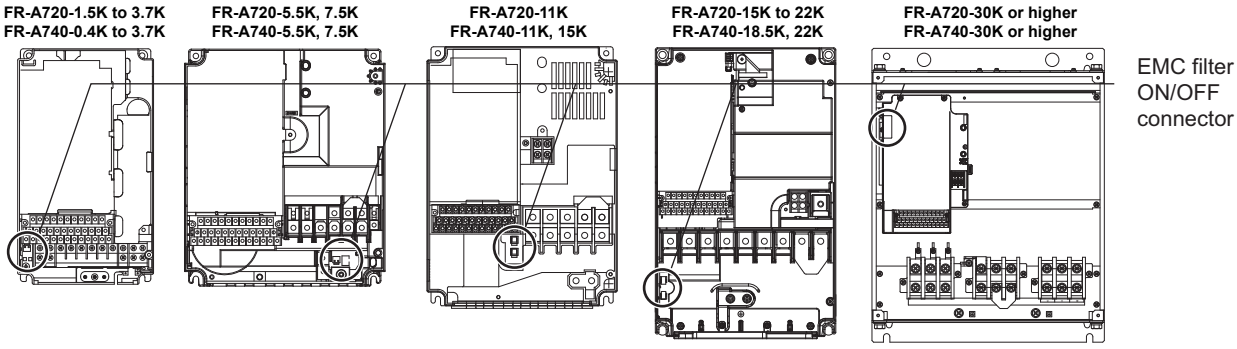

**CAUTION**

- To prevent a malfunction due to noise, keep the signal cables more than 10cm away from the power cables. Also separate the main circuit wire of the input side and 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 care not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch correctly. Different setting may cause a fault, failure or malfunction.

### 2.4.2 EMC filter

This inverter is equipped with a built-in EMC filter (capacitive filter) and common mode choke.
Effective for reduction of air-propagated noise on the input side of the inverter.
The EMC filter is factory-set to disable (OFF).
To enable it, fit the EMC filter ON/OFF connector to the ON position.
The input side common mode choke, built-in the 55K or lower inverter, is always valid regardless of on/off of the EMC filter on/off connector.



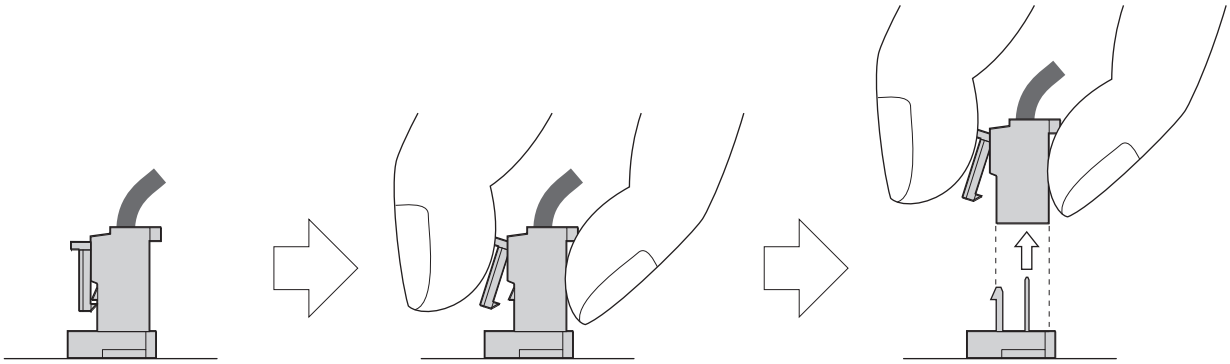




The FR-A720-0.4K and 0.75K are not provided with the EMC filter ON/OFF connector. (The EMC filter is always valid.)

**<How to disconnect the connector>**

(1) Before removing a front cover, check to make sure that the indication of the inverter operation panel is OFF, wait for at least 10 minutes after the power supply has been switched OFF, and check that there are no residual voltage using a tester or the like. (*Refer to page 6.*)

(2) When disconnecting the connector, push the fixing tab and pull the connector straight without pulling the cable or forcibly pulling the connector with the tab fixed. When installing the connector, also engage the fixing tab securely. If it is difficult to disconnect the connector, use a pair of long-nose pliers, etc.




**CAUTION**

- Fit the connector to either ON or OFF.
- Enabling (turning on) the EMC filter increases leakage current. *(Refer to Chapter 3 of the Instruction Manual (Applied))*

## ⚠ WARNING

⚠ While power is ON or when the inverter is running, do not open the front cover. Otherwise you may get an electric shock.

### 2.4.3 Specification of main circuit terminal

| Terminal Symbol | Terminal Name | Description | Refer to page |
|---|---|---|---|
| **R/L1, S/L2, T/L3** | **AC power input** | Connect to the commercial power supply.<br>Keep these terminals open when using the high power factor converter (FR-HC2) or power regeneration common converter (FR-CV). | — |
| **U, V, W** | **Inverter output** | Connect a three-phase squirrel-cage motor or an IPM motor. | — |
| **R1/L11, S1/L21** | **Power supply for control circuit** | Connected to the AC power supply terminals R/L1 and S/L2. To retain the fault display and fault output or when using the high power factor converter (FR-HC2) or power regeneration common converter (FR-CV), remove the jumpers from terminals R/L1-R1/L11 and S/L2-S1/L21 and apply external power to these terminals.<br>The power capacity necessary when separate power is supplied from R1/L11 and S1/L21 differs according to the inverter capacity. | 17 |
| **P/+, PR** | **Brake resistor connection (22K or lower)** | Remove the jumper from terminals PR-PX (7.5K or lower) and connect an optional brake resistor (FR-ABR) across terminals P/+-PR.<br>For the 22K or lower, connecting the resistor further provides regenerative braking power. | 35 |
| **P/+, N/-** | **Brake unit connection** | Connect the brake unit (FR-BU2, FR-BU, BU and MT-BU5), power regeneration common converter (FR-CV), power regeneration converter (MT-RC), high power factor converter (FR-HC2) or DC power supply (under the DC feeding mode). | 37 |
| **P/+, P1** | **DC reactor connection** | For the 55K or lower, remove the jumper across terminals P/+ - P1 and connect the DC reactor. (As a DC reactor is supplied with the 75K or higher as standard, be sure to connect the DC reactor.)<br>Keep the jumper across P/+ and P1 attached when a DC reactor is not connected. | 45 |
| **PR, PX** | **Built-in brake circuit connection** | When the jumper is connected across terminals PX-PR (initial status), the built-in brake circuit is valid. (Provided for the 7.5K or lower.) | — |
| ⏚ | **Earth (Ground)** | For earthing (grounding) the inverter chassis. Must be earthed (grounded). | 15 |

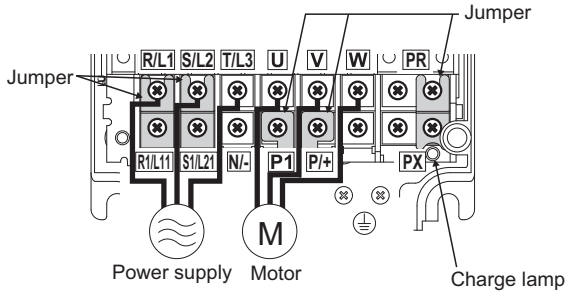
| | 11K or lower | 15K | 18.5K or higher |
|---|---|---|---|
| **200V class** | 60VA | 80VA | 80VA |
| **400V class** | 60VA | 60VA | 80VA |

**CAUTION**

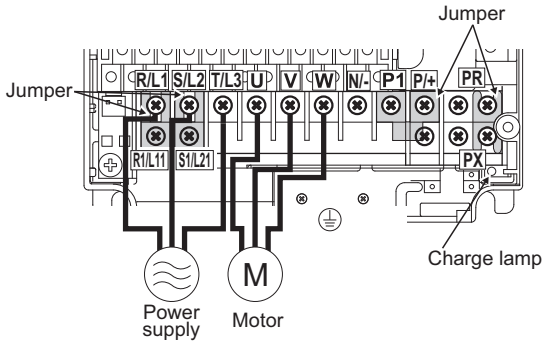
· When connecting a dedicated brake resistor (FR-ABR) and brake unit (FR-BU2, FR-BU, BU) remove jumpers across terminals PR-PX (7.5K or lower). For details, refer to *page 35*.

### 2.4.4 Terminal arrangement of the main circuit terminal, power supply and the motor wiring

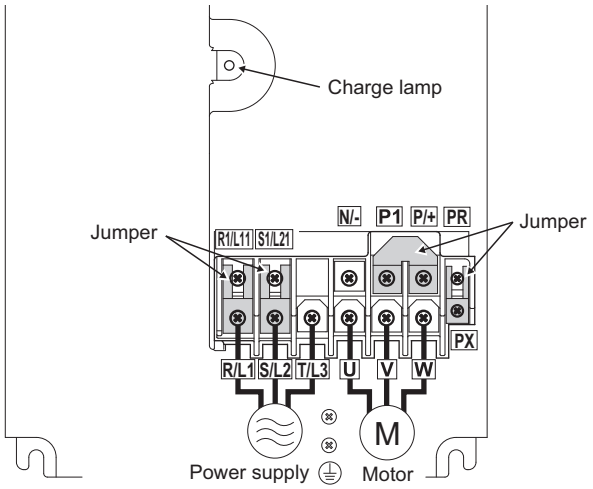
FR-A720-0.4K, 0.75K



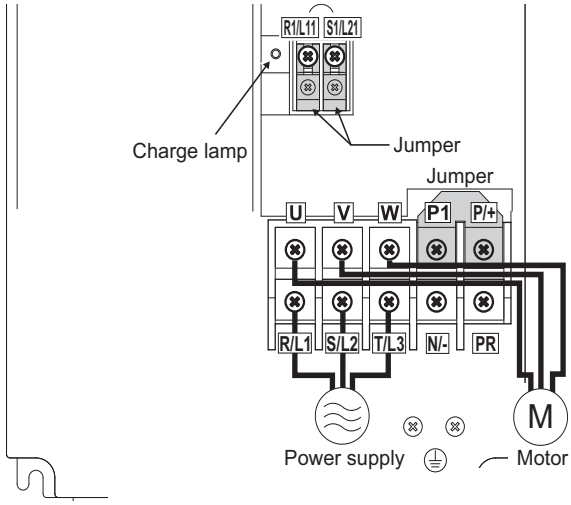

FR-A720-1.5K to 3.7K
FR-A740-0.4K to 3.7K



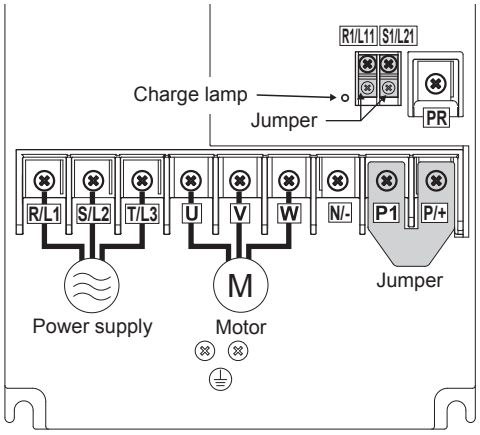
FR-A720-5.5K, 7.5K
FR-A740-5.5K, 7.5K



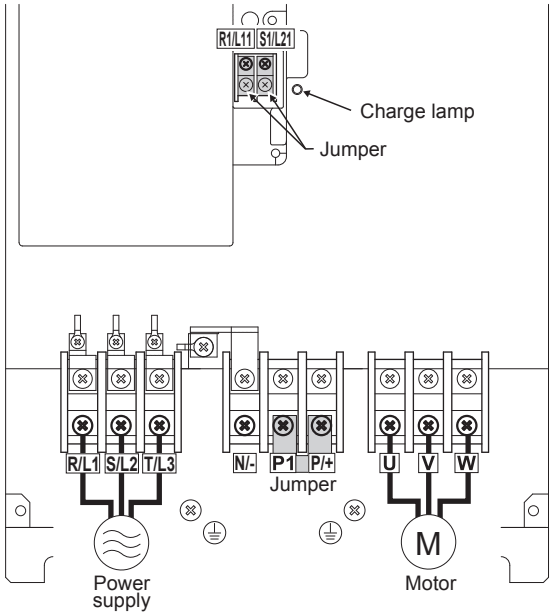

FR-A720-11K
FR-A740-11K, 15K



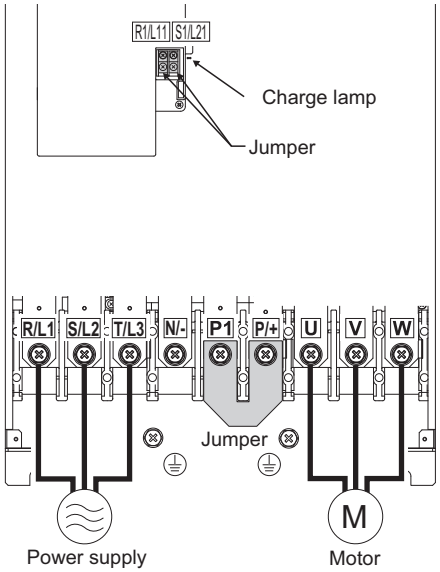

FR-A720-15K to 22K
FR-A740-18.5K, 22K



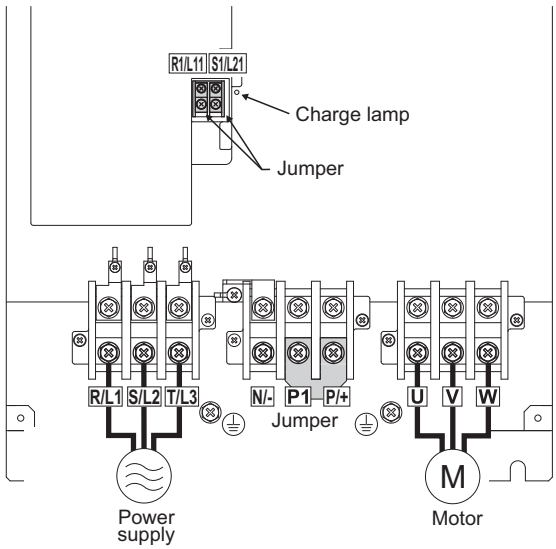

FR-A720-30K to 45K
FR-A740-30K to 45K



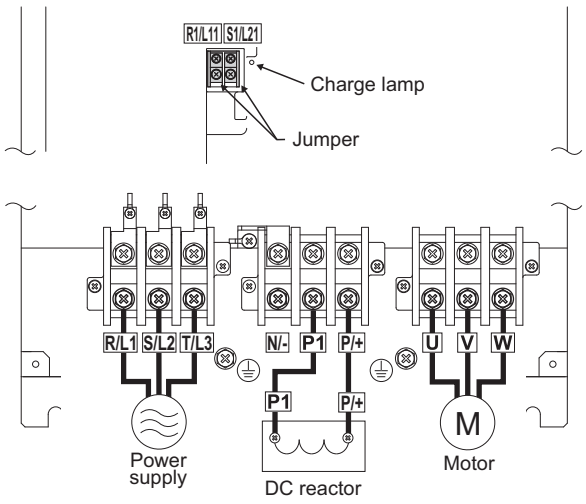

FR-A720-55K



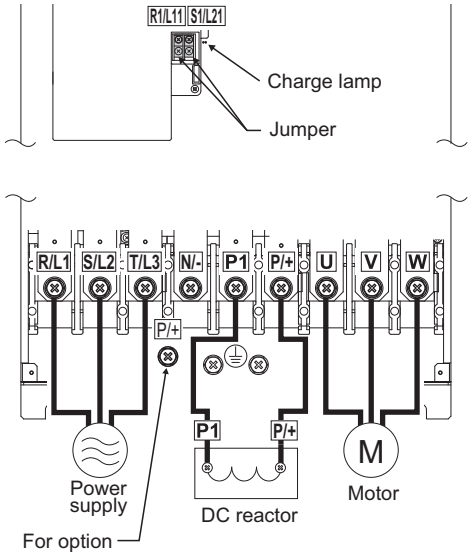

FR-A740-55K



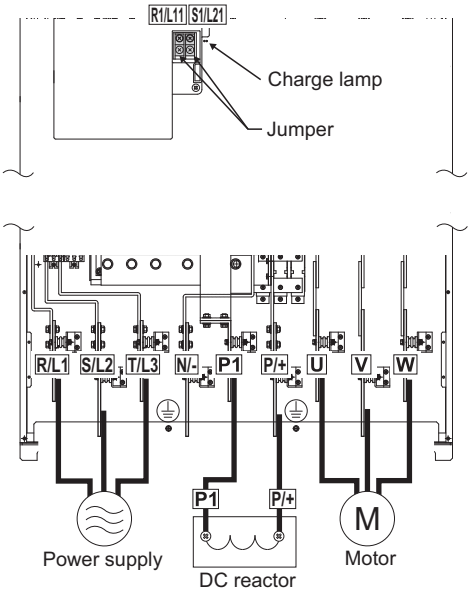
FR-A740-75K, 90K




FR-A720-75K, 90K
FR-A740-110K to 185K

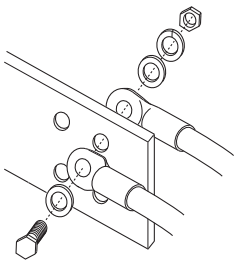



FR-A740-220K to 500K




**CAUTION**

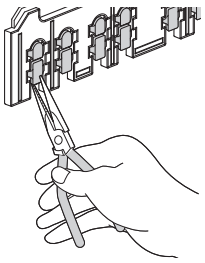
- The power supply cables must be connected to R/L1, S/L2, T/L3. (Phase sequence needs not to be matched.) Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter.
- Connect the motor to U, V, W. At this time, turning ON the forward rotation switch (signal) rotates the motor in the counterclockwise direction when viewed from the motor shaft.
- When wiring the inverter main circuit conductor of the 220K or higher, 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.

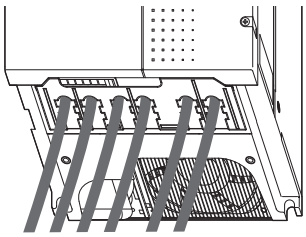


- Handling of the wiring cover
  (FR-A720-15K, 18.5K, 22K, FR-A740-18.5K, 22K)
  For the hook of the wiring cover, cut off the necessary parts using a pair of long-nose pliers etc.

**CAUTION**

Cut off the same number of lugs as wires. If parts where no wire is put through has been cut off (10mm or more), protective structure (JEM1030) becomes an open type (IP00).





## (1) Cable sizes and other specifications of the main circuit terminals and the earthing terminal

Select the recommended cable size to ensure that a voltage drop will be 2% max.
If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.
The following table indicates a selection example for the wiring length of 20m.

### 200V class (when input power supply is 220V)

| Applicable Inverter Model | Terminal Screw Size *4 | Tightening Torque N·m | Crimping Terminal | | Cable Sizes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | HIV, etc. (mm²) *1 | | | | AWG/MCM *2 | | PVC, etc. (mm²) *3 | | |
| | | | R/L1, S/L2, T/L3 | U, V, W | R/L1, S/L2, T/L3 | U, V, W | P/+, P1 | Earthing (grounding) cable | R/L1, S/L2, T/L3 | U, V, W | R/L1, S/L2, T/L3 | U, V, W | Earthing (grounding) cable |
| FR-A720-0.4K to 2.2K | M4 | 1.5 | 2-4 | 2-4 | 2 | 2 | 2 | 2 | 14 | 14 | 2.5 | 2.5 | 2.5 |
| FR-A720-3.7K | M4 | 1.5 | 5.5-4 | 5.5-4 | 3.5 | 3.5 | 3.5 | 3.5 | 12 | 12 | 4 | 4 | 4 |
| FR-A720-5.5K | M5(M4) | 2.5 | 5.5-5 | 5.5-5 | 5.5 | 5.5 | 5.5 | 5.5 | 10 | 10 | 6 | 6 | 6 |
| FR-A720-7.5K | M5(M4) | 2.5 | 14-5 | 8-5 | 14 | 8 | 14 | 5.5 | 6 | 8 | 16 | 10 | 16 |
| FR-A720-11K | M5 | 2.5 | 14-5 | 14-5 | 14 | 14 | 14 | 8 | 6 | 6 | 16 | 16 | 16 |
| FR-A720-15K | M6 | 4.4 | 22-6 | 22-6 | 22 | 22 | 22 | 14 | 4 | 4 | 25 | 25 | 16 |
| FR-A720-18.5K | M8(M6) | 7.8 | 38-8 | 38-8 | 38 | 38 | 38 | 14 | 2 | 2 | 35 | 35 | 25 |
| FR-A720-22K | M8(M6) | 7.8 | 38-8 | 38-8 | 38 | 38 | 38 | 22 | 2 | 2 | 35 | 35 | 25 |
| FR-A720-30K | M8(M6) | 7.8 | 60-8 | 60-8 | 60 | 60 | 60 | 22 | 1/0 | 1/0 | 50 | 50 | 25 |
| FR-A720-37K | M10(M8) | 14.7 | 80-10 | 80-10 | 80 | 80 | 80 | 22 | 3/0 | 3/0 | 70 | 70 | 35 |
| FR-A720-45K | M10(M8) | 14.7 | 100-10 | 100-10 | 100 | 100 | 100 | 38 | 4/0 | 4/0 | 95 | 95 | 50 |
| FR-A720-55K | M12(M8) | 24.5 | 100-12 | 100-12 | 100 | 100 | 100 | 38 | 4/0 | 4/0 | 95 | 95 | 50 |
| FR-A720-75K | M12(M10) | 24.5 | 150-12 | 150-12 | 125 | 125 | 125 | 38 | 250 | 250 | — | — | — |
| FR-A720-90K | M12(M10) | 24.5 | 150-12 | 150-12 | 150 | 150 | 150 | 38 | 300 | 300 | — | — | — |

### 400V class (when input power supply is 440V)

| Applicable Inverter Model | Terminal Screw Size *4 | Tightening Torque N·m | Crimping Terminal | | Cable Sizes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | HIV, etc. (mm²) *1 | | | | AWG/MCM *2 | | PVC, etc. (mm²) *3 | | |
| | | | R/L1, S/L2, T/L3 | U, V, W | R/L1, S/L2, T/L3 | U, V, W | P/+, P1 | Earthing (grounding) cable | R/L1, S/L2, T/L3 | U, V, W | R/L1, S/L2, T/L3 | U, V, W | Earthing (grounding) cable |
| FR-A740-0.4K to 3.7K | M4 | 1.5 | 2-4 | 2-4 | 2 | 2 | 2 | 2 | 14 | 14 | 2.5 | 2.5 | 2.5 |
| FR-A740-5.5K | M4 | 1.5 | 2-4 | 2-4 | 2 | 2 | 3.5 | 3.5 | 12 | 14 | 2.5 | 2.5 | 4 |
| FR-A740-7.5K | M4 | 1.5 | 5.5-4 | 5.5-4 | 3.5 | 3.5 | 3.5 | 3.5 | 12 | 12 | 4 | 4 | 4 |
| FR-A740-11K | M5 | 2.5 | 5.5-5 | 5.5-5 | 5.5 | 5.5 | 5.5 | 5.5 | 10 | 10 | 6 | 6 | 10 |
| FR-A740-15K | M5 | 2.5 | 8-5 | 8-5 | 8 | 8 | 8 | 5.5 | 8 | 8 | 10 | 10 | 10 |
| FR-A740-18.5K | M6 | 4.4 | 14-6 | 8-6 | 14 | 8 | 14 | 8 | 6 | 8 | 16 | 10 | 16 |
| FR-A740-22K | M6 | 4.4 | 14-6 | 14-6 | 14 | 14 | 22 | 14 | 6 | 6 | 16 | 16 | 16 |
| FR-A740-30K | M6 | 4.4 | 22-6 | 22-6 | 22 | 22 | 22 | 14 | 4 | 4 | 25 | 25 | 16 |
| FR-A740-37K | M8 | 7.8 | 22-8 | 22-8 | 22 | 22 | 22 | 14 | 4 | 4 | 25 | 25 | 16 |
| FR-A740-45K | M8 | 7.8 | 38-8 | 38-8 | 38 | 38 | 38 | 22 | 1 | 2 | 50 | 50 | 25 |
| FR-A740-55K | M8(M10) | 7.8 | 60-8 | 60-8 | 60 | 60 | 60 | 22 | 1/0 | 1/0 | 50 | 50 | 25 |
| FR-A740-75K | M10 | 14.7 | 60-10 | 60-10 | 60 | 60 | 60 | 22 | 1/0 | 1/0 | 50 | 50 | 25 |
| FR-A740-90K | M10 | 14.7 | 60-10 | 60-10 | 60 | 60 | 80 | 22 | 3/0 | 3/0 | 50 | 50 | 25 |
| FR-A740-110K | M10(M12) | 14.7 | 80-10 | 80-10 | 80 | 80 | 80 | 22 | 3/0 | 3/0 | 70 | 70 | 35 |
| FR-A740-132K | M10(M12) | 14.7 | 100-10 | 100-10 | 100 | 100 | 100 | 38 | 4/0 | 4/0 | 95 | 95 | 50 |
| FR-A740-160K | M12(M10) | 24.5 | 150-12 | 150-12 | 125 | 150 | 150 | 38 | 250 | 250 | 120 | 120 | 70 |
| FR-A740-185K | M12(M10) | 24.5 | 150-12 | 150-12 | 150 | 150 | 150 | 38 | 300 | 300 | 150 | 150 | 95 |
| FR-A740-220K | M12(M10) | 46 | 100-12 | 100-12 | 2×100 | 2×100 | 2×100 | 60 | 2×4/0 | 2×4/0 | 2×95 | 2×95 | 95 |
| FR-A740-250K | M12(M10) | 46 | 100-12 | 100-12 | 2×100 | 2×100 | 2×125 | 60 | 2×4/0 | 2×4/0 | 2×95 | 2×95 | 95 |
| FR-A740-280K | M12(M10) | 46 | 150-12 | 150-12 | 2×125 | 2×125 | 2×125 | 60 | 2×250 | 2×250 | 2×120 | 2×120 | 120 |
| FR-A740-315K | M12(M10) | 46 | 150-12 | 150-12 | 2×150 | 2×150 | 2×150 | 60 | 2×300 | 2×300 | 2×150 | 2×150 | 150 |
| FR-A740-355K | M12(M10) | 46 | C2-200 | C2-200 | 2×200 | 2×200 | 2×200 | 100 | 2×350 | 2×350 | 2×185 | 2×185 | 2×95 |
| FR-A740-400K | M12(M10) | 46 | C2-200 | C2-200 | 2×200 | 2×200 | 2×200 | 100 | 2×400 | 2×400 | 2×185 | 2×185 | 2×95 |
| FR-A740-450K | M12(M10) | 46 | C2-250 | C2-250 | 2×250 | 2×250 | 2×250 | 100 | 2×500 | 2×500 | 2×240 | 2×240 | 2×120 |
| FR-A740-500K | M12(M10) | 46 | C2-200 | C2-250 | 3×200 | 2×250 | 3×200 | 2×100 | 2×500 | 2×500 | 2×240 | 2×240 | 2×120 |

*1 For the 55K or lower, the cable size is that of the cable (HIV cable (600V class 2 vinyl-insulated cable) etc.) with continuous maximum permissible temperature of 75°C. Assumes that the surrounding air temperature is 50°C or less and the wiring distance is 20m or less.
For the 75K or higher, the recommended cable size is that of the cable (LMFC (heat resistant flexible cross-linked polyethylene insulated cable) etc.) with continuous maximum permissible temperature of 90°C. Assumes that the surrounding air temperature is 50°C or less and wiring is performed in an enclosure.

*2 For the all capacity of 200V class, and FR-A740-45K or lower, the recommended cable size is that of the cable (THHW cable) with continuous maximum permissible temperature of 75°C. Assumes that the surrounding air temperature is 40°C or less and the wiring distance is 20m or less.
For the FR-A740-55K or higher, the recommended cable size is that of the cable (THHN cable) with continuous maximum permissible temperature of 90°C. Assumes that the surrounding air temperature is 40°C or less and wiring is performed in an enclosure.
(Selection example for use mainly in the United States.)

*3 For the FR-A720-15K or lower, and FR-A740-45K or lower, the recommended cable size is that of the cable (PVC cable) with continuous maximum permissible temperature of 70°C. Assumes that the surrounding air temperature is 40°C or less and the wiring distance is 20m or less.
For the FR-A720-18.5K or higher, and FR-A740-55K or higher, the recommended cable size is that of the cable (XLPE cable) with continuous maximum permissible temperature of 90°C. Assumes that the surrounding air temperature is 40°C or less and wiring is performed in an enclosure.
(Selection example for use mainly in Europe.)

*4 The terminal screw size indicates the terminal size for R/L1, S/L2, T/L3, U, V, W, PR, PX, P/+, N/-, P1 and a screw for earthing (grounding).
For the FR-A720-5.5K and 7.5K, screw size of terminal PR and PX is indicated in ( ).
A screw for earthing (grounding) of the FR-A720-18.5K or higher is indicated in ( ).
The screw size of the terminals P/+, N/-, and P1 in FR-A740-55K is indicated in parentheses.
A screw for P/+ terminal for option connection of the FR-A740-110K and 132K is indicated in ( ).
A screw for earthing (grounding) of the FR-A740-160K or higher is indicated in ( ).

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

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

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

**CAUTION**

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

## (2) Notes on earthing (grounding)

- Leakage currents flow in the inverter. To prevent an electric shock, the inverter and motor must be earthed (grounded). This inverter must be earthed (grounded). Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)
  A neutral-point earthed (grounded) power supply for 400V class inverter in compliance with EN standard must be used.
- Use the dedicated earth (ground) terminal to earth (ground) the inverter.
  (Do not use the screw in the casing, chassis, etc.)
- Use the thickest possible earth (ground) cable. Use the cable whose size is equal to or greater than that indicated in *page 14,* and minimize the cable length. The earthing (grounding) point should be as near as possible to the inverter.

***To be compliant with the EU Directive (Low Voltage Directive), earth (ground) the inverter according to the instructions on page 213.***

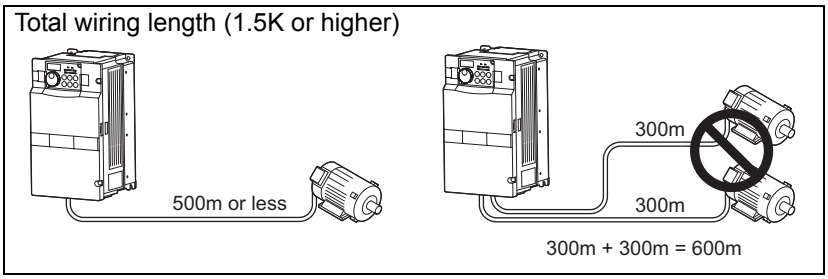
### (3) Total wiring length

#### ● Under induction motor control

Connect one or more induction motors within the total wiring length shown in the following table.

| Cable type | *Pr. 72* setting (carrier frequency) | 0.4K | 0.75K | 1.5K or higher |
|---|---|---|---|---|
| Unshielded cable * | 2 (2kHz) or lower | 300m | 500m | 500m |
| | 3 (3kHz) or higher | 200m | 300m | 500m |
| Shielded cable | 2 (2kHz) or lower | 75m | 100m | 100m |
| | 3 (3kHz) or higher | 200m | 300m | 500m |

* The wiring length should be 100m or less under vector control.




**REMARKS**

When driving a 400V class motor by the inverter, surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor. Take the following measure 1) or 2) in this case.

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

| | Wiring Length | | |
|---|---|---|---|
| | 50m or less | 50m to 100m | exceeding 100m |
| *Pr. 72 PWM frequency selection* | 15 (14.5kHz) or lower | 9 (9kHz) or lower | 4 (4kHz) or lower |

2) Connect the surge voltage suppression filter (FR-ASF-H/FR-BMF-H) to the 55K or lower and the sine wave filter (MT-BSL/BSC) to the 75K or higher on the inverter output side.

For the details, refer to *Chapter 3 of the Instruction Manual (Applied)*.

#### ● Under IPM motor control

Use the following length of cable or shorter when connecting an IPM motor.

| Voltage class | Cable type | *Pr. 72* setting (carrier frequency) * | 0.4K | 0.75K | 1.5K or higher |
|---|---|---|---|---|---|
| 200V | Unshielded cable | 0 (2kHz) to 15 (14kHz) | 100m | 100m | 100m |
| | Shielded cable | 5 (2kHz) or lower | 75m | 100m | 100m |
| | | 6 (6kHz) or higher | 50m | 75m | 100m |
| 400V | Unshielded cable | 5 (2kHz) or lower | 100m | 100m | 100m |
| | | 6 to 9 (6kHz) | 50m | 50m | 100m |
| | | 10 (10kHz) or higher | 50m | 50m | 50m |
| | Shielded cable | 5 (2kHz) or lower | 75m | 100m | 100m |
| | | 6 to 9 (6kHz) | 50m | 50m | 100m |
| | | 10 (10kHz) or higher | 50m | 50m | 50m |

* The carrier frequency is limited during PM sensorless vector control.

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

**CAUTION**

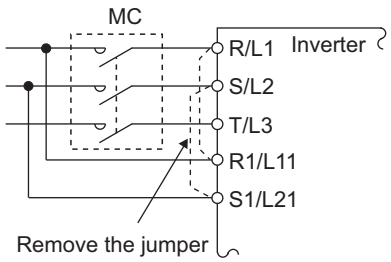
- Especially for long-distance wiring, the inverter may be affected by a charging current caused by the stray capacitances of the wiring, leading to a malfunction of the overcurrent protective function or fast response current limit function or a malfunction or fault of the equipment connected on the inverter output side. If fast response current limit function malfunctions, disable this function. (For *Pr. 156 Stall prevention operation selection, refer to Chapter 4 of the Instruction Manual (Applied).*)
- The surge voltage suppression filter (FR-ASF-H/FR-BMF-H) option and sine wave filter (MT-BSL/BSC) cannot be used under IPM motor control, so do not connect them.
- For details of *Pr. 72 PWM frequency selection , refer to Chapter 4 of the Instruction Manual (Applied)*. (When using an option sine wave filter (MT-BSL/BSC) for the 75K or higher, set "25" (2.5kHz) in *Pr. 72*.)
- The surge voltage suppression filter (FR-ASF-H/FR-BMF-H) can be used under V/F control and under Advanced magnetic flux vector control. The sine wave filter (MT-BSL/BSC) can be used under V/F control. (For explanation of surge voltage suppression filter (FR-ASF-H/FR-BMF-H) and sine wave filter (MT-BSL/BSC), refer to the manual of each option.)

### (4) Cable size of the control circuit power supply (terminal R1/L11, S1/L21)

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

### (5) Connecting the control circuit and the main circuit separately to the power supply

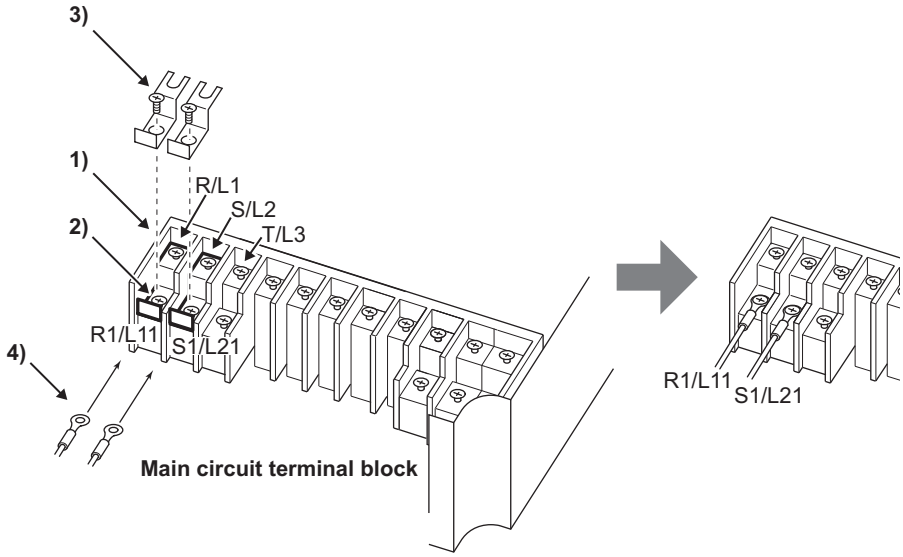
<Connection diagram>




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

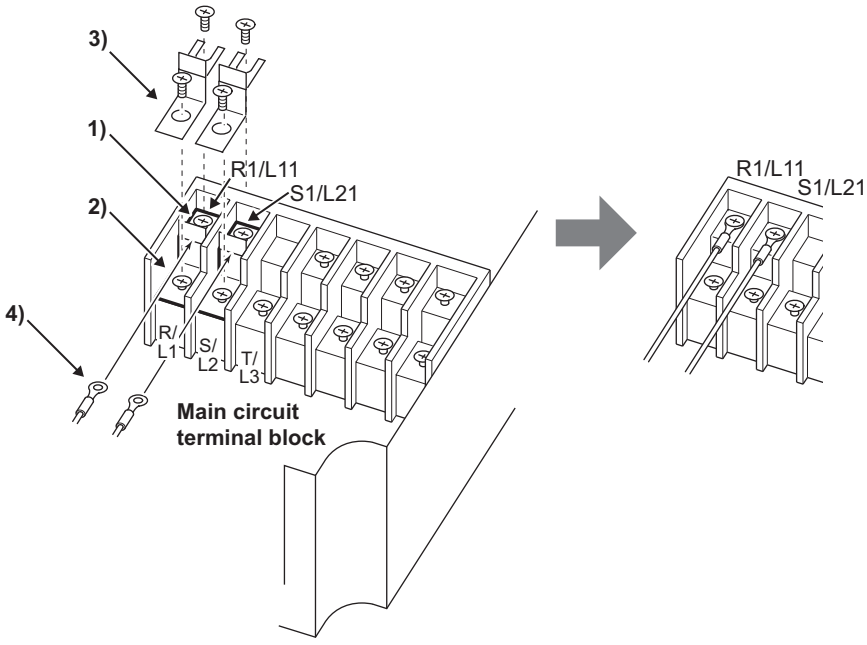
#### • FR-A720-0.4K to 3.7K, FR-A740-0.4K to 3.7K

1) Loosen the upper screws.
2) Remove the lower screws.
3) Remove the jumper
4) Connect the separate power supply cable for the control circuit to the lower terminals (R1/L11, S1/L21).



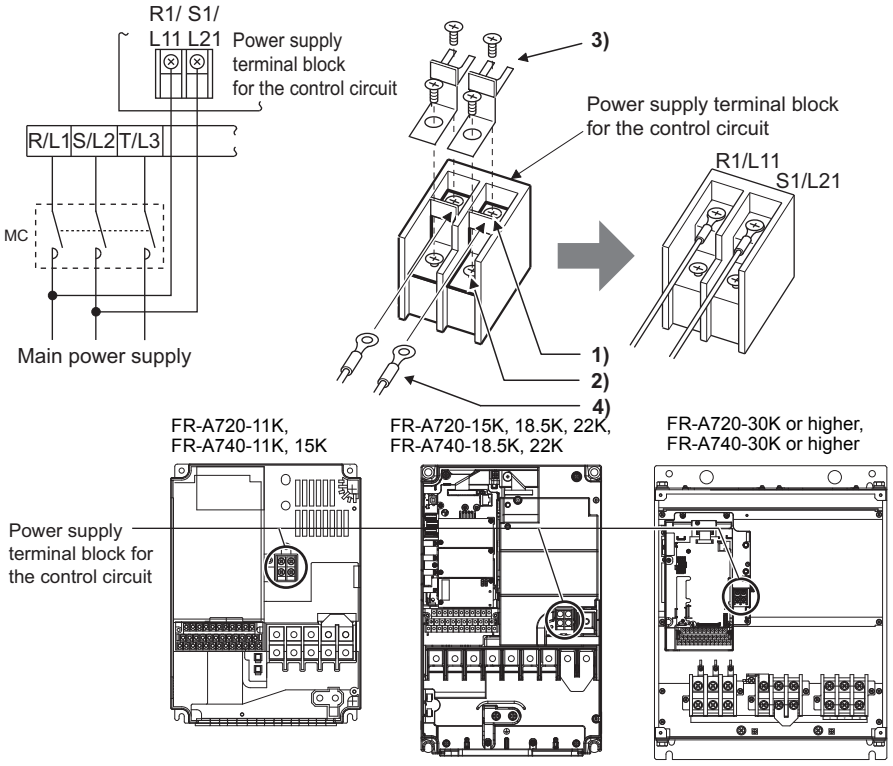

#### • FR-A720-5.5K, 7.5K, FR-A740-5.5K, 7.5K

1) Remove the upper screws.
2) Remove the lower screws.
3) Remove the jumper.
4) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).



## • FR-A720-11K or higher, FR-A740-11K or higher

1) Remove the upper screws.
2) Remove the lower screws.
3) Pull the jumper toward you to remove.
4) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).




**CAUTION**

- When using separate power supply, always remove the jumper across terminals R/L1 and R1/L11 and across S/L2 and S1/L21. The inverter may be damaged if you do not remove the jumper.
- The voltage should be the same as that of the main control circuit when the control circuit power is supplied from other than the primary side of the MC.
- The power capacity necessary when separate power is supplied from R1/L11 and S1/L21 differs according to the inverter capacity.

| | 11K or lower | 15K | 18.5K or higher |
|---|---|---|---|
| **200V class** | 60VA | 80VA | 80VA |
| **400V class** | 60VA | 60VA | 80VA |

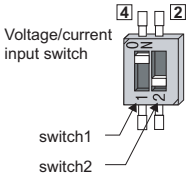
- If the main circuit power is switched OFF (for 0.1s or more) then ON again, the inverter resets and a fault output will not be held.

## 2.4.5 Control circuit terminals

indicates that terminal functions can be selected using *Pr. 178 to Pr. 196 (I/O terminal function selection) (Refer to Chapter 4 of the Instruction Manual (Applied).*)

### (1) Input signals

| Type | Terminal Symbol | Terminal Name | Description | | Rated Specifications | Refer to page |
|---|---|---|---|---|---|---|
| Contact input | STF | Forward rotation start | Turn ON the STF signal to start forward rotation and turn it OFF to stop. | When the STF and STR signals are turned ON simultaneously, the stop command is given. | Input resistance 4.7kΩ Voltage at opening 21 to 27VDC Current at short-circuited 4 to 6mADC | 95 |
| | STR | Reverse rotation start | Turn ON the STR signal to start reverse rotation and turn it OFF to stop. | | | |
| | STOP | Start self-holding selection | Turn ON the STOP signal to self-hold the start signal. | | | *2 |
| | RH, RM, RL | Multi-speed selection | Multi-speed can be selected according to the combination of RH, RM and RL signals. | | | 96 |
| | JOG | Jog mode selection | Turn ON the JOG signal to select Jog operation (initial setting) and turn ON the start signal (STF or STR) to start Jog operation. | | | *2 |
| | | Pulse train input | JOG terminal can be used as pulse train input terminal. To use as pulse train input terminal, the *Pr. 291* setting needs to be changed. (maximum input pulse: 100kpulses/s) | | Input resistance 2kΩ Current at short-circuited 8 to 13mADC | *2 |
| | RT | Second function selection | Turn ON the RT signal to select second function. When the second function such as "second torque boost" and "second V/F (base frequency)" are set, turning ON the RT signal selects these functions. | | Input resistance 4.7kΩ Voltage at opening 21 to 27VDC Current at short-circuited 4 to 6mADC | *2 |
| | MRS | Output stop | Turn ON the MRS signal (20ms or more) to stop the inverter output. Use to shut off the inverter output when stopping the motor by electromagnetic brake. | | | *2 |
| | RES | Reset | Use to reset fault output provided when fault occurs. Turn ON the RES signal for more than 0.1s, then turn it OFF. In the initial status, reset is set always-enabled. By setting *Pr. 75*, reset can be set enabled only at fault occurrence. Recover about 1s after reset is cancelled. | | | 149 |
| | AU | Terminal 4 input selection | Terminal 4 is valid only when the AU signal is turned ON. (The frequency setting signal can be set between 4 and 20mADC.) Turning the AU signal ON makes terminal 2 (voltage input) invalid. | | | 99 |
| | | PTC input | AU terminal is used as PTC input terminal (thermal protection of the motor). When using it as PTC input terminal, set the AU/PTC switch to PTC. | | | *2 |
| | CS | Selection of automatic restart after instantaneous power failure | When the CS signal is left ON, the inverter restarts automatically at power restoration. Note that restart setting is necessary for this operation. In the initial setting, a restart is disabled. *(Refer to Pr. 57 Restart coasting time in Chapter 4 of the Instruction Manual (Applied).)* | | | *2 |
| | SD | Contact input common (sink) (initial setting) | Common terminal for contact input terminal (sink logic) and terminal FM. | | —— | — |
| | | External transistor common (source) | Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable currents. | | | |
| | | 24VDC power supply common | Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE. | | | |

| Type | Terminal Symbol | Terminal Name | Description | Rated Specifications | Refer to page |
|---|---|---|---|---|---|
| Contact input | PC | External transistor common (sink) (initial setting) | Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic to avoid malfunction by undesirable currents. | Power supply voltage range 19.2 to 28.8VDC Permissible load current 100mA | 23 |
| | | Contact input common (source) | Common terminal for contact input terminal (source logic). | | |
| | | 24VDC power supply | Can be used as 24VDC 0.1A power supply. | | |
| Frequency setting | 10E | Frequency setting power supply | When connecting the frequency setting potentiometer at an initial status, connect it to terminal 10.<br>Change the input specifications of terminal 2 when connecting it to terminal 10E. *(Refer to Pr. 73 Analog input selection in Chapter 4 of the Instruction Manual (Applied).)* | 10VDC Permissible load current 10mA | *2 |
| | 10 | | | 5VDC Permissible load current 10mA | 93, 97 |
| | 2 | Frequency setting (voltage) | Inputting 0 to 5VDC (or 0 to 10V, 0 to 20mA) provides the maximum output frequency at 5V (10V, 20mA) and makes input and output proportional. Use *Pr. 73* to switch from among input 0 to 5VDC (initial setting), 0 to 10VDC, and 0 to 20mA.<br>Set the voltage/current input switch in the ON position to select current input (0 to 20mA). *1 | Voltage input: Input resistance 10kΩ ± 1kΩ Maximum permissible voltage 20VDC Current input: Input resistance 245Ω ± 5Ω Maximum permissible current 30mA   | 93, 97 |
| | 4 | Frequency setting (current) | Inputting 4 to 20mADC (or 0 to 5V, 0 to 10V) provides the maximum output frequency at 20mA makes input and output proportional. This input signal is valid only when the AU signal is ON (terminal 2 input is invalid). Use *Pr. 267* to switch from among input 4 to 20mA (initial setting), 0 to 5VDC, and 0 to 10VDC. Set the voltage/current input switch in the OFF position to select voltage input (0 to 5V/0 to 10V).*1 Use *Pr. 858* to switch terminal functions.<br>*(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | 94, 99 |
| | 1 | Frequency setting auxiliary | Inputting 0 to ±5 VDC or 0 to ±10VDC adds this signal to terminal 2 or 4 frequency setting signal. Use *Pr. 73* to switch between the input 0 to ±5VDC and 0 to ±10VDC (initial setting).<br>Use *Pr. 868* to switch terminal functions. | Input resistance 10kΩ ± 1kΩ Maximum permissible voltage ± 20VDC | *2 |
| | 5 | Frequency setting common | Common terminal for frequency setting signal (terminal 2, 1 or 4) and analog output terminal AM. Do not earth (ground). | ——— | — |

*1 Set *Pr. 73*, *Pr. 267*, and a voltage/current input switch correctly, then input an analog signal in accordance with the setting.
Applying a voltage signal with voltage/current input switch ON (current input is selected) or a current signal with switch OFF (voltage input is selected) could cause component damage of the inverter or analog circuit of signal output devices.

*2 *Refer to Chapter 4 of the Instruction Manual (Applied).*

## (2) Output signals

| Type | Terminal Symbol | Terminal Name | Description | Rated Specifications | Refer to page |
|---|---|---|---|---|---|
| Relay | A1, B1, C1 | Relay output 1 (Fault output) | 1 changeover contact output indicates that the inverter protective function has activated and the output stopped.<br>Fault: No conduction across B-C (Across A-C Continuity),<br>Normal: Across B-C Continuity (No conduction across A-C) | Contact capacity: 230VAC 0.3A (Power factor = 0.4) 30VDC 0.3A | * |
| | A2, B2, C2 | Relay output 2 | 1 changeover contact output | | * |

| Type | Terminal Symbol | Terminal Name | Description | | Rated Specifications | Refer to page |
|---|---|---|---|---|---|---|
| Open collector | RUN | Inverter running | Switched low when the inverter output frequency is equal to or higher than the starting frequency (initial value 0.5Hz). Switched high during stop or DC injection brake operation.* | | Permissible load 24VDC (27VDC maximum) 0.1A (A voltage drop is 2.8V maximum when the signal is ON.) Low is when the open collector output transistor is ON (conducts). High is when the transistor is OFF (does not conduct) | * |
| | SU | Up to frequency | Switched low when the output frequency reaches within the range of ±10% (initial value) of the set frequency. Switched high during acceleration/ deceleration and at a stop. | Fault code (4bit) output | | * |
| | OL | Overload warning | Switched low when stall prevention is activated by the stall prevention function. Switched high when stall prevention is cancelled. | | | * |
| | IPF | Instantaneous power failure | Switched low when an instantaneous power failure and under voltage protections are activated. | | | * |
| | FU | Frequency detection | Switched low when the inverter output frequency is equal to or higher than the preset detected frequency and high when less than the preset detected frequency. | | | * |
| | SE | Open collector output common | Common terminal for terminals RUN, SU, OL, IPF, FU | | ——— | — |
| Pulse | FM | For meter | Select one e.g. output frequency from monitor items. Not output during inverter reset. The output signal is proportional to the magnitude of the corresponding monitoring item. Use *Pr. 55*, *Pr. 56*, and *Pr. 866* to set full scales for the monitored output frequency, output current, and torque. *(Refer to page 281)* | Output item: Output frequency (initial setting) | Permissible load current 2mA 1440pulses/s at full scale | * |
| | | NPN open collector output | | signals can be output from the open collector terminals by setting *Pr. 291*. | Maximum output pulse: 50kpulses/s Permissible load current : 80mA | * |
| Analog | AM | Analog signal output | | Output item: Output frequency (initial setting) | Output signal 0 to 10VDC Permissible load current 1mA (load impedance 10kΩ or more) Resolution 8 bit | * |

* *Refer to Chapter 4 of the Instruction Manual (Applied).*

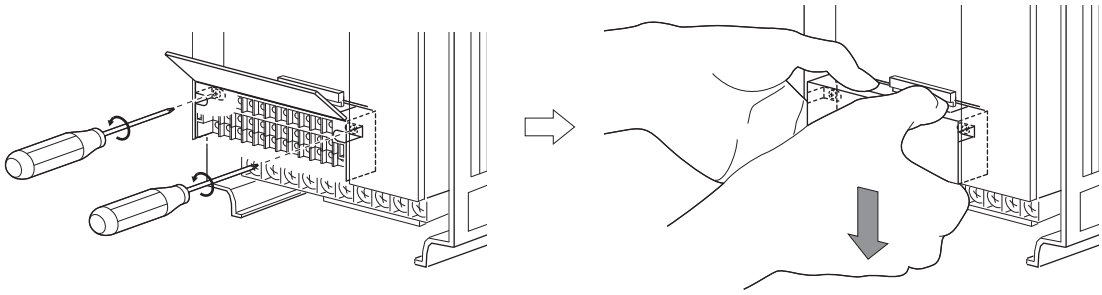
## (3) Communication

| Type | Terminal Symbol | | Terminal Name | Description | Refer to page |
|---|---|---|---|---|---|
| RS-485 | ——— | | PU connector | With the PU connector, communication can be made through RS-485. (for connection on a 1:1 basis only)<br>. Conforming standard : EIA-485 (RS-485)<br>. Transmission format : Multidrop<br>. Communication speed : 4800 to 38400bps<br>. Overall length : 500m | 25 |
| | RS-485 terminals | TXD+ | Inverter transmission terminal | With the RS-485 terminals, communication can be made through RS-485.<br>Conforming standard : EIA-485 (RS-485)<br>Transmission format : Multidrop link<br>Communication speed : 300 to 38400bps<br>Overall length : 500m | 26 |
| | | TXD- | | | |
| | | RXD+ | Inverter reception terminal | | |
| | | RXD- | | | |
| | | SG | Earth (Ground) | | |
| USB | ——— | | USB connector | By connecting an inverter to the personal computer through USB, FR Configurator can be used for setting the inverter, monitoring, and testing the operation.<br>Interface: Conforms to USB1.1<br>Transmission speed: 12Mbps<br>Connector: USB B connector (B receptacle) | 27 |

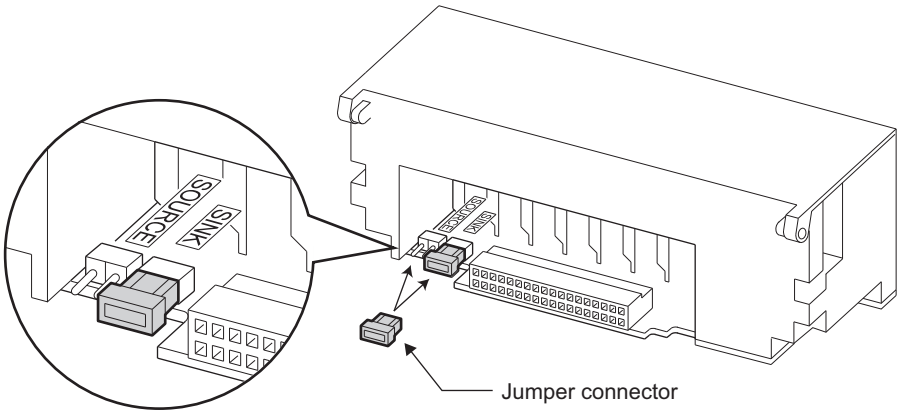
### 2.4.6 Changing the control logic

The input signals are set to sink logic (SINK) when shipped from the factory.
To change the control logic, the jumper connector on the back of the control circuit terminal block must be moved to the other position.
(The output signals may be used in either the sink or source logic independently of the jumper connector position.)

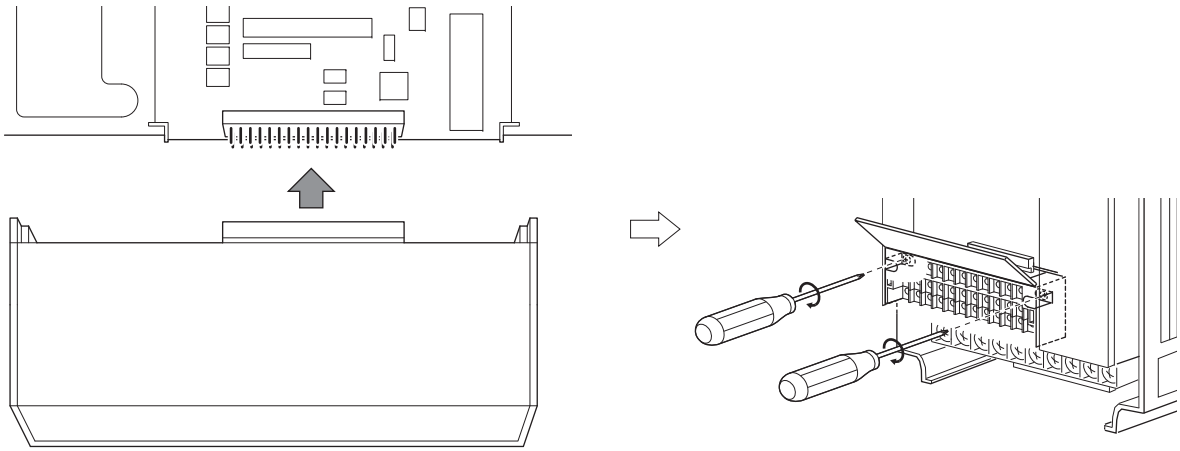
1) Loosen the two mounting screws in both ends of the control circuit terminal block. (These screws cannot be removed.)
   Pull down the terminal block from behind the control circuit terminals.



2) Change the jumper connector set to the sink logic (SINK) on the rear panel of the control circuit terminal block to source logic (SOURCE).




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



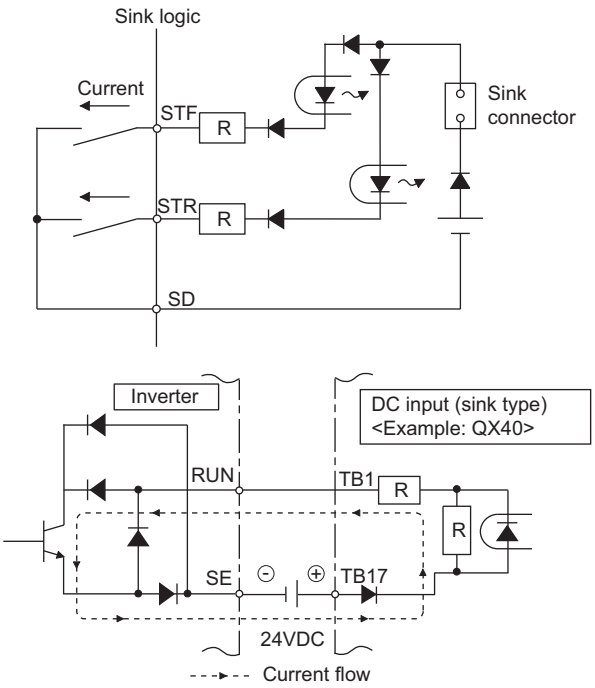
**CAUTION**

1. Make sure that the control circuit connector is fitted correctly.
2. While power is ON, never disconnect the control circuit terminal block.

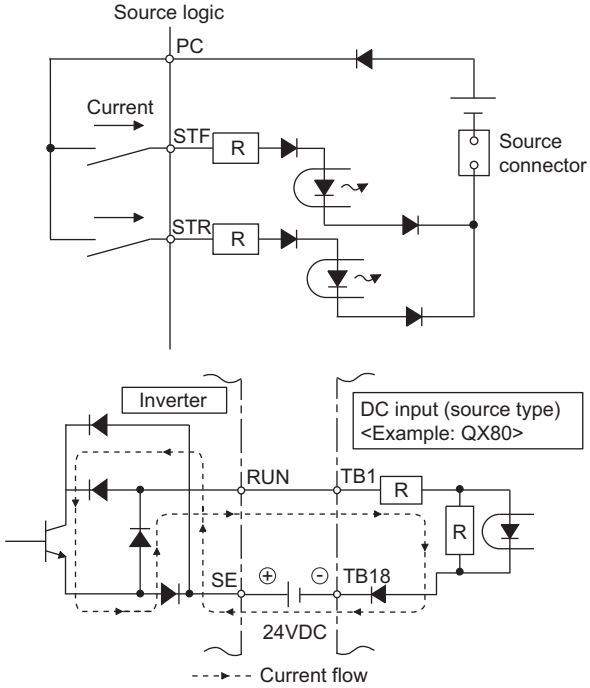
4) Sink logic and source logic

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

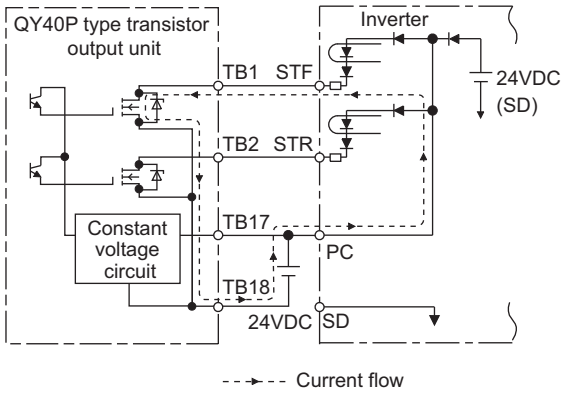
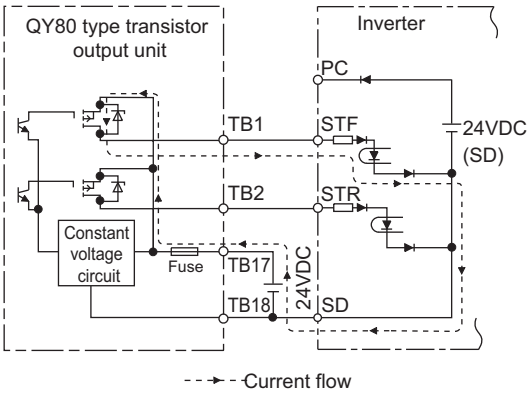
**●Current flow concerning the input/output signal when sink logic is selected**




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

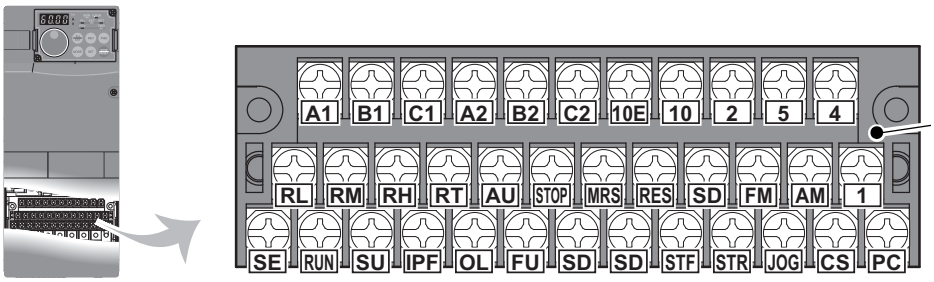



- When using an external power supply for transistor output

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

## 2.4.7 Wiring of control circuit

### (1) Control circuit terminal layout



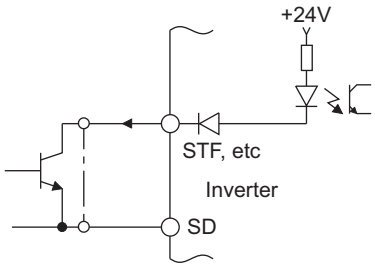

Control circuit terminal *
Terminal screw size: M3.5
Tightening torque: 1.2N·m
* Refer to instruction manuals of options for the available control terminals other than the standard control circuit terminal.

### (2) Common terminals of the control circuit (SD, 5, SE)

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

### (3) Signal inputs by contactless switches

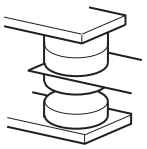
The contacted input terminals of the inverter (STF, STR, STOP, RH, RM, RL, JOG, RT, MRS, RES, AU, CS) can be controlled using a transistor instead of a contacted switch as shown on the right.



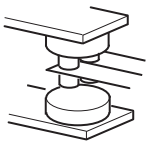

External signal input using transistor

## 2.4.8 Wiring instructions

- It is recommended to use the cables of 0.75mm$^2$ gauge for connection to the control circuit terminals.
  If the cable gauge used is 1.25mm$^2$ or more, the front cover may be lifted when there are many cables running or the cables are run improperly, resulting in an operation panel contact fault.
- The wiring length should be 30m (200m for terminal FM) maximum.
- When using contact inputs, use two or more parallel micro-signal contacts or twin contacts to prevent a contact faults since the control circuit input signals are micro-currents.
- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to the terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A, B, C) via a relay coil, lamp, etc.



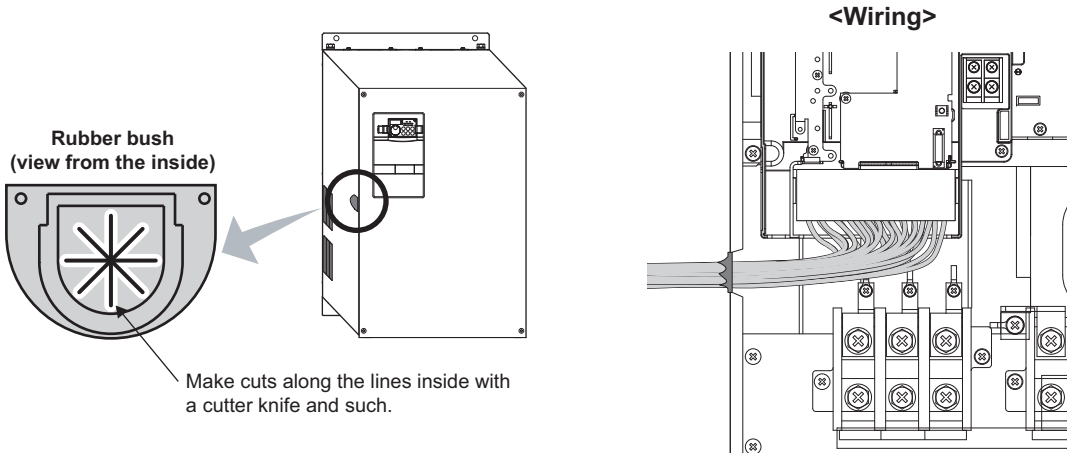
Micro signal contacts



Twin contacts

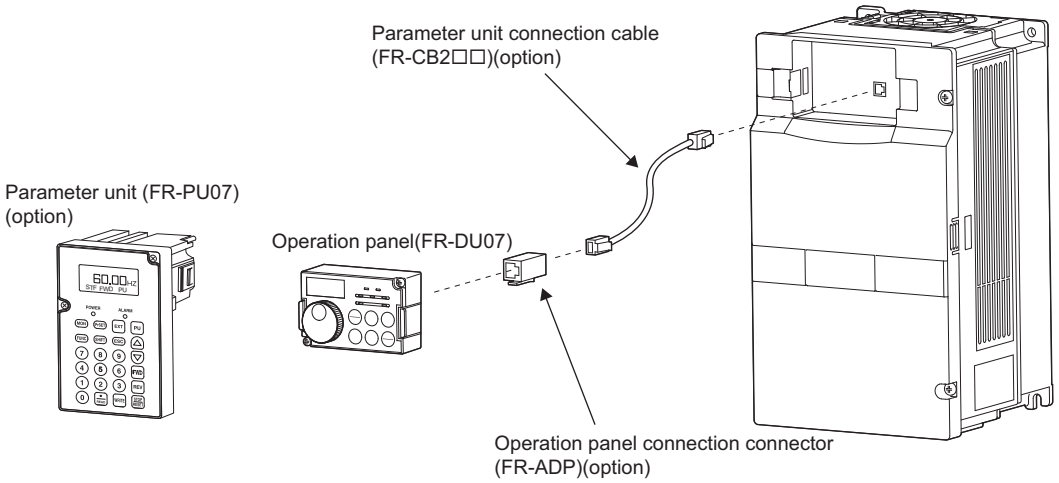
## ● Wiring of the control circuit of the 75K or higher

For wiring of the control circuit of the 75K or higher, separate away from wiring of the main circuit.
Make cuts in rubber bush of the inverter side and lead wires.




## *2.4.9 Mounting the operation panel (FR-DU07) or parameter unit (FR-PU07) on the enclosure surface*

Having an operation panel or a parameter unit on the enclosure surface is convenient.
With a connection cable, you can mount the operation panel (FR-DU07) or the parameter unit (FR-PU07) to the enclosure surface, and connect it to the inverter. Use the option FR-CB2☐☐, or the connector and cable available on the market.
(For mounting the operation panel (FR-DU07), the optional connector (FR-ADP) is required.)
Securely insert one end of the connection cable until the stoppers are fixed.




**CAUTION**

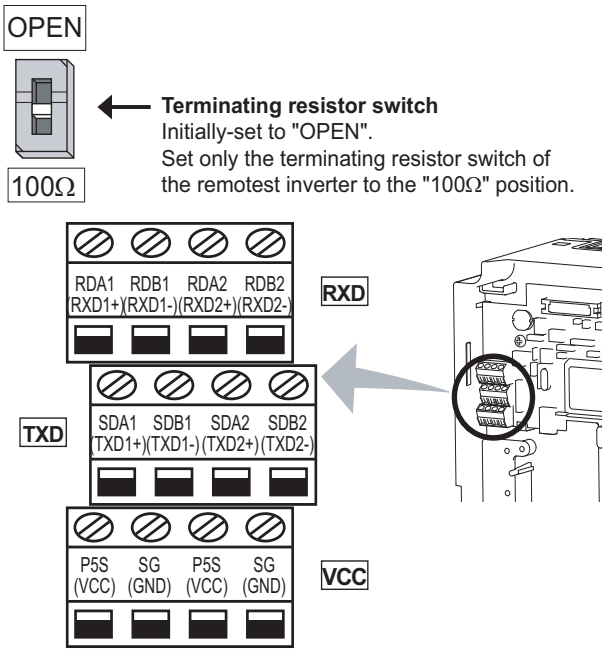
Do not connect the PU connector to the computer's LAN port, FAX modem socket or telephone connector.
The inverter and machine could be damaged due to differences in electrical specifications.

**REMARKS**

- *Refer to page 6* for removal method of the operation panel.
- When using a commercially available connector and cable as a parameter unit connection cable, refer to *Chapter 2 of the Instruction Manual (Applied)*.

## 2.4.10 RS-485 terminal block

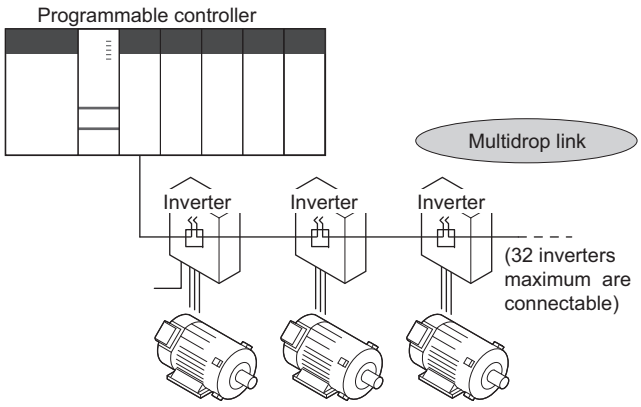
- Conforming standard: EIA-485(RS-485)
- Transmission format: Multidrop link
- Communication speed: MAX 38400bps
- Overall length: 500m
- Connection cable:Twisted pair cable (4 pairs)




## 2.4.11 Communication operation

Using the PU connector or RS-485 terminal, you can perform communication operation from a personal computer etc. When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the inverter or read and write to parameters.
For the Mitsubishi inverter protocol (computer link operation), communication can be performed with the PU connector and RS-485 terminal.
For the Modbus-RTU protocol, communication can be performed with the RS-485 terminal.

For further details, refer to *Chapter 4 of* 📖 *the Instruction Manual (Applied)*.

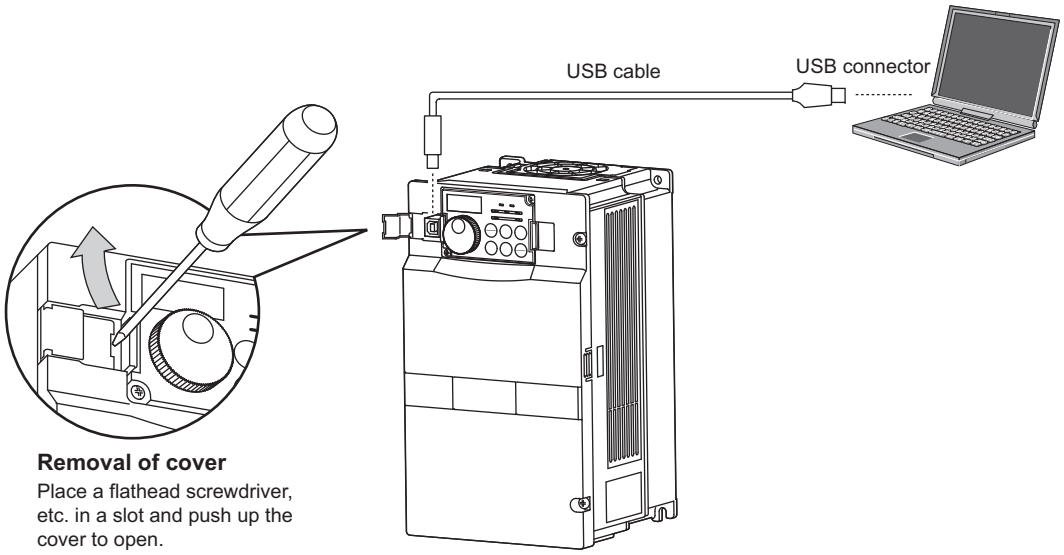


### *2.4.12 USB connector*

A personal computer and an inverter can be connected with a USB (Ver1. 1) cable.
You can perform parameter setting and monitoring with the FR Configurator.

•USB communication specifications

| | |
|---|---|
| **Interface** | Conforms to USB1.1 |
| **Transmission speed** | 12Mbps |
| **Wiring length** | Maximum 5m |
| **Connector** | USB B connector (B receptacle) |
| **Power supply** | Self-power supply |

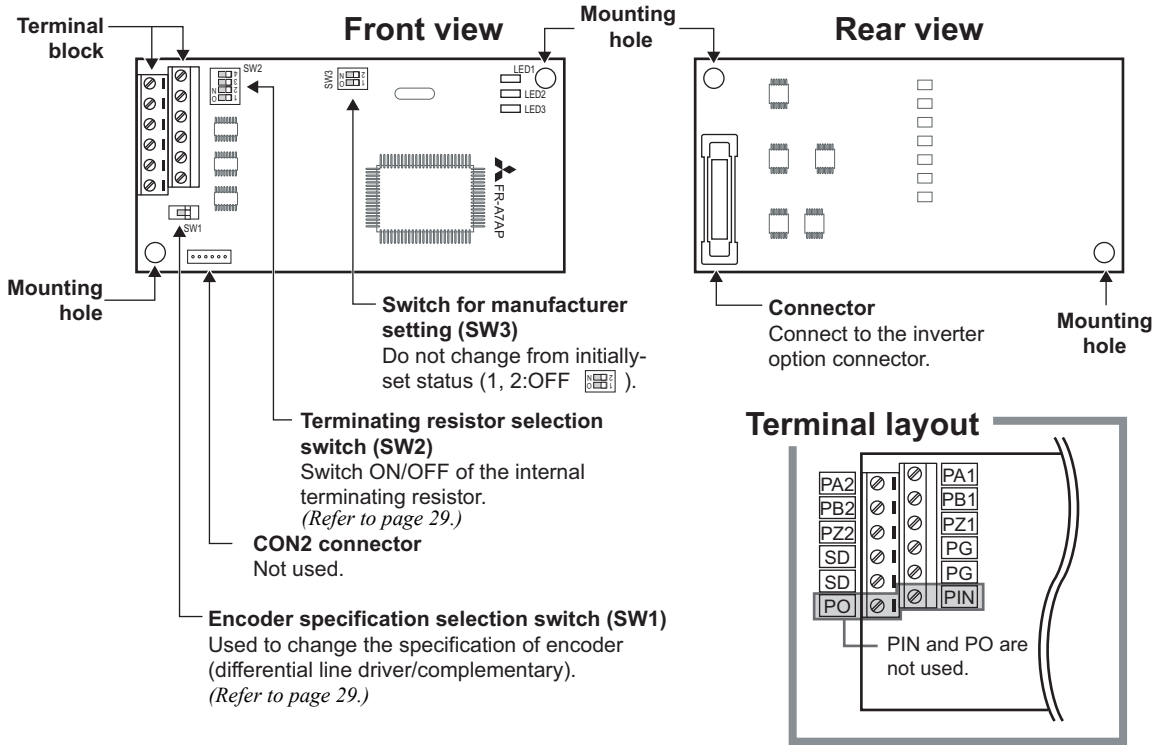



**Removal of cover**
Place a flathead screwdriver, etc. in a slot and push up the cover to open.

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

Orientation control and encoder feedback control, and speed control, torque control and position control by full-scale vector control operation can be performed using a motor with encoder and a plug-in option FR-A7AP.

(1) Structure of the FR-A7AP




(2) Terminals of the FR-A7AP

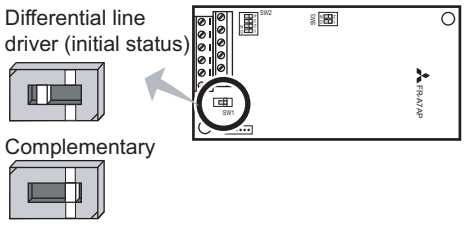
| Terminal | Terminal Name | Description |
|---|---|---|
| **PA1** | Encoder A-phase signal input terminal | A-, B- and Z-phase signals are input from the encoder. |
| **PA2** | Encoder A-phase inverse signal input terminal | |
| **PB1** | Encoder B-phase signal input terminal | |
| **PB2** | Encoder B-phase inverse signal input terminal | |
| **PZ1** | Encoder Z-phase signal input terminal | |
| **PZ2** | Encoder Z-phase inversion signal input terminal | |
| **PG** | Encoder power supply (positive side) input terminal | Input terminal for the encoder power supply. Connect the external power supply (5V, 12V, 15V, 24V) and the encoder power cable. When the encoder output is the differential line driver type, only 5V can be input. Make sure the voltage of the external power supply is the same as the encoder output voltage. (Check the encoder specification.) |
| **SD** | Encoder power supply ground terminal | |
| **PIN** | Not used. | |
| **PO** | | |

**CAUTION**

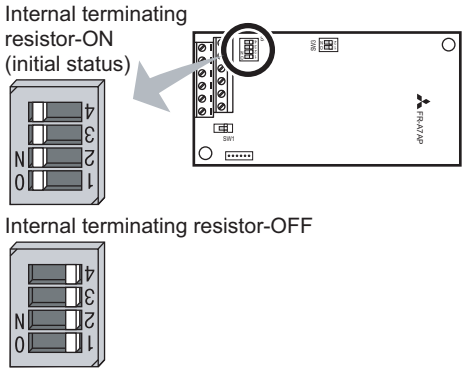
- When the input power supply voltage to the encoder and its output voltage differ, the signal loss detection (E.ECT) may occur.
- Incorrect wiring or faulty setting to the encoder will cause a fault such as an overcurrent (E.OC☐) and an inverter overload (E.THT). Correctly perform wiring and setting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

(3) Switches of the FR-A7AP

• Encoder specification selection switch (SW1)
Select either differential line driver or complementary
It is initially set to the differential line driver. Switch its position according to output circuit.




• Terminating resistor selection switch (SW2)
Select ON/OFF of the internal terminating resistor. Set the switch to ON (initial status) when an encoder output type is differential line driver and set to OFF when complementary.
ON : with internal terminating resistor (initial status)
OFF : without internal terminating resistor




**REMARKS**

- Set all switches to the same setting (ON/OFF).
- If the encoder output type is differential line driver, set the terminating resistor switch to the "OFF" position when sharing the same encoder with other unit (NC (computerized numerical controller), etc.) or a terminating resistor is connected to other unit.

• Motor used and switch setting

| Motor | | Encoder Specification Selection Switch (SW1) | Terminating Resistor Selection Switch (SW2) | Power Specifications *2 |
|---|---|---|---|---|
| Mitsubishi standard motor with encoder<br>Mitsubishi high efficiency motor with encoder | SF-JR | Differential | ON | 5V |
| | SF-HR | Differential | ON | 5V |
| | Others | *1 | *1 | *1 |
| Mitsubishi constant-torque motor with encoder | SF-JRCA | Differential | ON | 5V |
| | SF-HRCA | Differential | ON | 5V |
| | Others | *1 | *1 | *1 |
| Vector control dedicated motor | SF-V5RU | Complementary | OFF | 12V |
| Other manufacturer motor with encoder | – | *1 | *1 | *1 |

*1 Set according to the motor (encoder) used.
*2 Choose a power supply (5V/12V/15V/24V) for encoder according to the encoder output voltage. When the encoder output is the differential line driver type, only 5V can be input.

**CAUTION**

SW3 switch is for manufacturer setting. Do not change the setting.

• Encoder specification

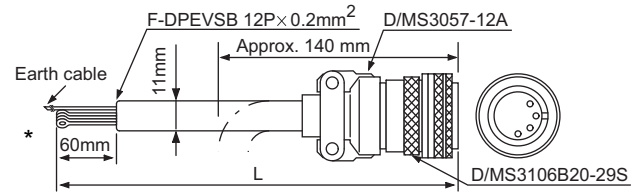
| Item | Encoder for SF-JR | Encoder for SF-V5RU |
|---|---|---|
| Resolution | 1024 Pulse/Rev | 2048 Pulse/Rev |
| Power supply voltage | 5VDC±10% | 12VDC±10% |
| Current consumption | 150mA | 150mA |
| Output signal form | A, B phases (90° phase shift)<br>Z phase: 1 pulse/rev | A, B phases (90° phase shift)<br>Z phase: 1 pulse/rev |
| Output circuit | Differential line driver 74LS113 equivalent | Complementary |
| Output voltage | H level: 2.4V or more<br>L level: 0.5V or less | H level: "Power supply for encoder-3V" or more<br>L level: 3V or less |

**CAUTION**

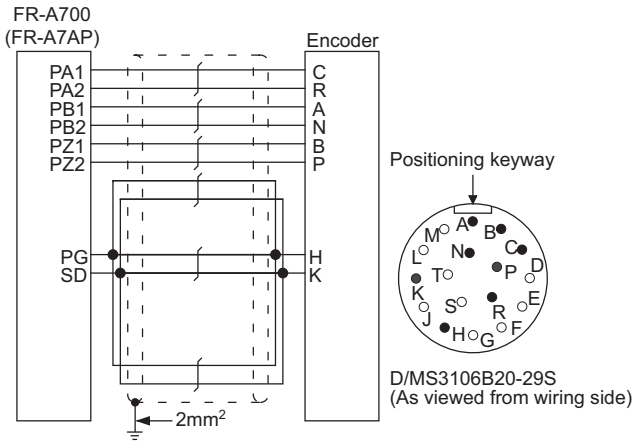
Encoder with resolution of 1000 to 4096 pulse/rev is recommended.

(4) Encoder Cable

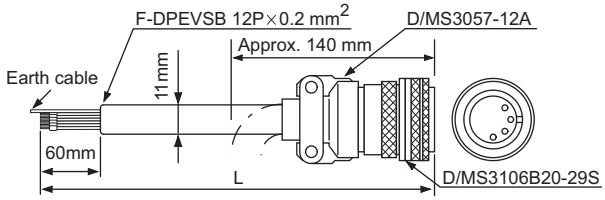
**SF-JR Motor with Encoder**




| Type | Length L (m) |
|---|---|
| FR-JCBL5 | 5 |
| FR-JCBL15 | 15 |
| FR-JCBL30 | 30 |

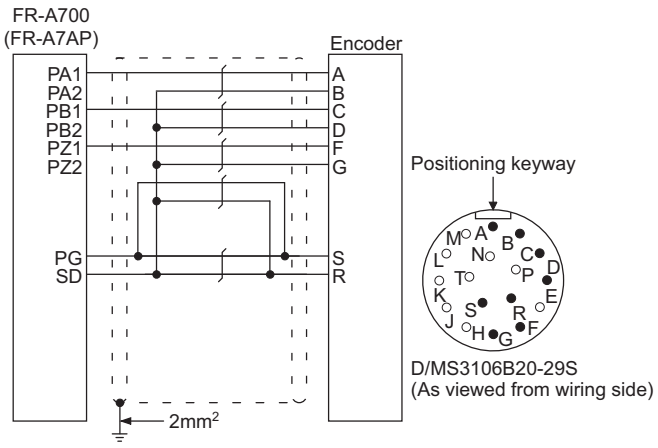



**SF-V5RU, SF-THY**



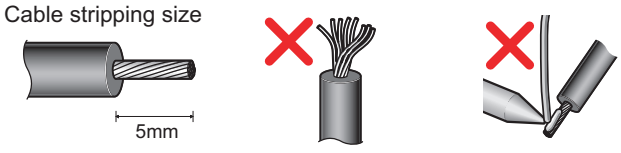

· A P clip for earthing (grounding) a shielded cable is provided.

| Type | Length L (m) |
|---|---|
| FR-V7CBL5 | 5 |
| FR-V7CBL15 | 15 |
| FR-V7CBL30 | 30 |




* As the terminal block of the FR-A7AP is an insertion type, earth cables need to be modified. (See below)

- When using the dedicated encoder cable (FR-JCBL, FR-V5CBL, etc.) for the conventional motor, cut the crimpling terminal of the encoder cable and strip its sheath to make its cables loose.
  Also, protect the shielded cable of the shielded twisted pair cable to ensure that it will not make contact with the conductive area.
  Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it.




**REMARKS**

**Information on blade terminals**

Commercially available products (as of February 2012)

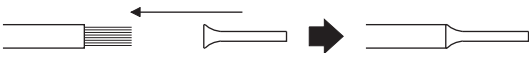
●Phoenix Contact Co.,Ltd.

| Terminal Screw Size | Wire Size (mm2) | Ferrule Terminal Model | | Crimping Tool Name |
|---|---|---|---|---|
| | | with insulation sleeve | without insulation sleeve | |
| M2 | 0.3, 0.5 | AI 0,5-6WH | A 0,5-6 | CRIMPFOX 6 |

●NICHIFU Co.,Ltd.

| Terminal Screw Size | Wire Size (mm2) | Blade terminal product number | Insulation product number | Crimping Tool Product Number |
|---|---|---|---|---|
| M2 | 0.3 to 0.75 | BT 0.75-7 | VC 0.75 | NH 69 |

When using the blade terminal (without insulation sleeve), use care so that the twisted wires do not come out.

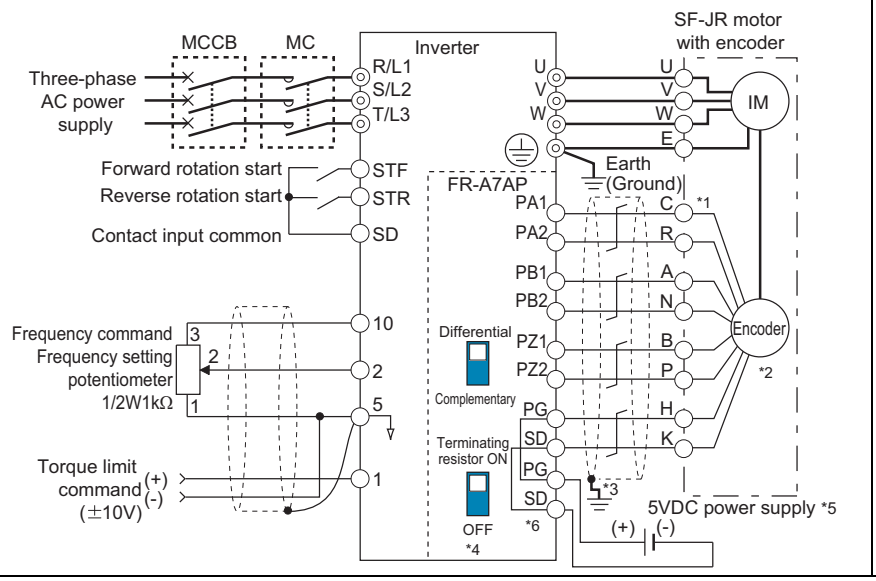
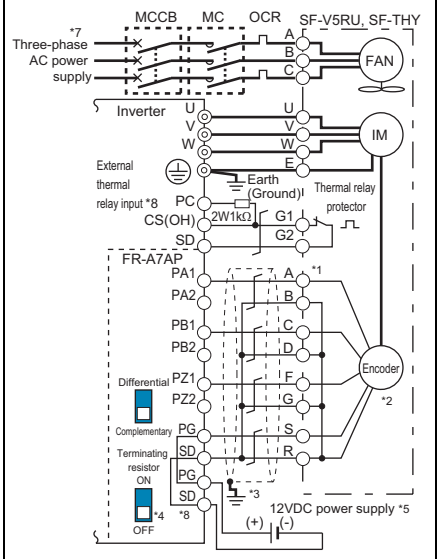


## Connection terminal compatibility table

| Motor | | SF-V5RU, SF-THY | SF-JR/HR/JRCA/HRCA (with Encoder) |
|---|---|---|---|
| Encoder cable | | FR-V7CBL | FR-JCBL |
| FR-A7AP terminal | PA1 | PA | PA |
| | PA2 | Keep this open. | PAR |
| | PB1 | PB | PB |
| | PB2 | Keep this open. | PBR |
| | PZ1 | PZ | PZ |
| | PZ2 | Keep this open. | PZR |
| | PG | PG | 5E |
| | SD | SD | AG2 |

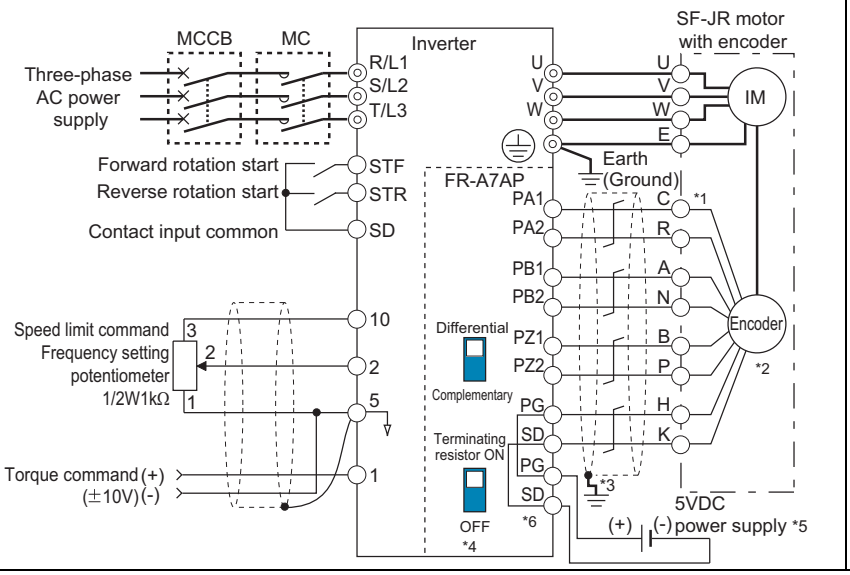
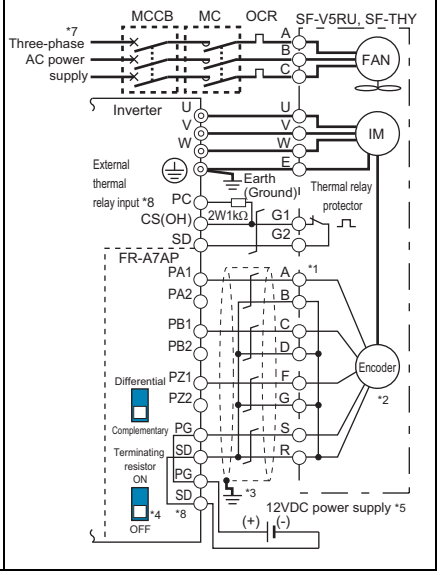
(5) Wiring

• Speed control

| Standard motor with encoder (SF-JR), 5V differential line driver | Vector control dedicated motor (SF-V5RU, SF-THY), 12V complementary |
|---|---|
|  |  |

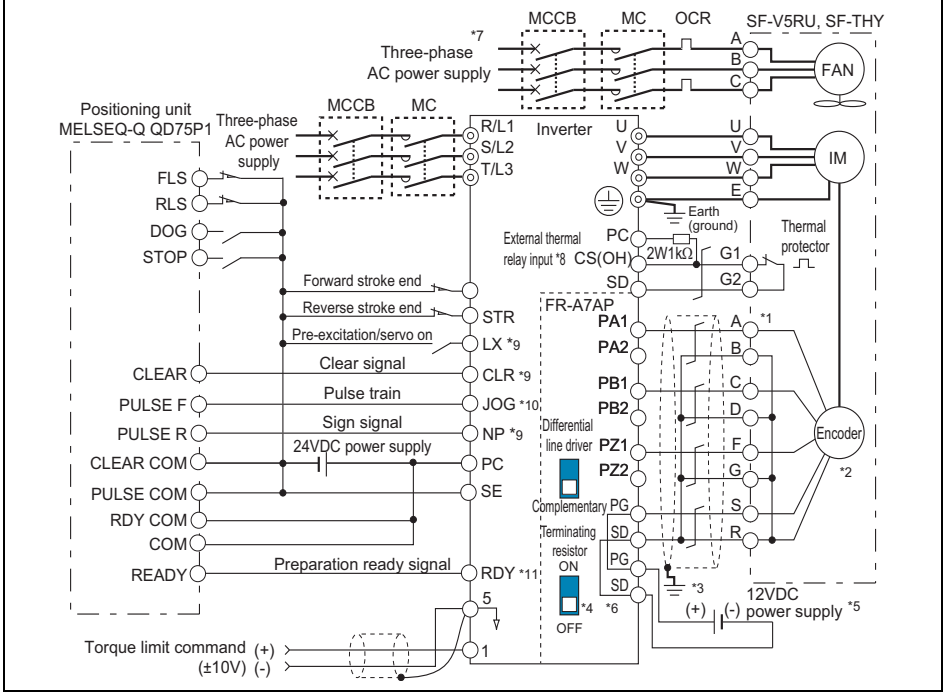


• Torque control

| Standard motor with encoder (SF-JR), 5V differential line driver | Vector control dedicated motor (SF-V5RU, SF-THY), 12V complementary |
|---|---|
|  |  |

- Position control

**Vector control dedicated motor (SF-V5RU, SF-THY), 12V complementary**




*1 The pin number differs according to the encoder used.
Speed control, torque control and position control by pulse train input could be normally performed with or without connecting Z phase.

*2 Connect the encoder so that there is no looseness between the motor and motor shaft. Speed ratio should be 1:1.

*3 Earth (Ground) the shielded cable of the encoder cable to the enclosure with a P-clip, etc. *(Refer to page 33.)*

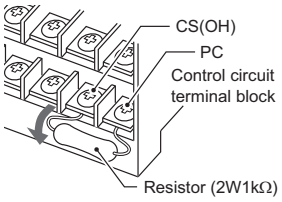
*4 For the complementary, set the terminating resistor selection switch to OFF position. *(Refer to page 29.)*

*5 A separate power supply of 5V/12V/15V/24V is necessary according to the encoder power specification. When the encoder output is the differential line driver type, only 5V can be input.
Make the voltage of the external power supply the same as the encoder output voltage, and connect the external power supply between PG and SD.

*6 For terminal compatibility of the FR-JCBL, FR-V7CBL and FR-A7AP, refer to *page 31*.

*7 For the fan of the 7.5kW or lower dedicated motor, the power supply is single phase. (200V/50Hz, 200 to 230V/60Hz)

*8 Assign OH (external thermal input) signal to the terminal CS. (Set "7" in *Pr. 186* )
Connect the recommended 2W1kΩ resistor between the terminal PC and CS (OH) (Recommended product: MOS2C102J2W1kΩ by KOA Corporation). Install the resistor pushing against the bottom part of the terminal block so as to avoid a contact with other cables.
*Refer to Chapter 4 of the Instruction Manual (Applied) for details of Pr. 186 CS terminal function selection.*




*9 Assign the function using *Pr. 178 to Pr. 184, Pr. 187 to Pr. 189 (input terminal function selection)*.

*10 When position control is selected, terminal JOG function is invalid and simple position pulse train input terminal becomes valid.

*11 Assign the function using *Pr. 190 to Pr. 194 (output terminal function selection)*.

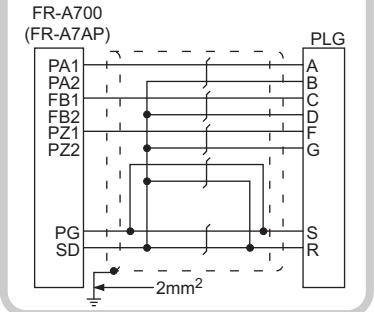
(6) Instructions for encoder cable wiring

- Use shielded twisted pair cables (0.2mm$^2$ or larger) to connect the FR-A7AP and position detector. Cables to terminals PG and SD should be connected in parallel or be larger in size according to the cable length.
  To protect the cables from noise, run them away from any source of noise (e.g. the main circuit and power supply voltage).

| Wiring Length | Parallel Connection | | Larger-Size Cable |
|---|---|---|---|
| Within 10m | At least two cables in parallel | Cable gauge 0.2mm$^2$ | 0.4mm$^2$ or larger |
| Within 20m | At least four cables in parallel | | 0.75mm$^2$ or larger |
| Within 100m * | At least six cables in parallel | | 1.25mm$^2$ or larger |

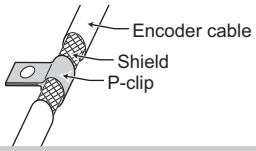
* When differential line driver is set and a wiring length is 30m or more
The wiring length can be extended to 100m by slightly increasing the power by 5V (approx. 5.5V) using six or more cables with gauge size of 0.2mm$^2$ in parallel or a cable with gauge size of 1.25mm$^2$ or more. Note that the voltage applied should be within power supply specifications of encoder.

**Example of parallel connection with two cables (with complementary encoder output)**




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

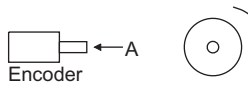
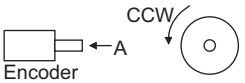
**Earthing (grounding) example using a P-clip**




**REMARKS**

- For details of the optional encoder dedicated cable (FR-JCBL/FR-V7CBL), refer to *page 30*.
- The FR-V7CBL is provided with a P clip for earthing (grounding) shielded cable.

(7) Parameter for encoder *(Pr. 359, Pr. 369)*

| Parameter Number | Name | Initial Value | Setting Range | Description | |
|---|---|---|---|---|---|
| **359** | **Encoder rotation direction** | 1 | 0 |   Forward rotation is clockwise rotation when viewed from A. | Set the rotation direction according to the motor specification. |
| | | | 1 |   Forward rotation is counterclockwise rotation when viewed from A. | |
| **369** | **Number of encoder pulses** | 1024 | 0 to 4096 | Set the number of encoder pulses output.<br>Set the number of pulses before it is multiplied by 4. | |

The above parameters can be set when the FR-A7AP/FR-A7AL (option) is mounted.

(8) Motor for vector control and parameter setting

| Motor Name | | *Pr. 9* Electronic thermal O/L relay | *Pr. 71* Applied motor | *Pr. 80* Motor capacity | *Pr. 81* Number of motor poles | *Pr. 359* Encoder rotation direction | *Pr. 369* Number of encoder pulses |
|---|---|---|---|---|---|---|---|
| Mitsubishi standard motor | SF-JR | Rated motor current | **0** | Motor capacity | Number of motor poles | 1 | 1024 |
| | SF-JR 4P 1.5kW or lower | Rated motor current | 20 | Motor capacity | 4 | 1 | 1024 |
| | SF-HR | Rated motor current | 40 | Motor capacity | Number of motor poles | 1 | 1024 |
| | Others | Rated motor current | 3 *1 | Motor capacity | Number of motor poles | *2 | *2 |
| Mitsubishi constant-torque motor | SF-JRCA 4P | Rated motor current | 1 | Motor capacity | 4 | 1 | 1024 |
| | SF-HRCA | Rated motor current | 50 | Motor capacity | Number of motor poles | 1 | 1024 |
| | Others | Rated motor current | 13 *1 | Motor capacity | Number of motor poles | *2 | *2 |
| Mitsubishi vector control dedicated motor | SF-V5RU (1500r/min series) | 0 *3 | 30 | Motor capacity | 4 | 1 | 2048 |
| | SF-V5RU (except for 1500r/min series) | 0 *3 | 13 *1 | Motor capacity | 4 | 1 | 2048 |
| | SF-THY | 0 *3 | 33 *1 | Motor capacity | 4 | 1 | 2048 |
| Other manufacturer's standard motor | — | Rated motor current | 3 *1 | Motor capacity | Number of motor poles | *2 | *2 |
| Other manufacturer's constant-torque motor | — | Rated motor current | 13 *1 | Motor capacity | Number of motor poles | *2 | *2 |

Values in the bolded frame are initial values.

*1 Offline auto tuning is necessary. *(Refer to page 80)*
*2 Set this parameter according to the motor (encoder) used.
*3 Use thermal protector input provided with the motor.

When using the inverter with the SF-V5RU (1500r/min series), refer to the table below to set *Pr.83 Rated motor voltage* and *Pr.84 Rated motor frequency*. Refer to *page 77* for the settings of SF-V5RU1, 3, and 4.

| Motor capacity | SF-V5RU | | | |
|---|---|---|---|---|
| | 200V | | 400V | |
| | *Pr. 83* (V) | *Pr. 84* (Hz) | *Pr. 83* (V) | *Pr. 84* (Hz) |
| 1.5kW | 188 | 52 | 345 | 52 |
| 2.2kW | 188 | 52 | 360 | 52 |
| 3.7kW | 190 | 52 | 363 | 52 |
| 5.5kW | 165 | 51 | 322 | 51 |
| 7.5kW | 164 | 51 | 331 | 51 |
| 11kW | 171 | 51 | 320 | 51 |
| 15kW | 164 | 51 | 330 | 51 |

| Motor capacity | SF-V5RU | | | |
|---|---|---|---|---|
| | 200V | | 400V | |
| | *Pr. 83* (V) | *Pr. 84* (Hz) | *Pr. 83* (V) | *Pr. 84* (Hz) |
| 18.5kW | 171 | 51 | 346 | 51 |
| 22kW | 160 | 51 | 336 | 51 |
| 30kW | 178 | 51 | 328 | 51 |
| 37kW | 166 | 51 | 332 | 51 |
| 45kW | 171 | 51 | 342 | 51 |
| 55kW | 159 | 51 | 317 | 51 |

(9) Combination with a vector control dedicated motor
Refer to the table below when using with a vector control dedicated motor.

• Combination with the SF-V5RU and SF-THY

| Voltage | 200V class | | | 400V class | | |
|---|---|---|---|---|---|---|
| Rated speed | 1500r/min | | | | | |
| Base frequency | 50Hz | | | | | |
| Maximum speed | 3000r/min | | | | | |
| Motor capacity | Motor frame number | Motor type | Inverter model | Motor frame number | Motor type | Inverter model |
| 1.5kW | 90L | SF-V5RU1K | FR-A720-2.2K | 90L | SF-V5RUH1K | FR-A740-2.2K |
| 2.2kW | 100L | SF-V5RU2K | FR-A720-3.7K | 100L | SF-V5RUH2K | FR-A740-2.2K |
| 3.7kW | 112M | SF-V5RU3K | FR-A720-5.5K | 112M | SF-V5RUH3K | FR-A740-3.7K |
| 5.5kW | 132S | SF-V5RU5K | FR-A720-7.5K | 132S | SF-V5RUH5K | FR-A740-7.5K |
| 7.5kW | 132M | SF-V5RU7K | FR-A720-11K | 132M | SF-V5RUH7K | FR-A740-11K |
| 11kW | 160M | SF-V5RU11K | FR-A720-15K | 160M | SF-V5RUH11K | FR-A740-15K |
| 15kW | 160L | SF-V5RU15K | FR-A720-18.5K | 160L | SF-V5RUH15K | FR-A740-18.5K |
| 18.5kW | 180M | SF-V5RU18K | FR-A720-22K | 180M | SF-V5RUH18K | FR-A740-22K |
| 22kW | 180M | SF-V5RU22K | FR-A720-30K | 180M | SF-V5RUH22K | FR-A740-30K |
| 30kW | 200L *2 | SF-V5RU30K | FR-A720-37K | 200L *2 | SF-V5RUH30K | FR-A740-37K |
| 37kW | 200L *2 | SF-V5RU37K | FR-A720-45K | 200L *2 | SF-V5RUH37K | FR-A740-45K |
| 45kW | 200L *2 | SF-V5RU45K | FR-A720-55K | 200L *2 | SF-V5RUH45K | FR-A740-55K |
| 55kW | 225S *1 | SF-V5RU55K | FR-A720-75K | 225S *1 | SF-V5RUH55K | FR-A740-75K |
| 75kW | 250MD | SF-THY | FR-A720-90K | 250MD | SF-THY | FR-A740-90K |
| 90kW | — | — | — | 250MD | SF-THY | FR-A740-110K |
| 110kW | — | — | — | 280MD | SF-THY | FR-A740-132K |
| 132kW | — | — | — | 280MD | SF-THY | FR-A740-160K |
| 160kW | — | — | — | 280MD | SF-THY | FR-A740-185K |
| 200kW | — | — | — | 280L | SF-THY | FR-A740-220K |
| 250kW | — | — | — | 315H | SF-THY | FR-A740-280K |

• Combination with the SF-V5RU1, 3, 4 and SF-THY

| | SF-V5RU□1 (1:2) | | | SF-V5RU□3 (1:3) | | | SF-V5RU□4 (1:4) | | |
|---|---|---|---|---|---|---|---|---|---|
| Voltage | 200V class | | | | | | | | |
| Rated speed | 1000r/min | | | 1000r/min | | | 500r/min | | |
| Base frequency | 33.33Hz | | | 33.33Hz | | | 16.6Hz | | |
| Maximum speed | 2000r/min | | | 3000r/min | | | 2000r/min | | |
| Motor capacity | Motor frame number | Motor type | Inverter model | Motor frame number | Motor type | Inverter model | Motor frame number | Motor type | Inverter model |
| 1.5kW | 100L | SF-V5RU1K1 | FR-A720-2.2K | 112M | SF-V5RU1K3 | FR-A720-2.2K | 132M | SF-V5RU1K4 | FR-A720-2.2K |
| 2.2kW | 112M | SF-V5RU2K1 | FR-A720-3.7K | 132S | SF-V5RU2K3 | FR-A720-3.7K | 160M | SF-V5RU2K4 | FR-A720-3.7K |
| 3.7kW | 132S | SF-V5RU3K1 | FR-A720-5.5K | 132M | SF-V5RU3K3 | FR-A720-5.5K | 160L | SF-V5RU3K4 | FR-A720-7.5K |
| 5.5kW | 132M | SF-V5RU5K1 | FR-A720-7.5K | 160M | SF-V5RU5K3 | FR-A720-7.5K | 180L | SF-V5RU5K4 | FR-A720-7.5K |
| 7.5kW | 160M | SF-V5RU7K1 | FR-A720-11K | 160L | SF-V5RU7K3 | FR-A720-11K | 200L | SF-V5RU7K4 | FR-A720-11K |
| 11kW | 160L | SF-V5RU11K1 | FR-A720-15K | 180M | SF-V5RU11K3 | FR-A720-15K | 225S | SF-V5RU11K4 | FR-A720-15K |
| 15kW | 180M | SF-V5RU15K1 | FR-A720-18.5K | 180L | SF-V5RU15K3 | FR-A720-18.5K | 225S | SF-V5RU15K4 | FR-A720-22K |
| 18.5kW | 180L | SF-V5RU18K1 | FR-A720-22K | 200L | SF-V5RU18K3 | FR-A720-22K | 250MD | SF-THY | FR-A720-22K |
| 22kW | 200L | SF-V5RU22K1 | FR-A720-30K | 200L | SF-V5RU22K3 | FR-A720-30K | 280MD | SF-THY | FR-A720-30K |
| 30kW | 200L*3 | SF-V5RU30K1 | FR-A720-37K | 225S*1 | SF-V5RU30K3 | FR-A720-37K | 280MD | SF-THY | FR-A720-37K |
| 37kW | 225S | SF-V5RU37K1 | FR-A720-45K | 250MD*1 | SF-THY | FR-A720-45K | 280MD | SF-THY | FR-A720-45K |
| 45kW | 250MD | SF-THY | FR-A720-55K | 250MD*1 | SF-THY | FR-A720-55K | 280MD | SF-THY | FR-A720-55K |
| 55kW | 250MD | SF-THY | FR-A720-75K | 280MD*1 | SF-THY | FR-A720-75K | 280L | SF-THY | FR-A720-75K |

Models surrounded by black borders and 400V class are developed upon receipt of order.

*1 The maximum speed is 2400r/min.
*2 80% output in the high-speed range. (The output is reduced when the speed is 2400r/min or more.)
*3 90% output in the high-speed range. (The output is reduced when the speed is 1000r/min or more.)

# 2.5 Connection of stand-alone option units

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

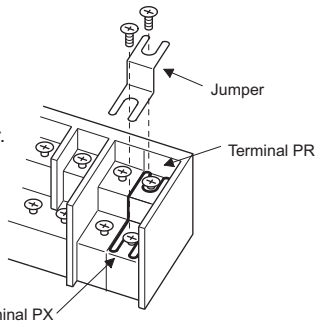
## *2.5.1 Connection of the dedicated external brake resistor (FR-ABR)*

The built-in brake resistor is connected across terminals P/+ and PR. Fit the external dedicated brake resistor (FR-ABR) when the built-in brake resistor does not have enough thermal capability for high-duty operation (22K or lower). At this time, remove the jumper from across terminals PR and PX (7.5K or lower) and connect the dedicated brake resistor (FR-ABR) across terminals P/+ and PR.
(For the locations of terminals P/+ and PR, refer to the terminal block layout *(page 11)*.)
Removing jumpers across terminals PR and PX disables the built-in brake resistor (power is not supplied).
Note that the built-in brake resistor is not need to be removed from the inverter.
The lead wire of the built-in brake resistor is not need to be removed from the terminal.
Set parameters below.

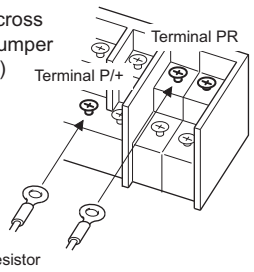
· *Pr. 30 Regenerative function selection* = "1"
· *Pr. 70 Special regenerative brake duty* = "7.5K or lower: 10%, 11K or higher: 6%"

**●FR-A720-0.4K to 0.75K**

1) Remove the screws in terminals PR and PX and remove the jumper.

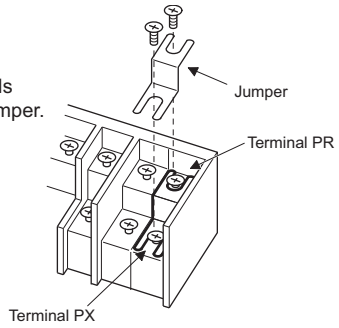



2) Connect the brake resistor across terminals P/+ and PR. (The jumper should remain disconnected.)

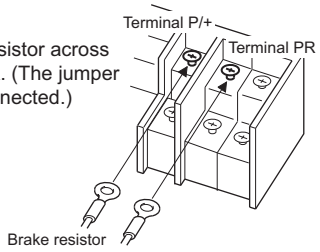



**●FR-A720-1.5 to 3.7K, FR-A740-0.4K to 3.7K**

1) Remove the screws in terminals PR and PX and remove the jumper.

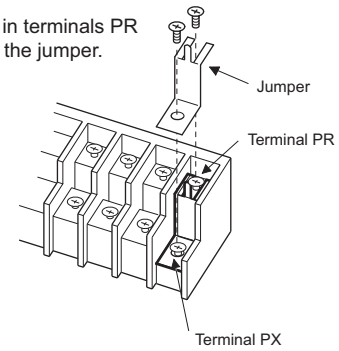



2) Connect the brake resistor across terminals P/+ and PR. (The jumper should remain disconnected.)

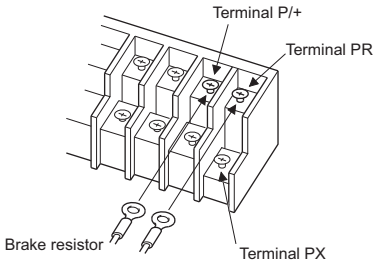


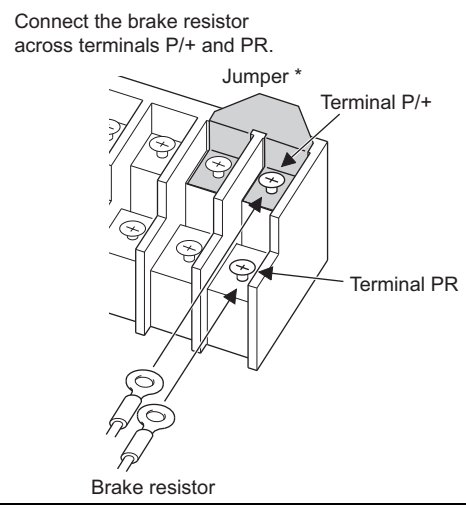
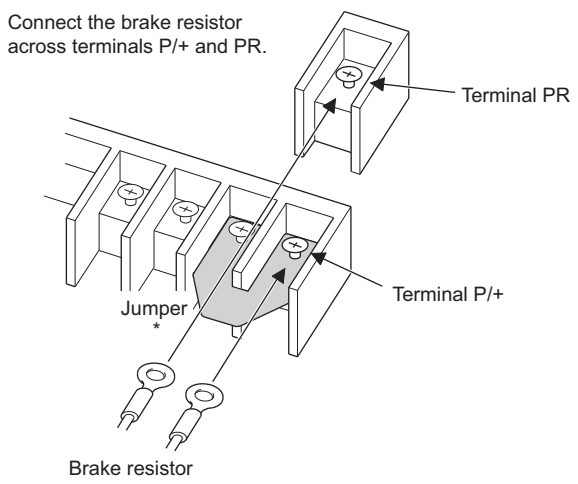

**●FR-A720-5.5K, 7.5K, FR-A740-5.5K, 7.5K**

1) Remove the screws in terminals PR and PX and remove the jumper.




2) Connect the brake resistor across terminals P/+ and PR. (The jumper should remain disconnected.)

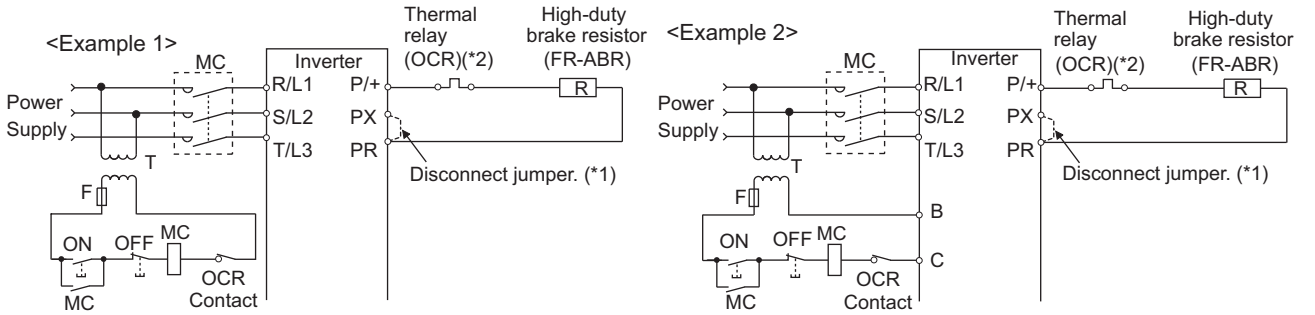


| ●FR-A720-11K, FR-A740-11K, 15K | ●FR-A720-15K to 22K, FR-A740-18.5K, 22K |
|---|---|
|  |  |



* Do not remove the jumper across terminal P/+ and P1 except when connecting a DC reactor (FR-HEL).

● When the regenerative brake transistor is damaged, the following sequence is recommended to prevent overheat and burnout of the brake resistor.

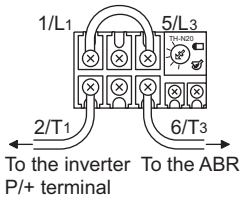




*1 Since the 11K or higher inverter is not provided with the PX terminal, a jumper is not need to be removed.

*2 Refer to the table below for the type number of each capacity of thermal relay and the diagram below for the connection. (Always install a thermal relay when using the 11K or higher)

| Power Supply Voltage | High-Duty Brake Resistor | Thermal Relay Type (Mitsubishi product) | Contact Rating |
|---|---|---|---|
| 200V | FR-ABR-0.4K | TH-N20CXHZ-0.7A | 110V 5AAC, 220V 2AAC(AC-11 class) 110V 0.5ADC, 220V 0.25ADC(DC-11 class) |
| | FR-ABR-0.75K | TH-N20CXHZ-1.3A | |
| | FR-ABR-2.2K | TH-N20CXHZ-2.1A | |
| | FR-ABR-3.7K | TH-N20CXHZ-3.6A | |
| | FR-ABR-5.5K | TH-N20CXHZ-5A | |
| | FR-ABR-7.5K | TH-N20CXHZ-6.6A | |
| | FR-ABR-11K | TH-N20CXHZ-11A | |
| | FR-ABR-15K | TH-N20CXHZ-11A | |
| | FR-ABR-22K | TH-N60-22A | |
| 400V | FR-ABR-H0.4K | TH-N20CXHZ-0.24A | |
| | FR-ABR-H0.75K | TH-N20CXHZ-0.35A | |
| | FR-ABR-H1.5K | TH-N20CXHZ-0.9A | |
| | FR-ABR-H2.2K | TH-N20CXHZ-1.3A | |
| | FR-ABR-H3.7K | TH-N20CXHZ-2.1A | |
| | FR-ABR-H5.5K | TH-N20CXHZ-2.5A | |
| | FR-ABR-H7.5K | TH-N20CXHZ-3.6A | |
| | FR-ABR-H11K | TH-N20CXHZ-6.6A | |
| | FR-ABR-H15K | TH-N20CXHZ-6.6A | |
| | FR-ABR-H22K | TH-N20-9A | |





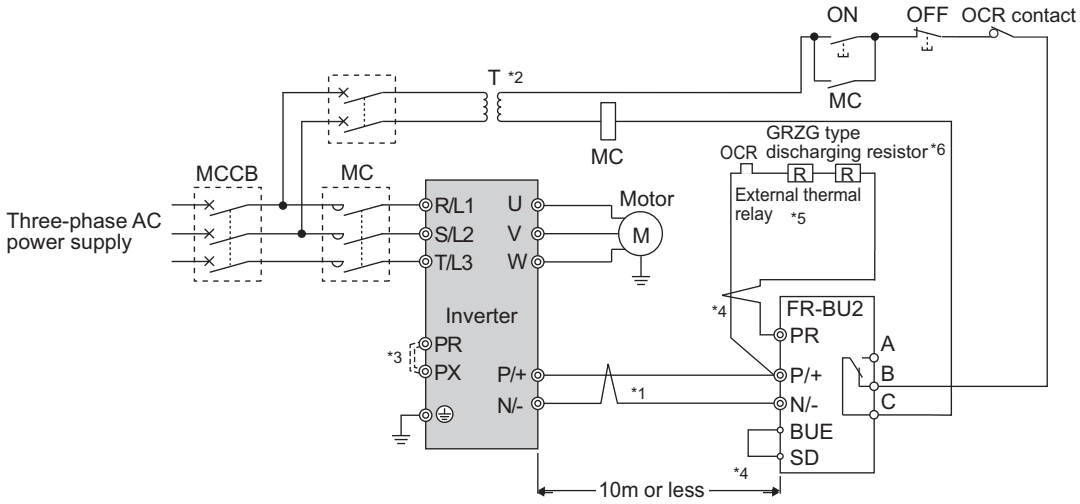
**CAUTION**

- The brake resistor connected should only be the dedicated brake resistor.
- The jumper across terminals PR and PX (7.5K or lower) must be disconnected before connecting the dedicated brake resistor. Doing so may damage the inverter.
- Brake resistor cannot be used with the brake unit, high power factor converter, power supply regeneration converter, etc.

## 2.5.2 Connection of the brake unit (FR-BU2)

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

### (1) Connection example with the GRZG type discharging resistor




*1 Connect the inverter terminals (P/+, N/-) and brake unit (FR-BU2) terminals so that their terminal names match with each other. (Incorrect connection will damage the inverter and brake unit.)

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

*3 Be sure to remove the jumper across terminals PR and PX when using the FR-BU2 with the inverter of 7.5K or lower.

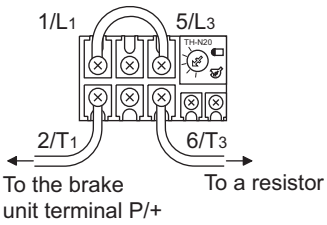
*4 Keep a wiring distance of within 5m between the inverter, brake unit (FR-BU2) and discharging resistor. Even when the wiring is twisted, the cable length must not exceed 10m.

*5 It is recommended to install an external thermal relay to prevent overheat of discharging resistors.

*6 Refer to FR-BU2 manual for connection method of discharging resistor.

**<Recommended external thermal relay>**

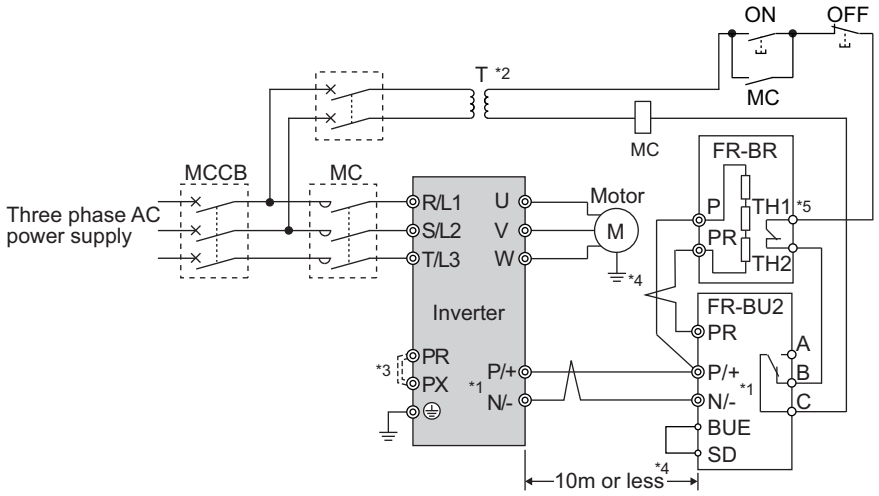
| Brake Unit | Discharging Resistor | Recommended External Thermal Relay |
|---|---|---|
| FR-BU2-1.5K | GZG 300W-50Ω (one) | TH-N20CXHZ 1.3A |
| FR-BU2-3.7K | GRZG 200-10Ω (three in series) | TH-N20CXHZ 3.6A |
| FR-BU2-7.5K | GRZG 300-5Ω (four in series) | TH-N20CXHZ 6.6A |
| FR-BU2-15K | GRZG 400-2Ω (six in series) | TH-N20CXHZ 11A |
| FR-BU2-H7.5K | GRZG 200-10Ω (six in series) | TH-N20CXHZ 3.6A |
| FR-BU2-H15K | GRZG 300-5Ω (eight in series) | TH-N20CXHZ 6.6A |
| FR-BU2-H30K | GRZG 400-2Ω (twelve in series) | TH-N20CXHZ 11A |




**CAUTION**

- Set "1" in *Pr. 0 Brake mode selection* of the FR-BU2 to use GRZG type discharging resistor.
- Do not remove the jumper across terminal P/+ and P1 except when connecting a DC reactor (FR-HEL).

## (2) FR-BR-(H) connection example with resistor unit



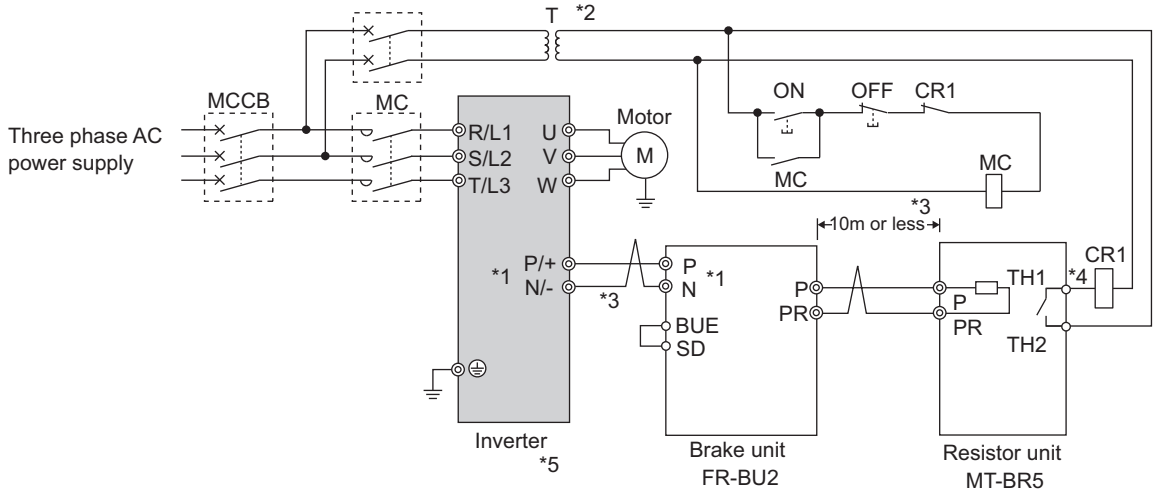

*1 Connect the inverter terminals (P/+, N/-) and brake unit (FR-BU2) terminals so that their terminal names match with each other. (Incorrect connection will damage the inverter and brake unit.)
*2 When the power supply is 400V class, install a stepdown transformer.
*3 Be sure to remove the jumper across terminals PR and PX when using the FR-BU with the inverter of 7.5K or lower.
*4 The wiring distance between the inverter, brake unit (FR-BU) and resistor unit (FR-BR) should be within 5m. Even when the wiring is twisted, the cable length must not exceed 10m.
*5 The contact between TH1 and TH2 is closed in the normal status and is open at a fault.

**CAUTION**

· Do not remove the jumper across terminal P/+ and P1 except when connecting a DC reactor (FR-HEL).

## (3) Connection example with MT-BR5 type resistor unit

After making sure that the wiring is correct, set the following parameters:
*Pr. 30 Regenerative function selection* = "1"
*Pr. 70 Special regenerative brake duty* = "0 (initial value)"
Set *Pr. 0 Brake mode selection* = "2" in the brake unit FR-BU2.




*1 Connect the inverter terminals (P/+, N/-) and brake unit (FR-BU2) terminals so that their terminal names match with each other. (Incorrect connection will damage the inverter and brake unit.)
*2 When the power supply is 400V class, install a stepdown transformer.
*3 The wiring distance between the inverter, brake unit (FR-BU2) and resistor unit (MT-BR5) should be within 5m. If twisted wires are used, the distance should be within 10m.
*4 The contact between TH1 and TH2 is open in the normal status and is closed at a fault.
*5 CN8 connector used with the MT-BU5 type brake unit is not used.

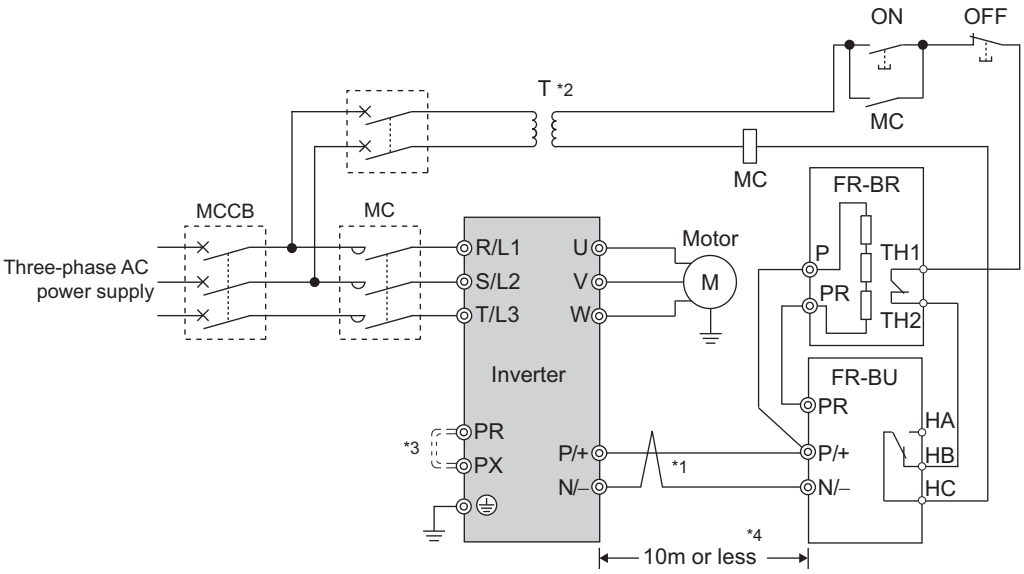
**CAUTION**

· The stall prevention (overvoltage), oL, does not occur while *Pr.30 Regenerative function selection* = "1" and *Pr.70 Special regenerative brake duty* = "0% (initial value)."

### 2.5.3 Connection of the brake unit (FR-BU/MT-BU5)

When connecting the brake unit (FR-BU(H)/MT-BU5) to improve the brake capability at deceleration, make connection as shown below.

(1) Connection with the FR-BU (55K or lower)




*1 Connect the inverter terminals (P/+, N/-) and brake unit (FR-BU (H)) terminals so that their terminal signals match with each other. (Incorrect connection will damage the inverter.)

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

*3 Be sure to remove the jumper across terminals PR and PX when using the FR-BU with the inverter of 7.5K or lower.

*4 The wiring distance between the inverter, brake unit (FR-BU) and resistor unit (FR-BR) should be within 5m. If twisted wires are used, the distance should be within 10m.

**CAUTION**

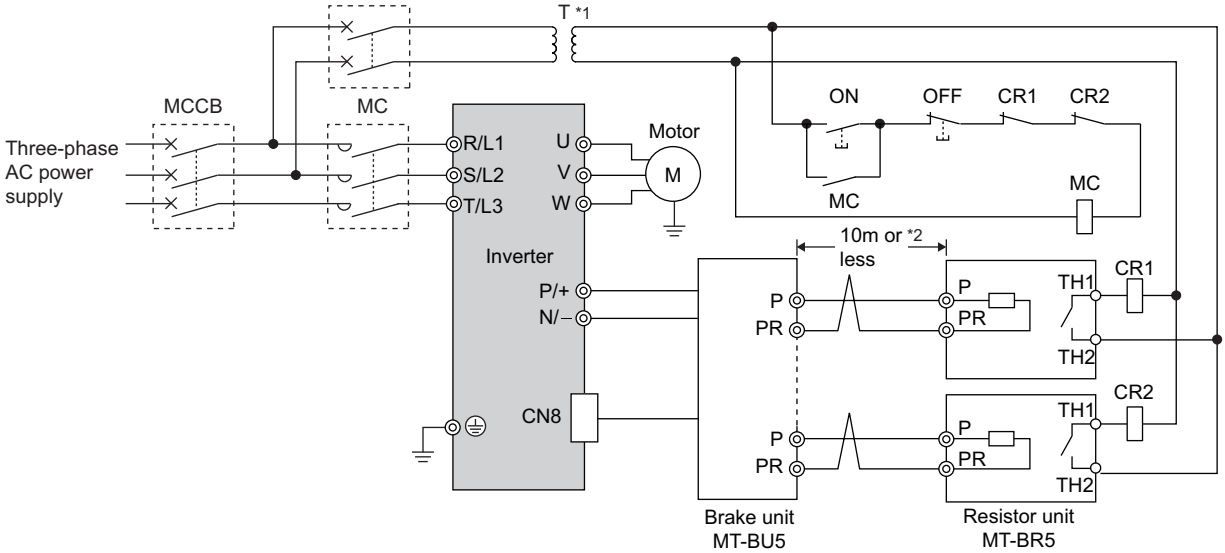
- If the transistors in the brake unit should become faulty, the resistor can be unusually hot, causing a fire. Therefore, install a magnetic contactor on the inverter's input side to configure a circuit so that a current is shut off in case of fault.
- Do not remove the jumper across terminal P/+ and P1 except when connecting a DC reactor (FR-HEL).

(2) Connection with the MT-BU5 (75K or higher)

After making sure that the MT-BU5 is properly connected, set the following parameters.

*Pr. 30 Regenerative function selection* = "1"

*Pr. 70 Special regenerative brake duty* = "10%"




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

*2 The wiring length between the resistor unit and brake resistor should be 10m maximum when wires are twisted and 5m maximum when wires are not twisted.

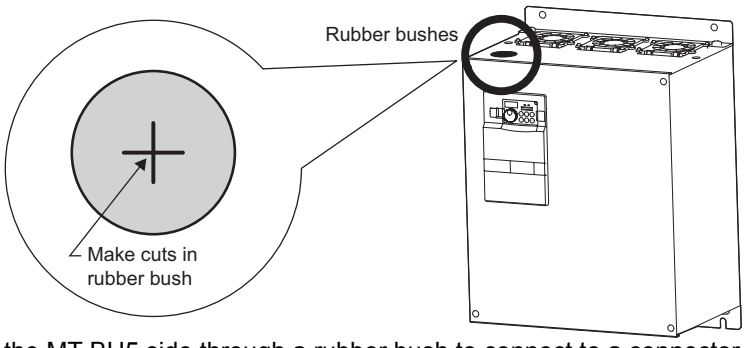
**CAUTION**

- Install the brake unit in a place where a cooling air reaches the brake unit heatsink and within a distance of the cable supplied with the brake unit reaches the inverter.
- For wiring of the brake unit and inverter, use an accessory cable supplied with the brake unit. Connect the main circuit cable to the inverter terminals P/+ and N/- and connect the control circuit cable to the CN8 connector inside by making cuts in the rubber bush at the top of the inverter for leading the cable.
- The brake unit which uses multiple resistor units has terminals equal to the number of resistor units. Connect one resistor unit to one pair of terminal (P, PR).

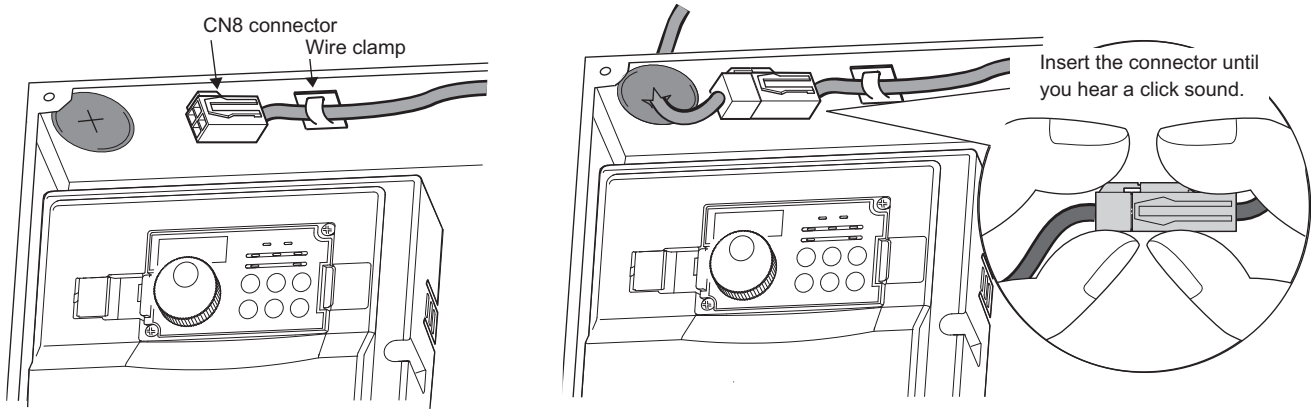
<Inserting the CN8 connector>

Make cuts in rubber bush of the upper portion of the inverter and lead a cable.

1) Make cuts in the rubber bush for leading the CN8 connector cable with a nipper or cutter knife.




2) Insert a connector on the MT-BU5 side through a rubber bush to connect to a connector on the inverter side.

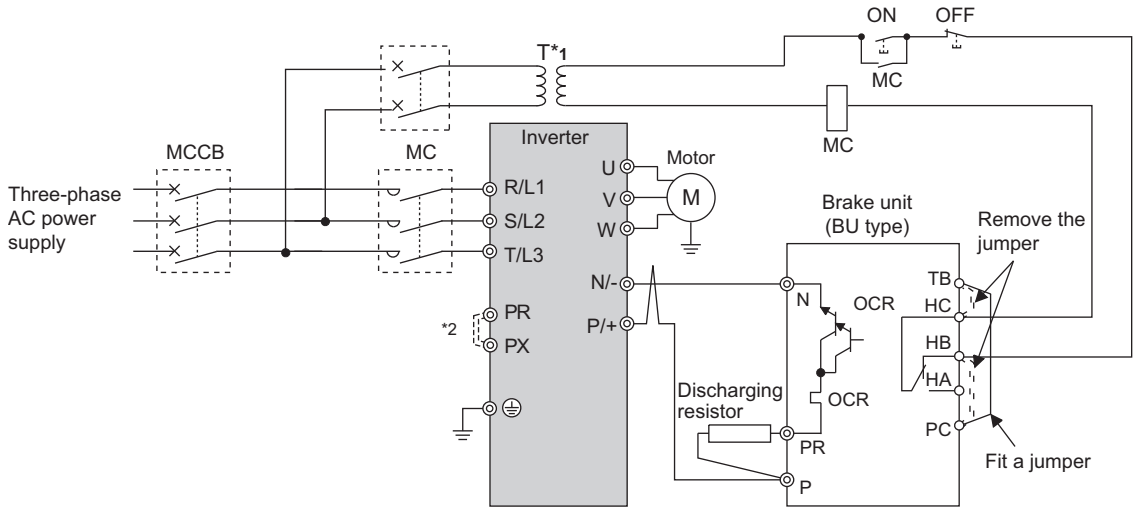



**CAUTION**

Clamp the CN8 connector cable on the inverter side with a wire clamp securely.
Do not connect the MT-BU5 to a CN8 connector of the FR-A740-55K.

## 2.5.4 Connection of the brake unit (BU type)

Connect the brake unit (BU type) correctly as shown below. Incorrect connection will damage the inverter. Remove the jumper across terminals HB-PC and terminals TB-HC of the brake unit and fit it across terminals PC-TB.




*1 When the power supply is 400V class, install a stepdown transformer.
*2 For capacity 7.5K or lower, remove the jumper across terminals PR and PX.

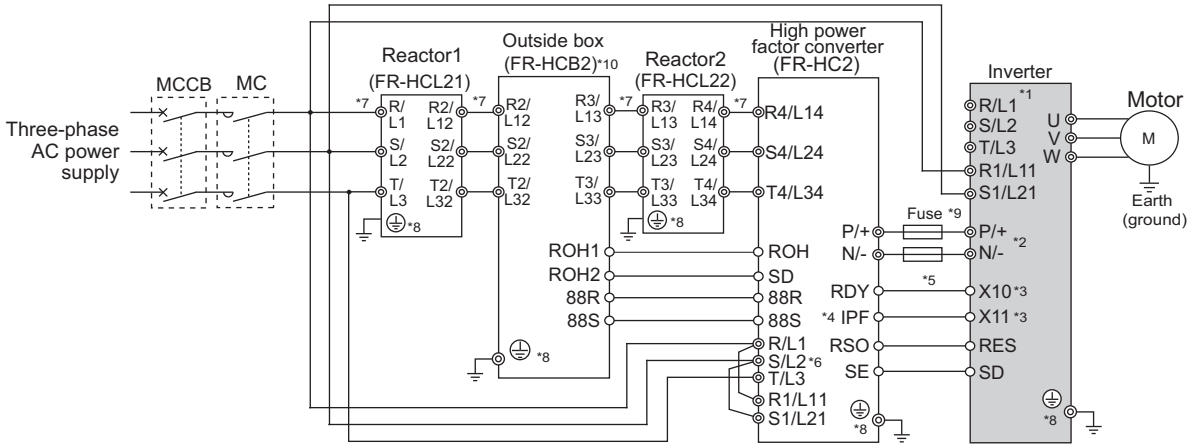
**CAUTION**

- The wiring distance between the inverter, brake unit and resistor unit should be within 2m. If twisted wires are used, the distance should be within 5m.
- If the transistors in the brake unit should become faulty, the resistor can be unusually hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to configure a circuit so that a current is shut off in case of fault.
- Do not remove the jumper across terminal P/+ and P1 except when connecting a DC reactor (FR-HEL).

## 2.5.5 Connection of the high power factor converter (FR-HC2)

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

Perform the wiring securely, and set the following parameters: *Pr.19 Base frequency voltage* = "rated motor current" and *Pr.30 Regenerative function selection* = "2".




*1 Remove the jumpers between terminals R/L1 and R/L11 as well as between S/L2 and S1/L21, and connect the power supply for the control circuit to across terminals R1/L11 and S1/L21. Do not connect anything to power input terminals (R/L1, S/L2, T/L3). Incorrect connection will damage the inverter. (E.OPT (option fault) will occur. (*Refer to page 161*))

*2 Do not install an MCCB for the terminals P/+ and N/- (between terminals P and P/+ or between N and N/-). Connecting the opposite polarity of terminals N/- and P/+ will damage the inverter.

*3 Assign the X10 (X11) signal to a terminal using any of *Pr. 178 to Pr. 189 (input terminal function selection)*. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*
For RS-485 or any other communication operation where the start command is only transmitted once, use the X11 signal to save the operation mode at the time of an instantaneous power failure.

*4 Assign the IPF signal to an FR-HC2 terminal. *(Refer to the Instruction Manual of FR-HC2.)*

*5 Always connect the FR-HC2 terminal RDY to a terminal where the X10 or MRS signal is assigned in the inverter. Always connect the FR-HC2 terminal SE to the inverter terminal SD. Not connecting these terminals may damage the FR-HC2.

*6 Always connect the R/L1, S/L2, and T/L3 terminals of FR-HC2 to the power supply. Operating the inverter without connecting them will damage FR-HC2.

*7 Do not install an MCCB or MC between the reactor 1 terminals (R/L1, S/L2, T/L3) and FR-HC2 terminals (R4/L14, S4/L24, T4/L34). It will not operate properly.

*8 Securely perform grounding (earthing) by using the ground (earth) terminal.

*9 Installation of a fuse is recommended. *(Refer to the Instruction Manual of FR-HC2.)*

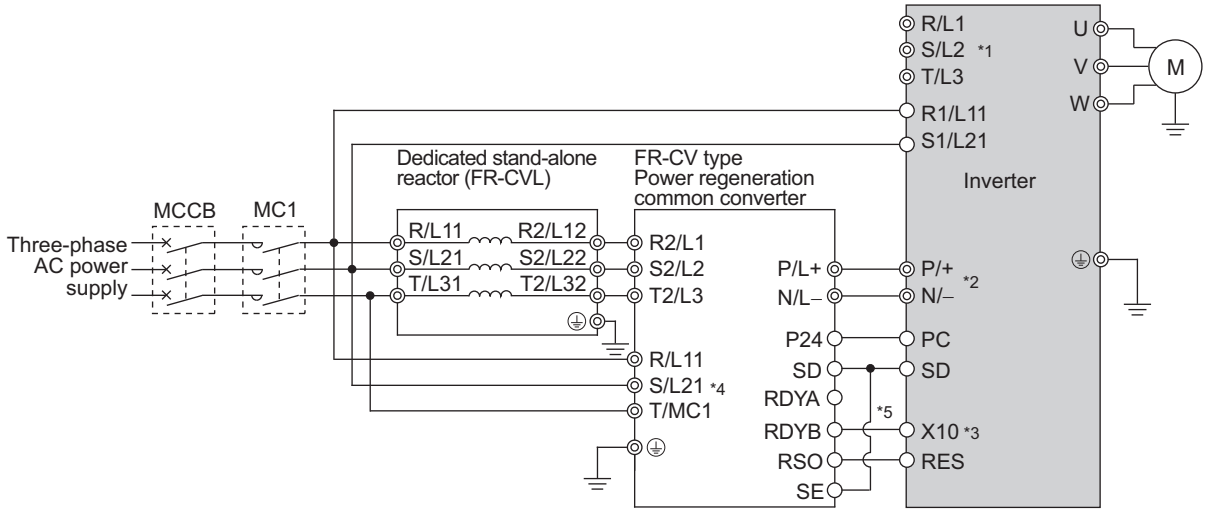
*10 Outside box is not available for FR-HC2-H280K or higher. Connect filter capacitors, inrush current limit resistors, and magnetic contactors. *(Refer to the Instruction Manual of FR-HC2.)*

**CAUTION**

- The voltage phases of terminals R/L1, S/L2, and T/L3 and the voltage phases of terminals R4/L14, S4/L24, and T4/L34 must be matched.
- Match the control logic (sink logic / source logic) of the high power factor converter and the inverter. *(Refer to page 22)*
- Do not connect a DC reactor (FR-HEL) to the inverter when FR-HC2 is connected.

## 2.5.6 Connection of the power regeneration common converter (FR-CV)

When connecting the power regeneration common converter (FR-CV), make connection so that the inverter terminals (P/+, N/-) and the terminal symbols of the power regeneration common converter (FR-CV) are the same (55K or lower). After making sure that the wiring is correct, set "2" in *Pr. 30 Regenerative function selection*.




*1 Remove the jumpers across terminals R/L1 and R1/L11 and S/L2 and S1/L21 of the inverter, and connect the control circuit power supply across terminals R1/L11 and S1/L21. Always keep the power input terminals R/L1, S/L2, T/L3 open. Incorrect connection will damage the inverter. (E.OPT (option alarm) will occur. *(Refer to page 161)*)

*2 Do not insert the MCCB between the terminals P/+ and N/- (between P/L+ and P/+, between N/L- and N/-). Opposite polarity of terminals N/-, P/+ will damage the inverter.

*3 Assign the terminal for X10 signal using any of *Pr. 178 to Pr. 189 (input terminal function selection)*. *(Refer to page 125)*

*4 Be sure to connect the power supply and terminals R/L11, S/L21, T/MC1.
Operating the inverter without connecting them will damage the power regeneration common converter.

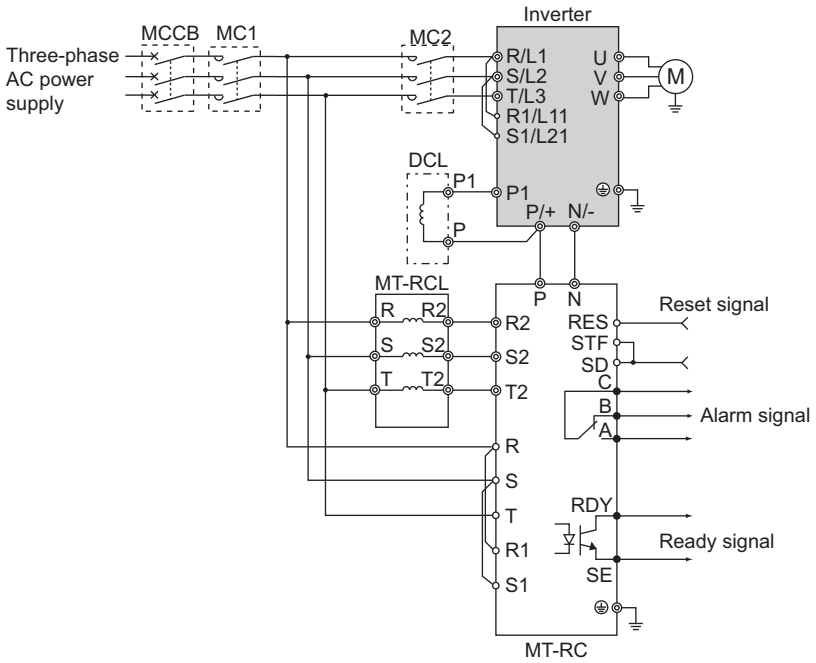
*5 Always connect the terminal RDYB (of FR-CV) to a terminal where the X10 or MRS signal is assigned in the inverter. Always connect the terminal SE (of FR-CV) to the terminal SD (of the inverter). Not doing so may damage FR-CV.

**CAUTION**

- The voltage phases of terminals R/L11, S/L21, T/MC1 and terminals R2/L1, S2/L2, T2/L3 must be matched.
- Use sink logic (factory setting) when the FR-CV is connected. The FR-CV cannot be connected when source logic is selected.
- Do not connect a DC reactor (FR-HEL) to the inverter when FR-CV is connected.

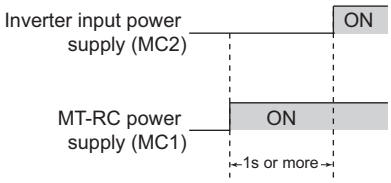
## 2.5.7 Connection of power regeneration converter (MT-RC)

When connecting a power regeneration converter (MT-RC), perform wiring securely as shown below. Incorrect connection will damage the regeneration converter and inverter (75K or higher). After connecting securely, set "1" in *Pr. 30 Regenerative function selection* and "0" in *Pr. 70 Special regenerative brake duty*.



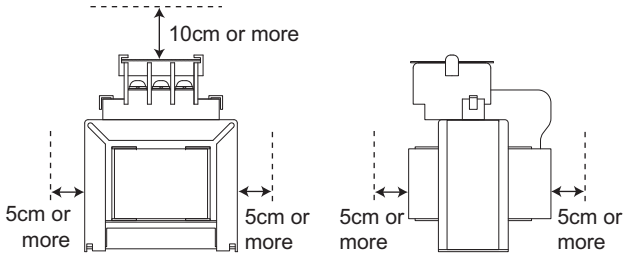

**CAUTION**

- When using the FR-A700 series together with the MT-RC, install a magnetic contactor (MC) at the input side of the inverter so that power is supplied to the inverter after 1s or more has elapsed after powering ON the MT-RC. When power is supplied to the inverter prior to the MT-RC, the inverter and the MT-RC may be damaged or the MCCB may trip or be damaged.
- Refer to the MT-RC manual for precautions for connecting the power coordination reactor and others.

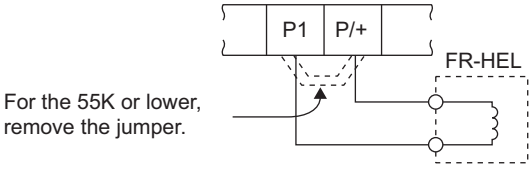


### 2.5.8 Connection of the power factor improving DC reactor (FR-HEL)

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




(2) When using the DC reactor (FR-HEL), connect it between terminals P1 and P/+.
For the 55K or lower, the jumper connected across terminals P1 and P/+ must be removed. Otherwise, the reactor will not exhibit its performance.
For the 75K or higher, a DC reactor is supplied. Always install the reactor.




(3) Since the DC reactor (FR-HEL) is electrically connected to the enclosure through mounting screws, the DC reactor is earthed (grounded) by being securely mounted to the enclosure. However, if the DC reactor is not earthed (grounded) securely enough, an earthing (grounding) cable may be used.
When you are using an earthing (grounding) cable with a FR-HEL-(H)55K or lower capacity inverter, wire the cable to the mounting hole where varnish is removed. (Refer to the Instruction Manual of FR-HEL.)
For FR-HEL-(H)75K or higher, use an earth (ground) terminal to perform earthing (grounding). *(Refer to page 192)*

**CAUTION**

- The wiring distance should be within 5m.
- The size of the cables used should be equal to or larger than that of the power supply cables (R/L1, S/L2, T/L3) and the earthing (grounding) cable. *(Refer to page 14)*
- Do not connect a DC reactor (FR-HEL) to the inverter when FR-HC2 or FR-CV is connected.

# 2.6 Power-off and magnetic contactor (MC)

### (1) Inverter input side magnetic contactor (MC)

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

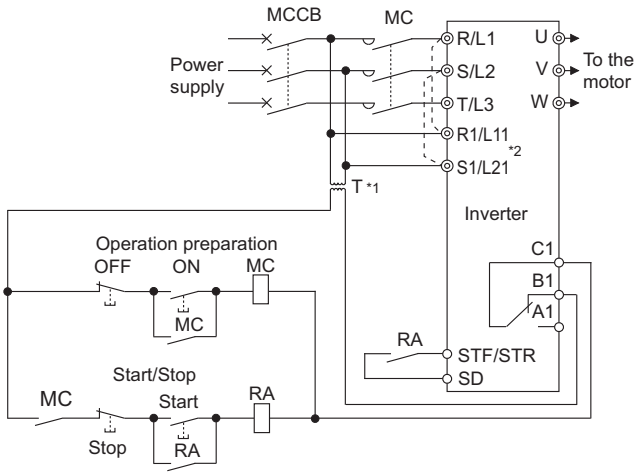
(*Refer to page 4* for selection.)

1) To release the inverter from the power supply when a fault occurs or when the drive is not functioning (e.g. emergency stop operation). For example, MC avoids overheat or burnout of the brake resistor when heat capacity of the resistor is insufficient or brake regenerative transistor is damaged with short while connecting an optional brake resistor.
2) To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure
3) 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 JEM1038-AC-3 class rated current.

**REMARKS**

Since repeated inrush currents at power ON will shorten the life of the converter circuit (switching life is about 1,000,000 times. (For the 200V class 30K or higher, switching life is about 500,000)), frequent starts and stops of the MC must be avoided. Turn on/off the inverter start controlling terminals (STF, STR) to run/stop the inverter.




**• Inverter start/stop circuit example**

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

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

*2 Connect the power supply terminals R1/L11, S1/L21 of the control circuit to the primary side of the MC to hold an alarm signal when the inverter's protective circuit is activated. At this time, remove jumpers across terminals R/L1 and R1/L11 and S/L2 and S1/L21. (Refer to *page 17* for removal of the jumper.)

### (2) Handling of the inverter output side magnetic contactor

Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned ON while the inverter is operating, overcurrent protection of the inverter and such will activate. When an MC is provided to switch to a commercial power supply, for example, it is recommended to use the electronic bypass function *Pr. 135 to Pr. 139 (Chapter 4 of the Instruction Manual (Applied))*. (The commercial power supply operation cannot be performed with the vector control dedicated motor (SF-V5RU, SF-THY) or with the IPM motor.)

**CAUTION**

IPM motor is a synchronous motor with high-performance magnets embedded in the rotor. Motor terminals hold high-voltage while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. When the motor is driven by the load in applications such as fan and blower, 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.

## 2.7 Precautions for use of the inverter

The FR-A700 series is a highly reliable product, but using incorrect peripheral circuits or incorrect operation/handling methods may shorten the product life or damage the product.
Before starting operation, always recheck the following items.

**(1) Use crimping terminals with insulation sleeve to wire the power supply and motor.**

**(2) Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.**

**(3) 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 care not to allow chips and other foreign matter to enter the inverter.

**(4) Use cables of the appropriate size to make a voltage drop of 2% maximum.**
If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.
Refer to *page 14* for the recommended cable sizes.

**(5) The total wiring length should be within the prescribed length.**
Especially for long distance wiring, the fast-response current limit function may decrease, or the equipment connected to the secondary side may malfunction. This is caused by a charging current due to the stray capacity of the wiring. Therefore, note the overall wiring length. *(Refer to page 16.)*

**(6) 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 this case, set the noise filter valid to minimize interference. *(Refer to page 10)*

**(7) Do not install a power factor correction capacitor, surge suppressor or radio noise filter on the inverter output side.**
This will cause the inverter to trip or the capacitor, and surge suppressor to be damaged. If any of the above devices are installed, immediately remove it.

**(8) For some short time after the power is switched OFF, a high voltage remains in the smoothing capacitor.**
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 no more than 30VDC using a tester.

**(9) A short circuit or earth (ground) fault on the inverter output side may damage the inverter modules.**
- Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits may damage the inverter modules. These short circuits may be caused by peripheral circuit inadequacy, an earth (ground) fault caused by wiring inadequacy, or reduced motor insulation resistance.
- Fully check the to-earth (ground) insulation and phase to phase insulation of the inverter output side before power-on. Especially for an old motor or use in a hostile atmosphere, securely check the motor insulation resistance etc.

**(10) Do not use the inverter input side magnetic contactor to start/stop the inverter.**
Since repeated inrush currents at power ON will shorten the life of the converter circuit (switching life is about 1,000,000 times. (For the 200V class 30K or higher, switching life is about 500,000)), frequent starts and stops of the MC must be avoided.
Always use the start signal (ON/OFF of STF and STR signals) to start/stop the inverter. *(Refer to page 9)*

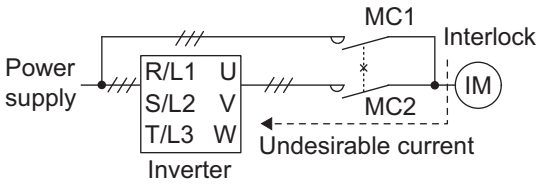
**(11) Across P/+ and PR terminals, connect only an external brake resistor.**
Do not connect a mechanical brake.

**(12) 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 across terminals 10E and 5.

**(13) Provide electrical and mechanical interlocks for MC1 and MC2 which are used for bypass operation.**

When the wiring is incorrect or if there is an electronic bypass circuit as shown on the right, the inverter will be damaged by leakage current from the power supply when it is connected to the inverter U, V, W terminals due to arcs generated at the time of switch-over or chattering caused by a sequence error.

(The commercial power supply operation cannot be performed with the vector control dedicated motor (SF-V5RU, SF-THY) or with the IPM motor.)




**(14) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor 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.

**(15) A motor with encoder is necessary for vector control. In addition, connect the encoder directly to the backlash-free motor shaft. (An encoder is not necessary for Real sensorless vector control.)**

**(16) Inverter input side magnetic contactor (MC)**

On the inverter input side, connect a MC for the following purposes. (*Refer to page 4* for selection.)

1)To release the inverter from the power supply when a fault occurs or when the drive is not functioning (e.g. emergency stop operation). For example, MC avoids overheat or burnout of the brake resistor when heat capacity of the resistor is insufficient or brake regenerative transistor is damaged with short while connecting an optional brake resistor.

2)To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure

3)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 JEM1038-AC-3 class rated current.

**(17) Handling of inverter output side magnetic contactor**

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 MC is provided for switching to the commercial power supply, for example, switch it ON/OFF after the inverter and motor have stopped.

IPM motor is a synchronous motor with high-performance magnets embedded in the rotor. Motor terminals hold high-voltage while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. When the motor is driven by the load in applications such as fan and blower, 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.

**(18) Countermeasures against inverter-generated EMI**

If electromagnetic noise generated from the inverter causes frequency setting signal to fluctuate and motor rotation speed to be unstable when changing motor speed with analog signal, 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 shield cables as signal cables.
· Install a ferrite core on the signal cable (Example: ZCAT3035-1330 TDK).

**(19) Instructions for overload operation**

When performing an operation of frequent start/stop with the inverter, rise/fall in the temperature of the transistor element of the inverter will repeat due to a continuous 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. Decreasing current may increase the life. However, decreasing current will result in insufficient torque and the inverter may not start. A counter action for this is to raise the permissible current level by increasing the inverter capacity (up to 2 ranks) when using an induction motor, and by increasing the inverter and IPM motor capacities when using an IPM motor.

**(20) Make sure that the specifications and rating match the system requirements.**

## 2.8 Failsafe of the system which uses the inverter

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

(1) Interlock method which uses the inverter status output signals

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

| No. | Interlock Method | Check Method | Used signals | Refer to Page |
|---|---|---|---|---|
| 1) | Inverter protective function operation | Operation check of an alarm contact<br>Circuit error detection by negative logic | Fault output signal (ALM signal) | *Refer to Chapter 4 of the Instruction Manual (Applied).* |
| 2) | Inverter running status | Operation ready signal check | Operation ready signal (RY signal) | *Refer to Chapter 4 of the Instruction Manual (Applied).* |
| 3) | Inverter running status | Logic check of the start signal and running signal | Start signal (STF signal, STR signal)<br>Running signal (RUN signal) | *Refer to Chapter 4 of the Instruction Manual (Applied).* |
| 4) | Inverter running status | Logic check of the start signal and output current | Start signal (STF signal, STR signal)<br>Output current detection signal (Y12 signal) | *Refer to Chapter 4 of the Instruction Manual (Applied).* |

(2) 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, when the inverter CPU fails, even if the interlock is provided using the inverter fault signal, start signal and RUN signal, there is a case where a fault signal is not output and RUN signal is kept output even if an inverter fault occurs.

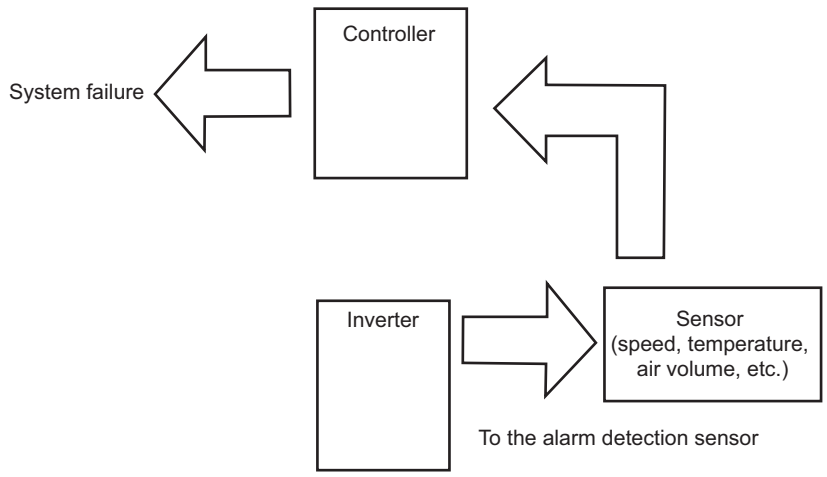
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as checking up as below according to the level of importance of the system.

1) 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 motor current runs as the motor is running for the period until the motor stops since the inverter starts decelerating even if the start signal turns off. For the logic check, configure a sequence considering the inverter deceleration time. In addition, it is recommended to check the three-phase current when using the current detector.

2) Command speed and actual operation check

Check if there is no gap between the actual speed and commanded speed by comparing the inverter speed command and detected speed of the speed detector.

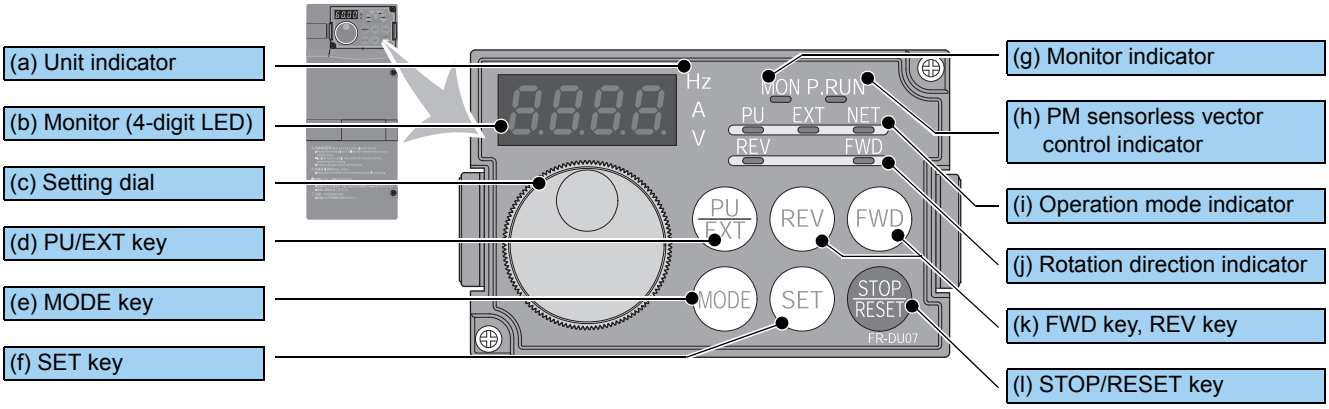


# 3 DRIVING THE MOTOR

## 3.1 Operation panel (FR-DU07)

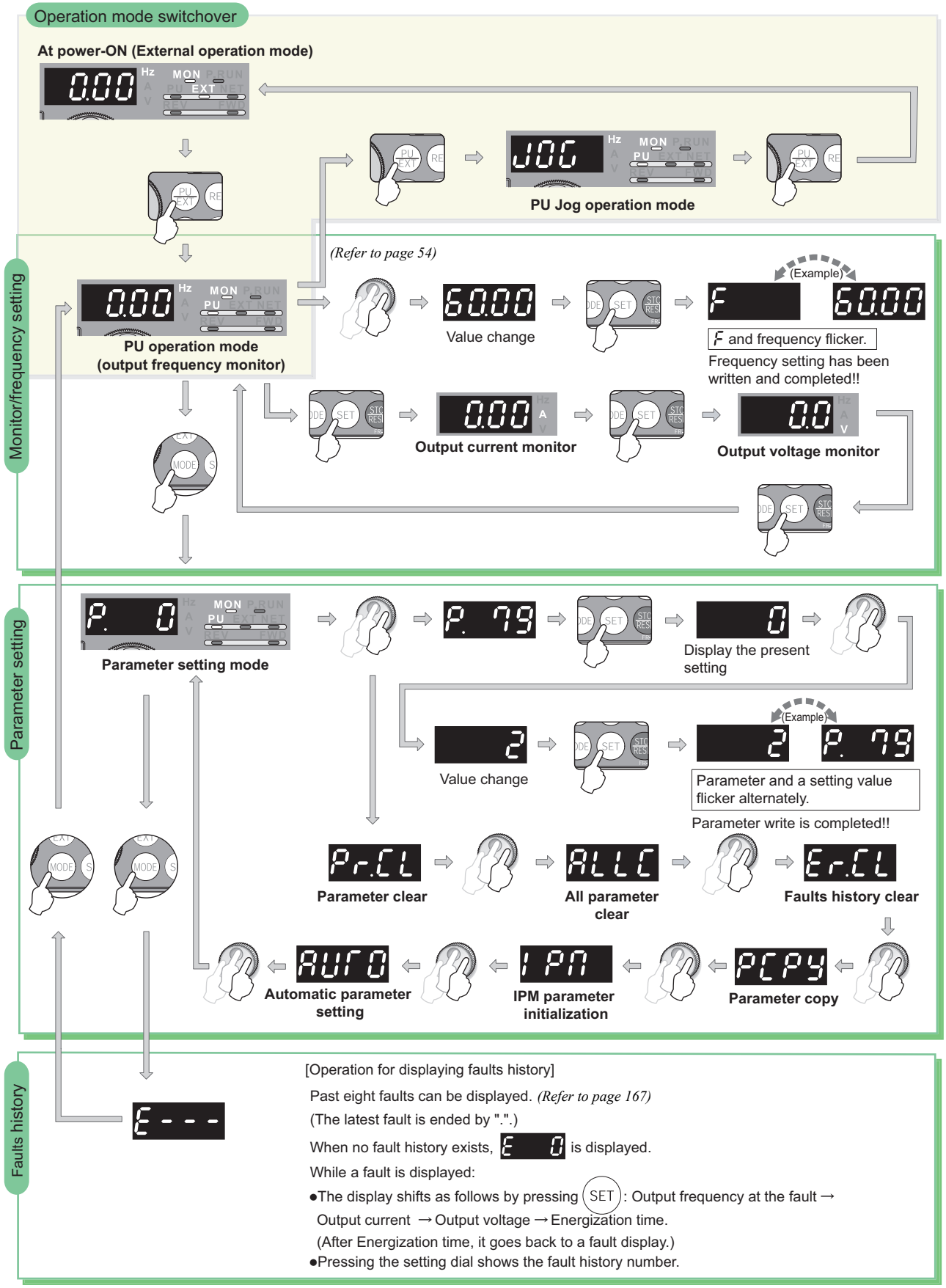
### 3.1.1 Parts of the operation panel (FR-DU07)

To mount the operation panel (FR-DU07) on the enclosure surface, *refer to page 25*.




| No. | Component | Name | Description |
|---|---|---|---|
| (a) | Hz A V | Unit indicator | Hz: Lit to indicate frequency. (Flickers when the set frequency monitor is displayed.)<br>A: Lit to indicate current.<br>V: Lit to indicate voltage. |
| (b) | 8.8.8.8. | Monitor (4-digit LED) | Shows the frequency, parameter number, etc.<br>(To monitor the output power, set frequency and other items, set *Pr.52*.) |
| (c) | | Setting dial | The dial of the Mitsubishi inverters. The setting dial is used to change the frequency and parameter settings.<br>Press the setting dial to perform the following operations:<br>• To display a set frequency in the monitor mode<br>• To display the present setting during calibration<br>• To display a fault history number in the faults history mode |
| (d) | PU/EXT | PU/EXT key | Used to switch between the PU and External operation modes.<br>To use the External operation mode (operation using a separately connected frequency setting potentiometer and start signal), press this key to light up the EXT indicator.<br>PU: PU operation mode<br>EXT: External operation mode<br>Used to cancel the PU stop also. |
| (e) | MODE | MODE key | Used to switch among different setting modes.<br>Holding this key for 2 seconds locks the operation. The key lock is invalid when *Pr.161* = "0 (initial setting)." (*Refer to page 52.*) |
| (f) | SET | SET key | Used to enter a setting.<br>If pressed during the operation, monitored item changes as the following: Output frequency → Output current → Output voltage*<br>* Energy saving monitor is displayed when the energy saving monitor is set with *Pr. 52*. |
| (g) | MON | Monitor indicator | Lit to indicate the monitor mode. |
| (h) | P.RUN | PM sensorless vector control indicator | Lit to indicate the PM sensorless vector control.<br>The indicator flickers when the IPM motor test operation is selected. |
| (i) | PU EXT NET | Operation mode indicator | PU: Lit to indicate the PU operation mode.<br>EXT: Lit to indicate the External operation mode. (EXT is lit at power-ON in the initial setting.)<br>NET: Lit to indicate the Network operation mode.<br>PU and EXT: Lit to indicate EXT/PU combined operation mode 1 and 2 |
| (j) | REV FWD | Rotation direction indicator | FWD: Lit to indicate the forward rotation.<br>REV: Lit to indicate the reverse rotation.<br>Lit: When the forward/reverse operation is being performed.<br>Flickers: When the frequency command is not given even if the forward/reverse command is given.<br>When the frequency command is lower than the starting frequency.<br>When the MRS signal is being input. |
| (k) | FWD REV | FWD key, REV key | FWD key: Used to give a start command in forward rotation.<br>REV key: Used to give a start command in reverse rotation. |
| (l) | STOP RESET | STOP/RESET key | Used to stop operation commands.<br>Used to reset a fault when the protective function (fault) is activated. |

### 3.1.2 Basic operation (factory setting)



### 3.1.3 Operation lock (Press [MODE] for an extended time (2s))

Operation using the setting dial and key of the operation panel can be set invalid to prevent parameter change, and unexpected start or frequency setting.

- Set "10 or 11" in *Pr. 161*, then press (MODE) for 2s to make the setting dial and key operation invalid.
- When the setting dial and key operation are invalid, HOLd appears on the operation panel.

  If dial or key operation is attempted while dial and key operation are invalid, HOLd appears. (When dial or key is not touched for 2s, the monitor display appears.)
- To make the setting dial and key operation valid again, press (MODE) for 2s.

**POINT**

Set "10 or 11" (key lock valid) in *Pr.161 Frequency setting/key lock operation selection*.

**Operation**

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

**2.** Operation mode change
Press (PU/EXT) to choose the PU operation mode. [PU] indicator is lit.

**3.** Parameter setting mode
Press (MODE) to choose the parameter setting mode. (The parameter number read previously appears.)

**4.** Selecting the parameter number
Turn dial until P.161 (*Pr. 161*) appears. Press (SET) to read the present set value. "0 " (initial value) appears.

**5.** Changing the setting value
Turn to dial change it to the setting value " 10". Press (SET) to set. " 10 " and " P.161 " flicker alternately.

**6.** Press (MODE) for 2s to activate the key lock. HOLd appears.

**Functions valid even in the operation lock status**

Stop and reset with (STOP/RESET).

**CAUTION**

Release the operation lock to release the PU stop by key operation.

### 3.1.4 Monitoring of output current and output voltage

**POINT**

Monitor display of output frequency, output current and output voltage can be changed by pushing (SET) during monitoring mode.

**Operation**

1. Press (MODE) during operation to choose the output frequency monitor. [Hz] indicator is lit.
2. Independently of whether the inverter is running in any operation mode or at a stop, the output current monitor appears by pressing (SET). [A] indicator is lit.
3. Press (SET) to show the output voltage monitor. [V] indicator is lit.

**REMARKS**

Monitored item can be changed from output voltage to other items such as output power and set frequency by setting *Pr. 52*. *Refer to Chapter 4 of the Instruction Manual (Applied)*.

### 3.1.5 First priority monitor

Hold down (SET) for 1s to set monitor description to be appeared first in the monitor mode.

(To return to the output frequency monitor, hold down (SET) for 1s after displaying the output frequency monitor.)

### 3.1.6 Displaying the set frequency

Press the setting dial (  ) in the PU operation mode or in the External/PU combined operation mode 1 (*Pr. 79* = "3") to show the set frequency.

### 3.1.7 Changing the parameter setting value

Changing example | Change the *Pr. 1 Maximum frequency* .

**Operation**

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

**2.** Operation mode change
Press (PU/EXT) to choose the PU operation mode. [PU] indicator is lit.

**3.** Parameter setting mode
Press (MODE) to choose the parameter setting mode. (The parameter number read previously appears.)

**4.** Selecting the parameter
Turn  until P. 1 (*Pr. 1*) appears. Press (SET) to read the present set value. " 120.0" (initial value) appears.

**5.** Changing the setting value
Turn  to change it to the set value "60.00". Press (SET) to set. "60.00" and "P. 1" flicker alternately.

- By turning  , you can read another parameter.
- Press (SET) to show the setting again.
- Press (SET) twice to show the next parameter.
- Press (MODE) twice to return the monitor to frequency monitor.

? Er 1 to Er 4 are displayed ... Why?

☞ Er 1 appears. .....Write disable error
Er2 appears. .....Write error during operation
Er3 appears. .....Calibration error
Er4 appears. .....Mode designation error

For details refer to *page 151*.

**REMARKS**

- The number of digits displayed on the operation panel (FR-DU07) is four.
  If the values to be displayed have five digits or more including decimal places, the fifth or later numerals cannot be displayed nor set.
  (Example) When *Pr. 1*
  When 60Hz is set, 60.00 is displayed.
  When 120Hz is set, 120.0 is displayed and second decimal place is not displayed nor set.

### 3.1.8 Parameter clear, all parameter clear

**POINT**

- Set "1" in *Pr. CL parameter clear* or *ALLC All parameter clear* to initialize all parameters. (Parameters are not cleared when "1" is set in *Pr. 77 Parameter write selection*. Calibration parameters are not cleared with Pr.CL either.)
- Refer to the parameter list on *page 101* and later for parameters to be cleared with this operation.

**Operation**

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

**2.** Operation mode change
Press (PU/EXT) to choose the PU operation mode. [PU] indicator is lit.

**3.** Parameter setting mode
Press (MODE) to choose the parameter setting mode. (The parameter number read previously appears.)

**4.** Selecting the parameter number
Turn the dial until "PrCL parameter clear" ("ALLC all parameter clear") appears. Press (SET) to read the present set value. "0" (initial value) appears.

**5.** Parameter clear
Turn the dial to change it to the set value " 1 ". Press (SET) to set.
" 1 " and "PrCL" flicker alternately after parameters are cleared.
- By turning the dial, you can read another parameter.
- Press (SET) to show the setting again.
- Press (SET) twice to show the next parameter.

? " 1 " and "Er4" are displayed alternately ... Why?

☞ The inverter is not in the PU operation mode.

1. Press (PU/EXT).
   PU is lit and the monitor (4 digit LED) displays "0" (*Pr. 79* = "0" (initial value)).
2. Carry out operation from step 5 again.

Stop the inverter first. A writing error occurs if parameter clear is attempted while the inverter is running.

### 3.1.9 Parameter copy and parameter verification

| PCPY Setting | Description |
|---|---|
| 0 | Cancel |
| 1 | Copy the source parameters to the operation panel. |
| 2 | Write the parameters copied to the operation panel into the destination inverter. |
| 3 | Verify parameters in the inverter and operation panel. *(Refer to page 57.)* |

**REMARKS**

- When the copy destination inverter is not the FR-A700 series or parameter copy write is performed after parameter copy read is stopped, "model error (rE4)" is displayed.
- Refer to the parameter list on *page 101* and later for availability of parameter copy.
- When the power is turned OFF or an operation panel is disconnected, etc. during parameter copy write, perform write again or check the values by parameter verification.
- Initial settings of certain parameters are different for different capacities, so some parameter settings may be automatically changed when parameter copy is performed from a different-capacity inverter. After performing a parameter copy from a different-capacity inverter, check the parameter settings. Especially under IPM motor control, check the *Pr.80 Motor capacity* setting before starting the operation. (Refer to the parameter list *(page 101)* for the parameters with different initial settings for different capacities.)
- If parameters are copied from an older inverter to a newer inverter that has additional parameters, out-of-range setting values may be written in some parameters. In that case, those parameters operate as if they were set to initial values.

#### (1) Parameter copy

Parameter settings can be copied to multiple inverters.

**Operation**

**1.** Connect the operation panel to the copy source inverter.

**2.** Parameter setting mode

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

**3.** Selecting the parameter number

Turn the dial until "PCPY" (parameter copy) appears. Press (SET) to read the currently set value. "0" (initial value) appears.

**4.** Copying to the operation panel

Turn the dial to change it to the setting value "1". Press (SET) to copy the source parameters to the operation panel. ("1" flickers for about 30s.)

"1" and "PCPY" flicker alternately after parameters are copied.

**5.** Connect the operation panel to the copy destination inverter.

**6.** After performing steps 2 and 3, turn the dial to change it to "2".

**7.** Writing to the inverter

Press (SET) to write the parameters copied to the operation panel to the destination inverter. ("2" flickers for about 30s.)

"2" and "PCPY" flicker alternately after parameters are copied.

**8.** After writing the parameter values to the copy destination inverter, always reset the inverter, e.g. switch power off once, before starting operation.

? rE1 appears...Why? ☞ Parameter read error. Perform operation from step 3 again.
? rE2 appears...Why? ☞ Parameter write error. Perform operation from step 6 again.
? CP and 0.00 flicker alternately
☞ Appears when parameters are copied between the inverter of 55K or lower and 75K or higher.

1. Set "0" (initial value) in *Pr. 160 User group read selection*.
2. Set the following setting (initial value) in *Pr. 989 Parameter copy alarm release*.

| | 55K or lower | 75K or higher |
|---|---|---|
| *Pr. 989* Setting | 10 | 100 |

3. Reset *Pr. 9, Pr. 30, Pr. 51, Pr. 52, Pr. 54, Pr. 56, Pr. 57, Pr. 61, Pr. 70, Pr. 72, Pr. 80, Pr. 82, Pr. 90 to Pr. 94 , Pr. 158, Pr. 455, Pr. 458 to Pr. 462, Pr. 557, Pr. 859, Pr. 860, Pr. 893*.

### (2) Parameter verification

Whether same parameter values are set in other inverters or not can be checked.

**Operation**

| | |
|---|---|
| **1.** | Move the operation panel to the inverter to be verified. |
| **2.** | Screen at power-ON<br>The monitor display appears. |
| **3.** | Parameter setting mode<br>Press (MODE) to choose the parameter setting mode. (The parameter number read previously appears.). |
| **4.** | Selecting the parameter number<br>Turn the dial until "PCPY" (parameter copy) appears. Press (SET) to read the currently set value. "0" (initial value) appears. |
| **5.** | Parameter verification<br>Turn the dial to change it to the setting value "3" (parameter copy verification mode).<br>Press (SET) to read the parameter setting of the verified inverter to the operation panel. ("3" flickers for about 30s.)<br>●If different parameters exist, different parameter numbers and "rE3" flicker.<br>●Hold down (SET) to verify. |
| **6.** | If there is no difference, "PCPY" and "3" flicker to complete verification. |

? rE3 flickers ... Why?

☞ Set frequencies, etc. may be different. Check set frequencies.

# 3.2 Before operation

## 3.2.1 Simple mode parameter list

For simple variable-speed operation of the inverter, the initial setting 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 made from the operation panel (FR-DU07). For details of parameters, refer to *Chapter 4 of the Instruction Manual (Applied)*.

**POINT**

Only simple mode parameter can be displayed using *Pr.160 User group read selection*. (All parameters are displayed with the initial setting.) Set *Pr. 160 User group read selection* as required. (Refer to *page 54* for parameter change.)

| Pr. 160 | Description |
|---|---|
| 9999 | Only the simple mode parameters can be displayed. |
| 0 (Initial Value) | Simple mode and extended mode parameters can be displayed. |
| 1 | Only the parameters registered in the user group can be displayed. |

| Parameter Number | Name | Increments | Initial Value | Range | Applications | Refer to |
|---|---|---|---|---|---|---|
| 0 | Torque boost | 0.1% | 6/4/3/2/1%*1 | 0 to 30% | Set to increase a starting torque or when the motor with a load will not rotate, resulting in an alarm [OL] and a trip [OC1] | 60 |
| 1 | Maximum frequency | 0.01Hz | 120/60Hz*2*3 | 0 to 120Hz | Set when the maximum output frequency need to be limited. | 60 |
| 2 | Minimum frequency | 0.01Hz | 0Hz | 0 to 120Hz | Set when the minimum output frequency need to be limited. | |
| 3 | Base frequency | 0.01Hz | 60Hz | 0 to 400Hz | Set when the rated motor frequency is 50Hz. Check the motor rating plate. | 59 |
| 4 | Multi-speed setting (high speed) | 0.01Hz | 60Hz*3 | 0 to 400Hz | Set when changing the preset speed in the parameter with a terminal. | 96 |
| 5 | Multi-speed setting (middle speed) | 0.01Hz | 30Hz | 0 to 400Hz | | |
| 6 | Multi-speed setting (low speed) | 0.01Hz | 10Hz | 0 to 400Hz | | |
| 7 | Acceleration time | 0.1s | 5/15s*4 | 0 to 3600s | Acceleration/deceleration time can be set. | 61 |
| 8 | Deceleration time | 0.1s | 5/15s*4 | 0 to 3600s | | |
| 9 | Electronic thermal O/L relay | 0.01/0.1A*5 | Inverter rated current*3 | 0 to 500/0 to 3600A*5 | Protect the motor from overheat by the inverter. Set the rated motor current. | 59 |
| 79 | Operation mode selection | 1 | 0 | 0, 1, 2, 3, 4, 6, 7 | Select the operation command location and frequency command location. | 63 |
| 125 | Terminal 2 frequency setting gain frequency | 0.01Hz | 60Hz*3 | 0 to 400Hz | Frequency for the maximum value of the potentiometer (5V initial value) can be changed. | 98 |
| 126 | Terminal 4 frequency setting gain frequency | 0.01Hz | 60Hz*3 | 0 to 400Hz | Frequency for the maximum current input (20mA initial value) can be changed. | 100 |
| 160 | User group read selection | 1 | 0 | 0, 1, 9999 | Parameter which can be read from the operation panel and parameter unit can be restricted. | — |
| 998 | IPM parameter initialization | 1 | 0 | 0, 3003, 3103, 8009, 8109 | By performing IPM parameter initialization, PM sensorless vector control is selected and the parameters, which are required to drive an IPM motor, are changed. | 74 |
| 999 | Automatic parameter setting | 1 | 9999 | 10, 11, 20, 21, 30, 31, 9999 | Parameter settings are changed as a batch. Those include communication parameter settings for a Mitsubishi human machine interface (GOT) connection, rated frequency settings of 50Hz/60Hz, and acceleration/deceleration time increment settings. | 148 |

*1 The initial value differs according to the inverter capacity. (0.4K, 0.75K/1.5K to 3.7K/5.5K, 7.5K/11K to 55K/75K or higher)
*2 The initial value differs according to the inverter capacity. (55K or lower/75K or higher)
*3 Performing IPM parameter initialization changes the settings. *(Refer to page 74)*
*4 The initial value differs according to the inverter capacity. (7.5K or lower/11K or higher)
*5 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)

### 3.2.2 Overheat protection of the motor by the inverter (Pr. 9)

Set the rated motor current in *Pr. 9 Electronic thermal O/L relay* to protect the motor from overheat.
Refer to *page 54* for how to change the parameter setting.

| Parameter Number | Name | Initial Value | Setting Range *2 | | Description |
|---|---|---|---|---|---|
| 9 | Electronic thermal O/L relay | Inverter rated current *1*3 | 55K or lower | 0 to 500A | Set the rated motor current. |
| | | | 75K or higher | 0 to 3600A | |

*1 *Refer to page 185* for the rated inverter current value. The initial values of the 0.4K and 0.75K are set to 85% of the rated inverter current.
*2 The minimum setting increments are 0.01A for the 55K or lower and 0.1A for the 75K or higher.
*3 Performing IPM parameter initialization changes the setting. *(Refer to page 74)*

**REMARKS**

- Set *Pr. 9* = "0" for vector-control-dedicated motors (SF-V5RU) because they are already equipped with thermal protectors.

**CAUTION**

- Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-off.
- When two or more motors are connected to the inverter, they cannot be protected by the electronic thermal relay function. Install an external thermal relay to each motor.
- 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.
- Electronic thermal relay may not function when 5% or less of inverter rated current is set to electronic thermal relay setting.
- PTC thermistor output built-in the motor can be input to the PTC signal (AU terminal). For details, refer to *Chapter 4 of the Instruction Manual (Applied)*.

### 3.2.3 When the rated motor frequency is 50Hz (Pr. 3) V/F

First, check the motor rating plate. If a frequency given on the rating plate is "50Hz" only, always set *Pr. 3 Base frequency* to "50Hz". Leaving the base frequency unchanged from "60Hz" may make the voltage low and the torque insufficient. It may result in an inverter trip (E.OC☐) due to overload. Refer to *page 54* for how to change the parameter setting.

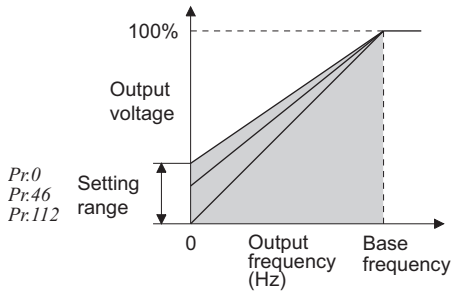
| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 3 | Base frequency | 60Hz | 0 to 400Hz | Set the frequency when the motor rated torque is generated. |

**REMARKS**

- *Pr. 3* is invalid under Advanced magnetic flux vector control, Real sensorless vector control, vector control, and PM sensorless vector control and *Pr.84 Rated motor frequency* is valid.

### 3.2.4 Increasing the starting torque (Pr. 0) V/F

Set this parameter when "the motor with a load will not rotate", "an alarm [OL] is output, resulting in an inverter trip due to [OC1], etc. When the motor with a load will not rotate, increase the *Pr. 0* value 1% by 1% unit by looking at the motor movement. (The guideline is for about 10% change at the greatest.)
Refer to *page 54* for how to change the parameter setting.




| Parameter Number | Name | Initial Value | | Setting Range | Description |
|---|---|---|---|---|---|
| 0 | Torque boost | 0.4K, 0.75K | 6% | 0 to 30% | Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque. |
| | | 1.5K to 3.7K | 4% | | |
| | | 5.5K, 7.5K | 3% | | |
| | | 11K to 55K | 2% | | |
| | | 75K or higher | 1% | | |

**REMARKS**

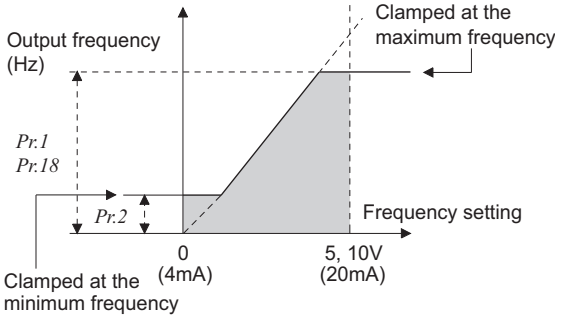
· A too large setting may cause the motor to overheat, resulting in an overcurrent trip (OL (overcurrent alarm) then E.OC1 (overcurrent trip during acceleration)), overload trip (E.THM (motor overload trip), and E.THT (inverter overload trip)).
(When a fault occurs, release the start command, and decrease the *Pr. 0* setting 1% by 1% to reset. *(Refer to page 54)*

**POINT**

If the inverter still does not operate properly after the above measures, adjust *Pr. 80*, *Pr. 81* (Advanced magnetic flux vector control), *Pr.800* (Real sensorless vector control). The *Pr.0* setting is invalid under Advanced magnetic flux vector control, Real sensorless vector control, vector control, and PM sensorless vector control. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

### 3.2.5 Limiting the maximum and minimum output frequency (Pr. 1, Pr. 2)

Motor speed can be limited. Refer to *page 54* for how to change the parameter setting.




| Parameter Number | Name | Initial Value | | Setting Range | Description |
|---|---|---|---|---|---|
| 1 | Maximum frequency | 55K or lower | 120Hz* | 0 to 120Hz | Set the upper limit of the output frequency. |
| | | 75K or higher | 60Hz* | | |
| 2 | Minimum frequency | 0Hz | | 0 to 120Hz | Set the lower limit of the output frequency. |

* Performing IPM parameter initialization changes the setting. *(Refer to page 74)*

**REMARKS**

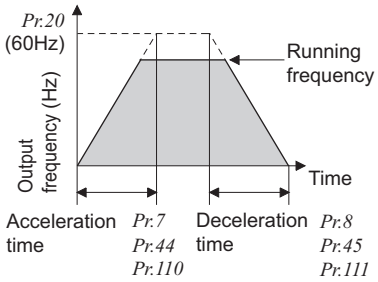
· The output frequency is clamped by the *Pr. 2* setting even if the set frequency is lower than the *Pr. 2* setting (The frequency will not decrease to the *Pr. 2* setting.)
Note that *Pr. 15 Jog frequency* has higher priority than the minimum frequency.
· When the *Pr. 1* setting is changed, frequency higher than the *Pr. 1* setting can not be set by .
· When performing a high speed operation at 120Hz or more, setting of *Pr. 18 High speed maximum frequency* is necessary.
*(Refer to Chapter 4 of the Instruction Manual (Applied).)*

## ⚠ CAUTION

⚠ If the *Pr. 2* setting is higher than the *Pr. 13 Starting frequency* value, note that the motor will run at the set frequency according to the acceleration time setting by merely switching the start signal on, without entry of the command frequency.

### 3.2.6 Changing acceleration and deceleration time (Pr. 7, Pr. 8)

Set in *Pr. 7 Acceleration time* a larger value for a slower speed increase and a smaller value for a faster speed increase.
Set in *Pr. 8 Deceleration time* a larger value for a slower speed decrease and a smaller value for a faster speed decrease. Refer to *page 54* for how to change the parameter setting.




| Parameter Number | Name | Initial Value | | Setting Range | Description |
|---|---|---|---|---|---|
| 7 | Acceleration time | 7.5K or lower | 5s | 0 to 3600/360s * | Set the motor acceleration time. |
| | | 11K or higher | 15s | | |
| 8 | Deceleration time | 7.5K or lower | 5s | 0 to 3600/360s * | Set the motor deceleration time. |
| | | 11K or higher | 15 | | |

* Depends on the *Pr. 21 Acceleration/deceleration time increments* setting. The initial value for the setting range is "0 to 3600s" and setting increments is "0.1s".

### 3.2.7 Energy saving operation for fans and pumps (Pr. 14, Pr. 60)

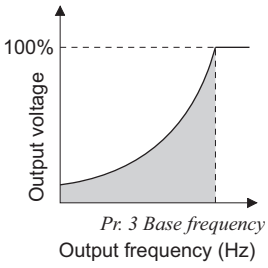
Set the following functions to perform energy saving operation for fans and pumps.

#### (1) Load pattern selection (*Pr. 14*)

Select the optimum output characteristic (V/F characteristic) that is suitable for the application and load characteristics.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 14 | Load pattern selection | 0 | 0 | For constant torque load |
| | | | 1 | For variable-torque load |
| | | | 2 | For constant torque elevators (at reverse rotation boost of 0%) |
| | | | 3 | For constant torque elevators (at forward rotation boost of 0%) |
| | | | 4 | RT signal ON: for constant torque load<br>RT signal OFF: for constant torque elevators at reverse rotation boost of 0% |
| | | | 5 | RT signal ON: for constant torque load<br>RT signal OFF: for constant torque elevators at forward rotation boost of 0% |

- Set *Pr.14 Load pattern selection* = "1 (for variable-torque load)."
- When the output frequency is equal to or less than the base frequency, the output voltage changes by its square in proportion to the output frequency. Use this setting to drive a load whose load torque changes in proportion to the square of the speed, such as a fan and a pump.




**CAUTION**

- Load pattern selection is available only under V/F control. Load pattern selection is not available under Advanced magnetic flux vector control, Real sensorless vector control, vector control, and PM sensorless vector control.

## (2) Energy saving control (*Pr. 60*)

Without complicated parameter settings, the inverter could automatically perform energy saving control. This inverter is optimal for fan and pump applications.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 60 | Energy saving control selection * | 0 | 0 | Normal operation mode |
| | | | 4 | Energy saving operation mode |

* When parameter is read using the FR-PU04, a parameter name different from an actual parameter is displayed.

- When "4" is set in *Pr. 60*, the inverter operates in the energy saving operation mode.
- In the energy saving operation mode, the inverter automatically controls the output voltage to minimize the inverter output voltage during a constant operation.

**REMARKS**

- For applications a large load torque is applied to or machines repeat frequent acceleration/deceleration, an energy saving effect is not expected.

**CAUTION**

- When the energy saving mode is selected, deceleration time may be longer than the setting value. Since overvoltage alarm tends to occur as compared to the constant torque load characteristics, set a longer deceleration time.
- The energy saving operation mode is available only under V/F control. When the Advanced magnetic flux vector control, Real sensorless vector control, vector control, or PM sensorless vector control are selected, the energy saving mode is invalid.
- Since output voltage is controlled in energy saving operation mode, output current may slightly increase.

### 3.2.8 Selection of the start command and frequency command locations (Pr. 79)

Select the start command location and frequency command location.

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th>Description</th><th>LED Indication<br>○: Off<br>●: On</th></tr>
<tr><td rowspan="8">79</td><td rowspan="8">Operation mode selection</td><td rowspan="8">0</td><td>0</td><td>Use External/PU switchover mode (press PU/EXT to switch between the PU and External operation mode. (Refer to page 90))<br>At power on, the inverter is in the External operation mode.</td><td>PU operation mode<br>  <br>External operation mode<br>  <br>NET operation mode<br>  </td></tr>
<tr><td>1</td><td>Fixed to PU operation mode</td><td>PU operation mode<br>  </td></tr>
<tr><td>2</td><td>Fixed to External operation mode<br>Operation can be performed by switching between the External and NET operation mode.</td><td>External operation mode<br>  <br>NET operation mode<br>  </td></tr>
<tr><td>3</td><td>External/PU combined operation mode 1<br>Running frequency | Start signal<br>PU (FR-DU07/FR-PU04/FR-PU07) setting or external signal input (multi-speed setting, across terminals 4 and 5 (valid when AU signal turns on)).*1 | External signal input (terminal STF, STR)</td><td rowspan="2">External/PU combined operation mode<br>  </td></tr>
<tr><td>4</td><td>External/PU combined operation mode 2<br>Running frequency | Start signal<br>External signal input (Terminal 2, 4, 1, JOG, multi-speed selection, etc.) | Input from the PU (FR-DU07/FR-PU04/FR-PU07) (FWD, REV)</td></tr>
<tr><td>6</td><td>Switchover mode<br>Switch among PU operation, External operation, and NET operation while keeping the same operation status.</td><td rowspan="2">PU operation mode<br>  <br>External operation mode<br>  <br>NET operation mode<br>  </td></tr>
<tr><td>7</td><td>External operation mode (PU operation interlock)<br>X12 signal ON *2<br>Operation mode can be switched to the PU operation mode.<br>(output stop during External operation)<br>X12 signal OFF *2<br>Operation mode can not be switched to the PU operation mode.</td></tr>
</table>

*1 The priorities of the frequency commands when *Pr. 79* = "3" are "Multi-speed operation (RL/RM/RH/REX) > PID control (X14) > terminal 4 analog input (AU) > digital input from the operation panel".

*2 For the terminal used for the X12 signal (PU operation interlock signal) input, set "12" in *Pr. 178 to Pr. 189 (input terminal function selection)* to assign functions.

For *Pr. 178 to Pr. 189*, refer to *Chapter 4 of the Instruction Manual (Applied)*.
When the X12 signal is not assigned, function of the MRS signal switches from MRS (output stop) to PU operation interlock signal.

## 3.2.9 Acquiring large starting torque and low speed torque (Advanced magnetic flux vector control, Real sensorless vector control) (Pr. 71, Pr. 80, Pr. 81, Pr. 83, Pr. 84, Pr. 800) Magnetic flux Sensorless

Advanced magnetic flux vector control can be selected by setting the capacity, poles and type of the motor used in *Pr. 80* and *Pr. 81*. Real sensorless vector control can be selected for applications requiring high accuracy and fast response control. Perform offline auto tuning and online auto tuning when using Real sensorless vector control.

- What is Advanced magnetic flux vector control?
  The low speed torque can be improved by providing voltage compensation to flow a motor current which meets the load torque. Output frequency compensation (slip compensation) is made so that the motor actual speed approximates a speed command value. Effective when load fluctuates drastically, etc.
  Low-speed torque is improved as compared to V/F control. In addition, speed accuracy is improved when load is applied.
- What is Real sensorless vector control?
  This function enables vector control with a general-purpose motor without encoder. Low speed torque and speed accuracy are improved as compared to Advanced magnetic flux vector control. Always perform offline auto tuning when using Real sensorless vector control.
  Real sensorless vector control is suitable for the following applications.
  · To minimize the speed fluctuation even at a severe load fluctuation
  · To generate low speed torque
  · To prevent machine from damage due to too large torque (torque limit)
  · To perform torque control

| Parameter Number | Name | Initial Value | Setting Range | | Description | |
|---|---|---|---|---|---|---|
| **71** | **Applied motor** | 0 | 0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54, 330, 333, 334, 8093, 8094 | | By selecting a standard motor or constant-torque motor, thermal characteristic and motor constants of each motor are set. | |
| **80** | **Motor capacity** | 9999 | 55K or lower | 0.4 to 55kW | Set the applied motor capacity. | |
| | | | 75K or higher | 0 to 3600kW | | |
| | | | 9999 | | V/F control | |
| **81** | **Number of motor poles** | 9999 | 2, 4, 6, 8, 10 | | Set the number of motor poles. | |
| | | | 12, 14, 16, 18, 20 | | X18 signal-ON:V/F control *1 | Set 10 + number of motor poles. |
| | | | 9999 | | V/F control | |
| **83** | **Rated motor voltage** | 200/ 400V*2 | 0 to 1000V | | Set the rated motor voltage(V). | |
| **84** | **Rated motor frequency** | 60Hz | 10 to 300Hz | | Set the rated motor frequency (Hz). (Limited at 120Hz when *Pr. 71* is set to a motor other than IPM) | |
| **800** | **Control method selection** | 20 | 0 to 5 | | Vector control *(Refer to page 66)* | |
| | | | 9 | | Vector control test operation | |
| | | | 10 | | Speed control | Real sensorless vector control |
| | | | 11 | | Torque control | |
| | | | 12 | | MC signal-ON: torque MC signal-OFF: speed *1 | |
| | | | 20 | | V/F control (Advanced magnetic flux vector control) | |

*1 Use *Pr. 178 to Pr. 189* to assign the terminals used for the X18 and MC signal. *(Refer to Chapter 4 of the Instruction Manual (Applied)).*
*2 The initial value differs according to the voltage level. (200V/400V)

**POINT**

If the following conditions are not satisfied, select V/F control since malfunction such as insufficient torque and uneven rotation may occur.
· The motor capacity should be equal to or one rank lower than the inverter capacity. (note that the capacity is 0.4kW or higher)
· Motor to be used is either Mitsubishi standard motor (SF-JR 0.4kW or higher), high efficiency motor (SF-HR 0.4kW or higher) or Mitsubishi constant-torque motor (SF-JRCA 4P, SF-HRCA 0.4kW to 55kW). When using a motor other than the above (SF-TH other manufacturer's motor), perform offline auto tuning without fail. (Advanced magnetic flux vector control) When performing Real sensorless vector control, offline auto tuning are necessary even when Mitsubishi motor is used.
· Single-motor operation (one motor run by one inverter) should be performed.
· The wiring length from inverter to motor should be within 30m. (Perform offline auto tuning in the state where actual wiring work is performed when the wiring length exceeds 30m.)

**CAUTION**

· Uneven rotation slightly increases as compared to the V/F control. (It is not suitable for machines such as grinding machine and wrapping machine which requires less uneven rotation at low speed.)
· Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.
· When Advanced magnetic flux vector control is performed with a surge voltage suppression filter (FR-ASF-H/FR-BMF-H) connected, output torque may decrease. In addition, do not use a sine wave filter (MT-BSL/BSC).
· Do not perform Real sensorless vector control with a surge voltage suppression filter (FR-ASF-H/FR-BMF-H) or sine wave filer (MT-BSL/BSC) connected.

<Selection method of Real sensorless vector control (speed control) >

Speed control is exercised to match the speed command and actual motor speed.

Perform secure wiring. *(Refer to page 9.)*

↓

Set the motor. *(Pr. 71) (Refer to page 64.)*

↓ Set "3" (standard motor) or "13" (constant-torque motor) in *Pr. 71 Applied motor*.

Set the motor overheat protection. *(Pr. 9) (Refer to page 59.)*

↓ Set the rated motor current (A) in *Pr. 9 Electronic thermal O/L relay*.

Set the motor capacity and the number of motor poles. *(Pr. 80, Pr. 81) (Refer to page 95.)*

↓ Set the motor capacity (kW) in *Pr. 80 Motor capacity* and set the number of motor poles (number of poles) in *Pr. 81 Number of motor poles*. (V/F control is performed when the setting is "9999" (initial value).)

Set the Rated motor voltage and the Rated motor frequency. *(Pr. 83, Pr. 84) (Refer to page 64.)*

↓ Set the rated motor voltage (V) in *Pr. 83 Rated motor voltage*, and set the rated motor frequency (Hz) in *Pr. 84 Rated motor frequency*.

Select a control method. *(Pr. 800) (Refer to page 64)*

↓ Set "10" (speed control) or "12" (speed-torque switchover) in *Pr. 800* and make speed control valid.

Set the operation command. *(Refer to page 90 )*

↓ Select the start command and speed command.

Set the torque limit. *(Pr. 810) (Refer to Chapter 4 of the Instruction Manual (Applied).)*

↓

Perform offline auto tuning. *(Pr. 96) (Refer to page 80.)*

↓

**Test run**

**As required**

- Select online auto tuning. *(Pr. 95) (Refer to page 83)*
- Easy gain tuning *(Refer to page 84)*
- Manual input speed control gain adjustment *(Refer to page 86)*

**CAUTION**

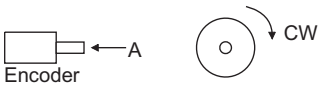
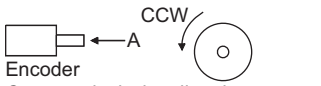
- Make sure to perform offline auto tuning before performing Real sensorless vector control.
- Speed command setting range is 0 to 120Hz for Real sensorless vector control.
- The carrier frequencies are selectable from among 2k, 6k, 10k, 14kHz for Real sensorless vector control.
- Torque control cannot be performed in the low speed (approx. 10Hz or less) regeneration range and with light load at low speed (approx. 20% or less of rated torque at approx. 5Hz or less). Choose vector control.
- Performing pre-excitation (LX signal and X13 signal) under torque control may start the motor running at a low speed even when the start command (STF or STR) is not input. The motor may run also at a low speed when the speed limit value = 0 with a start command input. Perform pre-excitation after making sure that there will be no problem in safety if the motor runs.
- Do not switch between the STF (forward rotation command) and STR (reverse rotation command) during operation under torque control. Overcurrent trip (E.OC☐) or opposite rotation deceleration fault (E.11) occurs.
- For the 0.4K to 3.7K, the speed deviation may become large at 20Hz or less and torque may become insufficient in the low speed range under 1Hz during continuous operation under Real sensorless vector control. In this case, stop the inverter once, then start again to improve.
- When the inverter is likely to start during motor coasting under Real sensorless vector control, set to make frequency search of automatic restart after instantaneous power failure valid (*Pr. 57* ≠ "9999", *Pr. 162* = "10").
- Enough torque may not be generated in the ultra-low speed range less than approx. 2Hz when performing Real sensorless vector control.
  The guideline of speed control range is as shown below.

| | | | |
|---|---|---|---|
| Driving: | 1:200 | (2, 4, 6 poles) | Can be used at 0.3Hz or more at rated 60Hz |
| | 1:30 | (8, 10 poles) | Can be used at 2Hz or more at rated 60Hz |
| Regeneration: | 1:12 | (2 to 10 poles) | Can be used at 5Hz or more at rated 60Hz |

## 3.2.10 Higher accuracy operation using a motor with encoder (Vector control) (Pr.71, Pr.80, Pr.81, Pr.83, Pr.84, Pr.359, Pr.369, Pr.800) Vector

Full-scale vector control can be performed fitting the FR-A7AP/FR-A7AL and using a motor with encoder. Fast response/high accuracy speed control (zero speed control, servo lock), torque control, and position control can be performed.

- What is vector control?
  Excellent control characteristics when compared to V/F control and other control techniques, achieving the control characteristics equal to those of DC machines.
  It is suitable for applications below.
  - To minimize the speed fluctuation even at a severe load fluctuation
  - To generate low speed torque
  - To prevent machine from damage due to too large torque (torque limit)
  - To perform torque control or position control
  - Servo-lock torque control which generates a torque at zero speed (i.e. status of motor shaft = stopped)

| Parameter Number | Name | Initial Value | Setting Range | | Description | |
|---|---|---|---|---|---|---|
| **71** | **Applied motor** | 0 | 0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54, 330, 333, 334, 8093, 8094 | | By selecting a standard motor or constant-torque motor, thermal characteristic and motor constants of each motor are set. | |
| **80** | **Motor capacity** | 9999 | 55K or lower | 0.4 to 55kW | Set the applied motor capacity. | |
| | | | 75K or higher | 0 to 3600kW | | |
| | | | 9999 | | V/F control | |
| **81** | **Number of motor poles** | 9999 | 2, 4, 6, 8, 10 | | Set the number of motor poles. | |
| | | | 12, 14, 16, 18, 20 | | X18 signal-ON:V/F control *1 | Set 10 + number of motor poles. |
| | | | 9999 | | V/F control | |
| **83** | **Rated motor voltage** | 200/ 400V*2 | 0 to 1000V | | Set the rated motor voltage(V). | |
| **84** | **Rated motor frequency** | 60Hz | 10 to 300Hz | | Set the rated motor frequency (Hz). (Limited at 120Hz when *Pr. 71* is set to a motor other than IPM) | |
| **359** | **Encoder rotation direction** | 1 | 0 | |  Encoder<br>Clockwise direction as viewed from A is forward rotation | Set the rotation direction according to the motor specification. |
| | | | 1 | |  Encoder<br>Counter clockwise direction as viewed from A is forward rotation | |
| **369** | **Number of encoder pulses** | 1024 | 0 to 4096 | | Set the number of pulses of the encoder.<br>Set the number of pulses before multiplied by four. | |
| **800** | **Control method selection** | 20 | 0 | | Speed control | Vector control |
| | | | 1 | | Torque control | |
| | | | 2 | | MC signal-ON:torque<br>MC signal-OFF:speed *1 | |
| | | | 3 | | Position control | |
| | | | 4 | | MC signal-ON:position<br>MC signal-OFF:speed *1 | |
| | | | 5 | | MC signal-ON:torque<br>MC signal-OFF:position *1 | |
| | | | 9 | | Vector control test operation<br>*(Refer to Chapter 4 of the Instruction Manual (Applied))* | |
| | | | 10 to 12 | | Real sensorless vector control<br>*(Refer to page 65)* | |
| | | | 20 | | V/F control (Advanced magnetic flux vector control) | |

*1 Use *Pr. 178 to Pr. 189* to assign the terminals used for the X18 and MC signal. *(Refer to Chapter 4 of the Instruction Manual (Applied)).*
*2 The initial value differs according to the voltage level. (200V/400V)

**POINT**

If the conditions below are not satisfied, malfunction such as insufficient torque and uneven rotation may occur.

- The motor capacity should be equal to or one rank lower than the inverter capacity. (note that the capacity is 0.4kW or higher)
- Motor to be used is either Mitsubishi standard motor with encoder (SF-JR 0.4kW or higher), high efficiency motor with encoder (SF-HR 0.4kW or higher) or Mitsubishi constant-torque motor with encoder (SF-JRCA 4P, SF-HRCA 0.4kW to 55kW) or vector with encoder control dedicated motor (SF-V5RU (1500r/min series)). When using a motor other than the above (other manufacturer's motor), perform offline auto tuning without fail.
- Single-motor operation (one motor run by one inverter) should be performed.
- Wiring length from inverter to motor should be within 30m. (Perform offline auto tuning in the state where wiring work is performed when the wiring length exceeds 30m.)

**CAUTION**

- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.
- Do not perform vector control with a surge voltage suppression filter (FR-ASF-H/FR-BMF-H) or sine wave filer (MT-BSL/BSC) connected.

<Selection method of speed control>

Speed control is exercised to match the speed command and actual motor speed.

Perform secure wiring. *(Refer to page 31.)*

↓ Mount the FR-A7AP/FR-A7AL (option).

Set the motor and encoder. *(Pr. 71, Pr. 359, Pr. 369)*

↓ Set *Pr. 71 Applied motor*, *Pr. 359 Encoder rotation direction* and *Pr. 369 Number of encoder pulses* according to the motor and encoder used. *(Refer to page 33.)*

Set the motor capacity and the number of motor poles *(Pr. 80, Pr. 81)* *(Refer to page 66.)*

↓ Set the motor capacity (kW) in *Pr. 80 Motor capacity* and set the number of motor poles (number of poles) in *Pr. 81 Number of motor poles*. (V/F control is performed when the setting is "9999" (initial value).)

Set the Rated motor voltage and the Rated motor frequency. *(Pr. 83, Pr. 84)* *(Refer to page 66.)*

↓ Set the rated motor voltage (V) in *Pr. 83 Rated motor voltage*, and set the rated motor frequency (Hz) in *Pr. 84 Rated motor frequency*.

Select a control method. *(Pr. 800) (Refer to page 66.)*

↓ Make speed control valid by selecting "0" (speed control), "2" (speed-torque switchover), or "4" (speed-position switchover) for *Pr. 800*.

Set the run command. *(Refer to page 91.)*

↓ Select the start command and speed command.

Set the torque limit. *(Pr. 810)* *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

↓

**Test run**

**As required**

- Perform offline auto tuning. *(Pr. 96) (refer to page 80)*.
- Select online auto tuning. *(Pr. 95) (refer to page 83)*.
- Easy gain tuning *(refer to page 84)*
- Manual input speed control gain adjustment *(refer to page 86)*

**CAUTION**

- Speed command setting range is 0 to 120Hz for vector control.
- The carrier frequencies are selectable from among 2k, 6k, 10k, 14kHz for vector control. (2k and 6kHz for the 75K or higher)

<Selection method of torque control>

- Torque control is exercised to develop torque as set in the torque command.
- The motor speed becomes constant when the motor output torque and load torque are balanced. For torque control, therefore, the speed is determined by the load.
- For torque control, the motor gains speed as the motor output torque becomes greater than the motor load. To prevent overspeed, set the speed limit value so that the motor speed does not increase too high. (Speed control is exercised during speed limit and torque control is disabled.)
- When speed limit is not set, the speed limit value setting is regarded as 0Hz to disable torque control.

Perform secure wiring. *(Refer to page 31.)*

↓ Mount the FR-A7AP/FR-A7AL (option).

Set the motor and encoder. *(Pr. 71, Pr. 359, Pr. 369)*

↓ Set *Pr. 71 Applied motor*, *Pr. 359 Encoder rotation direction* and *Pr. 369 Number of encoder pulses* according to the motor and encoder used. *(Refer to page 33.)*

Set the motor capacity and the number of motor poles. *(Pr. 80, Pr. 81)* *(Refer to page 66.)*

↓ Set the motor capacity (kW) in *Pr. 80 Motor capacity* and set the number of motor poles in *Pr. 81 Number of motor poles*. (V/F control is performed when the setting is "9999" (initial value).)

Set the Rated motor voltage and the Rated motor frequency. *(Pr. 83, Pr. 84)* *(Refer to page 66.)*

↓ Set the rated motor voltage (V) in *Pr. 83 Rated motor voltage*, and set the rated motor frequency (Hz) in *Pr. 84 Rated motor frequency*.

Select a control method. *(Pr. 800) (Refer to page 66.)*

↓ Set either "1" (torque control), "2" (speed-torque switchover) or "5" (position-torque switchover) in *Pr. 800* and make torque control valid.

Set the torque command. *(Pr. 804)* *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

↓

Set the speed limit. *(Pr. 807)* *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

↓

**Test run**

**As required**

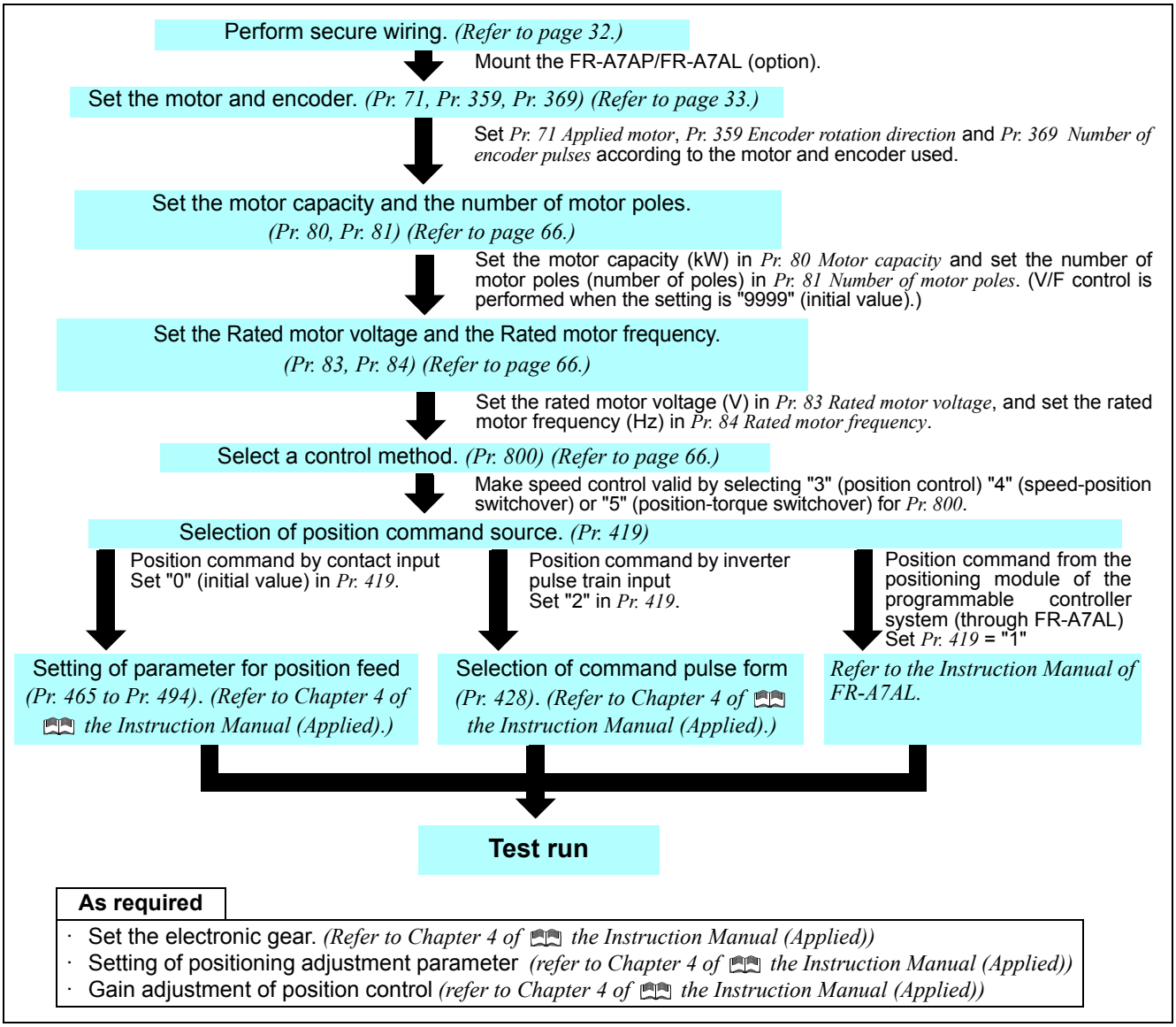
- Perform offline auto tuning. *(Pr. 96) (refer to page 80).*
- Select online auto tuning. *(Pr. 95) (refer to page 83).*
- Manual input torque control gain adjustment *(refer to Chapter 4 of the Instruction Manual (Applied))*

**CAUTION**

- The carrier frequencies are selectable from among 2k, 6k, 10k, 14kHz for vector control. (2k and 6kHz for the 75K or higher)

<Selection method of position control>

- In the position control, the speed command is calculated so that the difference between command pulse (or parameter setting) and the number of feedback pulses from the encoder is zero in order to run the motor.
- This inverter can perform simple position feed by contact input, position control by inverter simple pulse input, and position control by FR-A7AL pulse train input.




**CAUTION**

· The carrier frequencies are selectable from among 2k, 6k, 10k, 14kHz for vector control. (2k and 6kHz for the 75K or higher)

### 3.2.11 Performing high-accuracy operation and saving energy at the same time (PM sensorless vector control) (IPM, Pr. 998) PM

Highly efficient motor control and highly accurate motor speed control can be performed by using the inverter with an IPM (internal permanent magnet) motor, which is more efficient than an induction motor.
The motor speed is calculated based on the output voltage and current from the inverter. It does not require a speed detector such as an encoder. The inverter drives the IPM motor with the least required current when a load is applied in order to achieve the highest motor efficiency.
Performing the IPM parameter initialization makes the IPM motor MM-CF ready for the PM sensorless vector control.

**POINT**

The following conditions must be met to perform PM sensorless vector control.

- For the motor model, IPM motor must be used.
- The motor capacity must be equal to or one rank lower than the inverter capacity.
- Single-motor operation (one motor run by one inverter) must be performed.
- The overall wiring length with the motor must be 100m or less (refer to *page 16*). (Even with the IPM motor MM-CF, when the wiring length exceeds 30m, perform offline auto tuning.)

## <Selection method of PM sensorless vector control (speed control)>

· This inverter is set for a general-purpose motor in the initial setting. Follow the following procedure to change the setting for the PM sensorless vector control.

**Driving an MM-CF IPM motor**

Perform IPM parameter initialization by selecting IPM in the parameter setting mode on the operation panel.* (Refer to *page 73*)

Set "3003" (MM-CF IPM motor parameter setting (rotations per minute)) in IPM (IPM parameter initialization) to select the PM sensorless vector control.
P.RUN on the operation panel (FR-DU07) is lit when PM sensorless vector control is set.

**Driving an IPM motor other than MM-CF**

Make the motor setting. *(Pr. 71, Pr. 80, Pr. 81, etc.)* (Refer to *page 77*)

Set "8093" (IPM motor other than MM-CF) in *Pr. 71 Applied motor*, the motor capacity (kW) in *Pr. 80 Motor capacity*, and the number of poles in *Pr. 81 Number of motor poles*. Refer to *page 77* for other parameters.
(Setting "9999 (initial value)" in *Pr. 80* or *Pr. 81* selects V/F control.)

Perform offline auto tuning for an IPM motor. *(Pr. 96)* (Refer to *page 77*)

To perform tuning, set "1" (offline auto tuning without rotating motor (for other than MM-CF)) in *Pr. 96*.

Use *Pr.998* to perform IPM parameter initialization. (Refer to *page 74*)

Setting "8009" or "8109" in *Pr. 998 IPM parameter initialization* selects the IPM motor parameter settings.
"8009": Parameter (rotations per minute) settings for an IPM motor other than MM-CF
"8109": Parameter (frequency) settings for an IPM motor other than MM-CF

Set parameters such as the acceleration/deceleration time and multi-speed setting.

Set parameters such as the acceleration/deceleration time and multi-speed setting as required.

Set the operation command. (Refer to *page 90*)

Select the start command and speed command.

**Test run**

As required for MM-CF.

· Perform offline auto tuning for an IPM motor. (Refer to *page 77*)

* Two IPM parameter initialization methods are available for MM-CF IPM motors; setting *Pr.998 IPM parameter initialization*, and selecting IPM (IPM parameter initialization) mode on the operation panel. One of the two methods can be selected.
To change to the PM sensorless vector control, perform IPM parameter initialization at first. If parameter initialization is performed after setting other parameters, some of those parameters will be initialized too. (Refer to *page 75* for the parameters that are initialized.)

**REMARKS**

· "Er1" appears if IPM parameter initialization is performed while *Pr.72* = "25."
· To use a motor capacity that is one rank lower than the inverter capacity, set *Pr.80 Motor capacity* before performing IPM parameter initialization.
· To perform PM sensorless vector control on an IPM motor other than MM-CF, contact your sales representative.

**CAUTION**

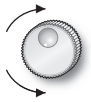
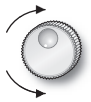
· The speed setting range for an MM-CF IPM motor is between 0 and 200Hz.
· The carrier frequency is limited during PM sensorless vector control. *(Refer to page 209)*
· Constant-speed operation cannot be performed in the low-speed range of 200r/min or less under current synchronization operation. *(Refer to page 140)*
· During PM sensorless vector control, the RUN signal is output about 100ms after turning ON the start command (STF, STR). The delay is due to the magnetic pole position detection.
· During PM sensorless vector control, the automatic restart after instantaneous power failure function operates only when an MM-CF IPM motor is connected.
When a built-in brake or a regeneration unit is used, the frequency search may not be available at 2200r/min or higher. The restart operation cannot be performed until the motor speed drops to a frequency where the frequency search is available.

### (1) PM sensorless vector control setting by selecting IPM in the parameter setting mode on the operation panel ( I PM )

**POINT**

· The parameters required to drive an MM-CF IPM motor are automatically changed as a batch. (Refer to *page 75*)

**Operation example** **Initialize the parameter setting for an MM-CF IPM motor by selecting IPM in the parameter setting mode on the operation panel.**

| Operation | Display |
|---|---|
| 1. Screen at power-ON<br>The monitor display appears. |  |
| 2. Parameter setting mode<br>Press (MODE) to choose the parameter setting mode. | (MODE) →  The parameter number read previously appears. |
| 3. Selecting the parameter<br>Turn dial until I PM (IPM parameter initialization) appears. |  →  |
| 4. Displaying the setting<br>Press (SET) to read the currently set value. "0" (initial value) appears. | (SET) →  |
| 5. Selecting the setting<br>Turn dial to change it to the set value "3003". |  →  |
| 6. Parameter setting<br>Press (SET) to set. | (SET) →  <br>Flicker ... Parameter setting complete!!<br>P.RUN indicator is lit.<br> |

· Turn dial to read another parameter.

· Press (SET) to show the setting again.

· Press (SET) twice to show the automatic parameter setting (AUTO).

| Setting | Description |
|---|---|
| 0 | Parameter settings for an induction motor |
| 3003 | Parameter settings for an IPM motor MM-CF (rotations per minute) |

**REMARKS**

· Performing IPM parameter initialization by selecting IPM in the parameter setting mode on the operation panel automatically changes the *Pr. 998 IPM parameter initialization* setting.

· In the initial parameter setting, the capacity same as the inverter capacity is set in *Pr. 80 Motor capacity*. (Refer to *page 189*.) To use a motor capacity that is one rank lower than the inverter capacity, set *Pr. 80 Motor capacity* before performing IPM parameter initialization.

· To set a speed or to display monitored items in frequency, set *Pr. 998*. (Refer to *page 74*.)

### (2) Initializing the parameters required for the PM sensorless vector control *(Pr. 998)*

**POINT**

- The parameters required to drive an IPM motor are automatically changed as a batch. (Refer to *page 75*)
- The units of monitored items and parameter settings related to speed can be selected. (Rotations per minute / frequency)

| Parameter number | Name | Initial value | Setting range | Description | |
|---|---|---|---|---|---|
| **998** *1 | **IPM parameter initialization** | 0 | 0 | Parameter settings for an induction motor (frequency) | Initial parameter settings required to drive an induction motor are set. |
| | | | 3003 | Parameter settings for an MM-CF IPM motor (rotations per minute) | Initial parameter settings required to drive an IPM motor are set. |
| | | | 3103 | Parameter settings for an MM-CF IPM motor (frequency) | |
| | | | 8009 | Parameter (rotations per minute) settings for an IPM motor other than MM-CF (after tuning) *2 | |
| | | | 8109 | Parameter (frequency) settings for an IPM motor other than MM-CF (after tuning) *2 | |

*1 This parameter allows its setting to be changed in any operation mode even if "0 (initial value)" is set in *Pr. 77 Parameter write selection*.
*2 To use an IPM motor other than MM-CF, offline auto tuning must be performed for the IPM motor.

- By performing IPM parameter initialization, initial settings required to drive an IPM motor are set in parameters.
- To use a motor capacity that is one rank lower than the inverter capacity, set *Pr.80 Motor capacity* before performing IPM parameter initialization.
- When *Pr. 998* = "3003," the monitor is displayed and the frequency is set using the motor rotations per minute. To use frequency to display or set, set *Pr. 998* = "3103."
- Set *Pr. 998* = "0" to change the PM sensorless vector control parameter settings to the parameter settings required to drive an induction motor.
- When using an IPM motor other than MM-CF, set *Pr. 998* = "8009 or 8109" to select the parameter settings required to perform PM sensorless vector control. The setting can be made after performing offline auto tuning for an IPM motor.

| *Pr.998* Setting | Description | Operation IPM in the parameter setting mode |
|---|---|---|
| 0 (initial value) | Parameter settings for an induction motor (frequency) | IPM (IPM)⇒ Write "0" |
| 3003 | Parameter settings for an IPM motor MM-CF (rotations per minute) | IPM (IPM)⇒ Write "3003" |
| 3103 | Parameter settings for an IPM motor MM-CF (frequency) | — |
| 8009 | Parameter (rotations per minute) settings for an IPM motor other than MM-CF (after tuning) | — |
| 8109 | Parameter (frequency) settings for an IPM motor other than MM-CF (after tuning) | — |

**REMARKS**

- Make sure to set *Pr. 998* before setting other parameters. If the *Pr. 998* setting is changed after setting other parameters, some of those parameters will be initialized too. (Refer to "(3) " for the parameters that are initialized.)
- To change back to the parameter settings required to drive an induction motor, perform parameter clear or all parameter clear.
- If the setting of *Pr. 998 IPM parameter initialization* is changed from "3003, 8009 (rotations per minute)" to "3103, 8109 (frequency)," or from "3103, 8109" to "3003, 8009," all the target parameters are initialized.
  The purpose of *Pr. 998* is not to change the display units. Use *Pr. 144 Speed setting switchover* to change the display units between rotations per minute and frequency. *Pr. 144* enables switching of display units between rotations per minute and frequency without initializing the parameter settings.
  Example) Changing the *Pr. 144* setting between "6" and "106" switches the display units between frequency and rotations per minute.
- To perform PM sensorless vector control on an IPM motor other than MM-CF, contact your sales representative.

### (3) IPM parameter initialization list

The parameter settings in the following table are changed to the settings required to perform PM sensorless vector control by selecting PM sensorless vector control with the IPM parameter initialization mode on the operation panel or with *Pr. 998 IPM parameter initialization* setting. The changed settings differ according to the IPM motor specification (capacity).
Performing parameter clear or all parameter clear sets back the parameter settings to the settings required to drive an induction motor.

| Parameter | Name | Pr.998 | Setting: Induction motor 0 (Initial setting) | Setting: IPM motor (rotations per minute) 3003 (MM-CF) | Setting: IPM motor (rotations per minute) 8009 (other than MM-CF) | Setting: IPM motor (frequency) 3103 (MM-CF) | Setting: IPM motor (frequency) 8109 (other than MM-CF) | Setting increments 3003, 8009 | Setting increments 0, 3103, 8109 |
|---|---|---|---|---|---|---|---|---|---|
| **1** | Maximum frequency | | 120/60Hz *1 | 3000r/min | — | 200Hz | — | 1r/min | 0.01Hz |
| **4** | Multi-speed setting (high speed) | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **9** | Electronic thermal O/L relay | | Rated inverter current | Rated motor current (Refer to *page 189*) | — | Rated motor current (Refer to *page 189*) | — | 0.01A/0.1A *1 | |
| **13** | Starting frequency | | 0.5Hz | 8r/min *5 | *Pr. 84* × 10% | 0.5Hz 6 | *Pr. 84* × 10% | 1r/min | 0.01Hz |
| **15** | Jog frequency | | 5Hz | 200r/min | *Pr. 84* × 10% | 13.33Hz | *Pr. 84* × 10% | 1r/min | 0.01Hz |
| **18** | High speed maximum frequency | | 120/60Hz *1 | 3000r/min | — | 200Hz | — | 1r/min | 0.01Hz |
| **20** | Acceleration/deceleration reference frequency | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **22** | Stall prevention operation level | | 150% | 150% | | | | 0.1% | |
| **37** | Speed display | | 0 | 0 | | | | 1 | |
| **55** | Frequency monitoring reference | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **56** | Current monitoring reference | | Rated inverter current | Rated motor current (Refer to *page 189*) | *Pr. 859* | Rated motor current (Refer to *page 189*) | *Pr. 859* | 0.01A/0.1A *1 | |
| **71** | Applied motor | | 0 | 330 *2 | — | 330 *2 | — | 1 | |
| **80** | Motor capacity | | 9999 | Motor capacity (MM-CF) *3 | — | Motor capacity (MM-CF) *3 | — | 0.01kW/0.1kW *1 | |
| **81** | Number of motor poles | | 9999 | 8 | — | 8 | — | 1 | |
| **84** | Rated motor frequency | | 60Hz | 2000r/min | — | 133.33Hz | — | 1r/min | 0.01Hz |
| **125 (903)** | Terminal 2 frequency setting gain frequency | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **126 (905)** | Terminal 4 frequency setting gain frequency | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **144** | Speed setting switchover | | 4 | 108 | *Pr. 81* +100 | 8 | *Pr. 81* | 1 | |
| **240** | Soft-PWM operation selection | | 1 | 0 | | | | 1 | |
| **263** | Subtraction starting frequency | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **266** | Power failure deceleration time switchover frequency | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **374** | Overspeed detection level | | 140Hz | 3150r/min | *Pr. 1 (Pr. 18)* × 105% | 210Hz | *Pr. 1 (Pr. 18)* × 105% | 1r/min | 0.01Hz |
| **386** | Frequency for maximum input pulse | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |
| **390** *4 | % setting reference frequency | | 60Hz | 133.33Hz | *Pr. 84* | 133.33Hz | *Pr. 84* | 0.01Hz | |
| **505** | Speed setting reference | | 60Hz | 133.33Hz | *Pr. 84* | 133.33Hz | *Pr. 84* | 0.01Hz | |
| **557** | Current average value monitor signal output reference current | | Rated inverter current | Rated motor current (Refer to *page 189*) | *Pr. 859* | Rated motor current (Refer to *page 189*) | *Pr. 859* | 0.01A/0.1A *1 | |
| **820** | Speed control P gain 1 | | 60% | 30% | | | | 1% | |
| **821** | Speed control integral time 1 | | 0.333s | 0.333s | | | | 0.001s | |
| **824** | Torque control P gain 1 (current loop proportional gain) | | 100% | 100% | | | | 1% | |
| **825** | Torque control integral time 1 (current loop integral time) | | 5ms | 20ms | | | | 0.1ms | |
| **870** | Speed detection hysteresis | | 0Hz | 8r/min | | 0.5Hz | | 1r/min | 0.01Hz |
| **885** | Regeneration avoidance compensation frequency limit value | | 6Hz | 200r/min | *Pr. 84* × 10% | 13.33Hz | *Pr. 84* × 10% | 1r/min | 0.01Hz |
| **893** | Energy saving monitor reference (motor capacity) | | Rated inverter capacity | Motor capacity *(Pr. 80)* | | | | 0.01kW/0.1kW *1 | |
| **C14 (918)** | Terminal 1 gain frequency (speed) | | 60Hz | 2000r/min | *Pr. 84* | 133.33Hz | *Pr. 84* | 1r/min | 0.01Hz |

—: The setting does not change.

*1 Initial values differ according to the inverter capacity. (55K or lower/75K or higher)
*2 Setting *Pr. 71 Applied motor* = one of "333, 334, 8093, 8094" does not change the *Pr. 71 Applied motor* setting.
*3 Setting *Pr. 80 Motor capacity* ≠ "9999" does not change the *Pr. 80 Motor capacity* setting.
*4 This parameter can be set when FR-A7NL is mounted.
*5 200r/min when *Pr. 788 Low-speed range torque characteristics selection* = "0".
*6 13.33Hz when *Pr. 788 Low-speed range torque characteristics selection* = "0".

**REMARKS**

If IPM parameter initialization is performed in rotations per minute (*Pr. 998* = "3003" or "8009"), the frequency-related parameters not listed in the table above and the monitored items are also set and displayed in rotations per minute.

### (4) PM sensorless vector control display and PM sensorless vector control signal

P.RUN on the operation panel (FR-DU07) is lit and the PM sensorless vector control signal (IPM) is output during PM sensorless vector control.
For the terminal to output the PM sensorless vector control signal, assign the function by setting "57 (positive logic)" or "157 (negative logic)" in any of *Pr.190 to Pr.196 (Output terminal function selection)*.

### 3.2.12 Exhibiting the best performance of the motor performance (offline auto tuning) (Pr.1, Pr.9, Pr.18, Pr.71, Pr.80, Pr.81, Pr.83, Pr.84, Pr.96, Pr.707, Pr.724, Pr.725)

Magnetic flux Sensorless Vector PM

The motor performance can be maximized with offline auto tuning.

- What is offline auto tuning?
  When performing Advanced magnetic flux vector control, Real sensorless vector control or vector control, the motor can be run with the optimum operating characteristics by automatically measuring the motor constants (offline auto tuning) even when each motor constants differs, other manufacturer's motor is used, or the wiring length is long.

| Parameter Number | Name | Initial Value | Setting Range | | Description | |
|---|---|---|---|---|---|---|
| 1 | Maximum frequency | 120/ 60Hz*1 | 0 to 120Hz | | Set the upper limit of the output frequency. | |
| 9 | Electronic thermal O/L relay | Rated inverter current | 0 to 500A | | Set the rated motor current. | |
| 18 | High speed maximum frequency | 120/ 60Hz*1 | 120 to 400Hz | | Set when performing the operation at 120Hz or more. (Limited at 300Hz under PM sensorless vector control) | |
| 71 | Applied motor | 0 | 0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54, 330, 333, 334, 8093, 8094 | | Setting a motor type selects its thermal characteristic and the motor constant. | |
| 80 | Motor capacity | 9999 | 55K or lower | 0.4 to 55kW | Set the applied motor capacity. | |
| | | | 75K or higher | 0 to 3600kW | | |
| | | | 9999 | | V/F control | |
| 81 | Number of motor poles | 9999 | 2, 4, 6, 8, 10 | | Set the number of motor poles. | |
| | | | 12, 14, 16, 18, 20 | | X18 signal-ON:V/F control | Set 10 + number of motor poles. |
| | | | 9999 | | V/F control | |
| 83 | Rated motor voltage | 200/ 400V*2 | 0 to 1000V | | Set the rated motor voltage (V). | |
| 84 | Rated motor frequency | 60Hz | 10 to 300Hz | | Set the rated motor frequency (Hz). (Limited at 120Hz when *Pr. 71* is set to a motor other than IPM) | |
| 96 | Auto tuning setting/ status | 0 | 0 | | Offline auto tuning is not performed | |
| | | | 1 | | Offline auto tuning is performed without motor running (other than MM-CF) | |
| | | | 11 | | Offline auto tuning is performed without motor running (MM-CF) | |
| | | | 101 | | Offline auto tuning by rotating a general-purpose motor (no tuning during PM sensorless vector control) | |
| 707 | Motor inertia (integer) | 9999 | 10 to 999 | | Set the motor inertia. | |
| | | | 9999 | | Uses the inertia of the MM-CF IPM motor | |
| 724 | Motor inertia (exponent) | 9999 | 1 to 7 | | Set the motor inertia. | |
| | | | 9999 | | Uses the inertia of the MM-CF IPM motor | |
| 725 | Motor protection current level | 9999 | 0 to 500% | | Set the maximum current (OCT) level of the motor (%). | |
| | | | 9999 | | Uses the maximum current of MM-CF | |

*1 Initial values differ according to the inverter capacity. (55K or lower/75K or higher)

*2 The initial value differs according to the voltage level. (200V/400V)

**POINT**

- This function is valid only Advanced magnetic flux vector control, Real sensorless vector control, vector control or PM sensorless vector control is selected.
- Reading/writing of motor constants tuned by offline auto tuning are enabled. You can copy the offline auto tuning data (motor constants) to another inverter with the PU (FR-DU07/FR-PU07).
- Even when motors (other manufacturer's motor, SF-JRC, SF-TH, etc.) other than Mitsubishi standard motor (SF-JR 0.4kW or higher), high efficiency motor (SF-HR 0.4kW or higher), Mitsubishi constant-torque motor (SF-JRCA 4P, SF-HRCA 0.4kW to 55kW), vector control dedicated motor (SF-V5RU (1500r/min series)) and IPM motor (MM-CF) are used or the wiring length is long (30mor more as a reference), using the offline auto tuning function runs the motor with the optimum operating characteristics.
- The offline auto tuning enables the operation with an IPM motor other than MM-CF.
- Tuning is enabled even when a load is connected to the motor. (As the load is lighter, tuning accuracy is higher. Tuning accuracy does not change even if the inertia is large.)
- When an induction motor is used, the motor rotation can be locked (*Pr. 96* = "1") or unlocked (*Pr. 96* = "101") during offline auto tuning. The rotation mode (motor unlocked) has a higher tuning accuracy than the non-rotation mode (motor locked).
- The offline auto tuning status can be monitored with the PU (FR-DU07/FR-PU07/FR-PU04).
- Do not connect a surge voltage suppression filter (FR-ASF-H/FR-BMF-H) to the 55K or lower and sine wave filter (MT-BSL/BSC) to the 75K or higher between the inverter and motor.

### (1) Before performing offline auto tuning

Check the following before performing offline auto tuning.

- Make sure Advanced magnetic flux vector control *(Pr. 80, Pr. 81)*, Real sensorless vector control, vector control *(Pr. 800)* or PM sensorless vector control (MM-CF) is selected.
- A motor should be connected. Note that the motor should be at a stop at a tuning start.
- The motor capacity should be equal to or one rank lower than the inverter capacity. (Note that the capacity is 0.4kW or higher.)
- Motors such as high-slip motor, high-speed motor and special motor cannot be tuned.
- The maximum frequency is 120Hz under induction motor control, and 300Hz under PM sensorless vector control.
- Even if tuning is performed without motor running (*Pr. 96 Auto tuning setting/status* = "1"), the motor may run slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs. (Caution is required especially in vertical lift applications). Note that if the motor runs slightly, tuning performance is unaffected.
- When driving an induction motor, note the following when selecting offline auto tuning performed with motor running (*Pr. 96 Auto tuning setting/status* = "101").
  Torque is not enough during tuning.
  The motor may be run at nearly its rated speed.
  The mechanical brake is open.
  No external force is applied to rotate the motor.
- Offline auto tuning will not be performed properly if it is performed with a surge voltage suppression filter (FR-ASF-H/FR-BMF-H) connected to the 55K or lower and sine wave filter (MT-BSL/BSC) connected to the 75K or higher between the inverter and motor. Remove it before starting tuning.
- When exercising vector control, use the encoder that is coupled directly to the motor shaft without looseness. Speed ratio should be 1:1.
- Tuning is not available during position control.

## (2) Setting

●Induction motor

1) Select the Advanced magnetic flux vector control, Real sensorless vector control or vector control.
2) Set "1" or "101" in *Pr. 96 Auto tuning setting/status*.
   · When the setting is "1" . . . . . Tuning is performed without motor running.
   It takes approximately 25 to 120s * until tuning is completed.
   (Excitation noise is produced during tuning.)
   *Tuning time differs according to the inverter capacity and motor type.
   · When the setting is "101" . . . . . Tuning is performed with motor running.
   It takes approximately 40s until tuning is completed.
   The motor runs at nearly its rated frequency.
3) Set the rated motor current (initial value is rated inverter current) in *Pr. 9 Electronic thermal O/L relay*.
4) Set the rated voltage of motor (initial value is 200V/400V) in *Pr. 83 Rated motor voltage* and rated frequency of motor (initial value is 60Hz) in *Pr. 84 Rated motor frequency*.
   (For a Japanese standard motor, etc. which has both 50Hz and 60Hz rated values, set (200V/60Hz or 400V/60Hz).)
   For the vector control dedicated motor SF-V5RU (1500r/min series), refer to *page 33*.
   For vector control dedicated motor SF-V5RU / SF-V5RU1 / V5RU3 / V5RU4, set as the following table.

| | ***Pr. 83* Setting** | | ***Pr. 84* Setting** |
|---|---|---|---|
| | **200V class** | **400V class** | |
| SF-V5RU1K1 to SF-V5RU30K1 | 160V | 320V | 33.33Hz |
| SF-V5RU37K1 | 170V | 340V | |
| SF-V5RU1K3 to SF-V5RU22K3 | 160V | 320V | |
| SF-V5RU30K3 | 170V | 340V | |
| SF-V5RU3K4, SF-V5RU7K4 | 150V | 300V | 16.67Hz |
| SF-V5RU4-other than the above | 160V | 320V | |

**REMARKS**

- Perform auto tuning for SF-V5RU (except for 1500 r/min series) with setting 13 or 14 in *Pr. 71* (For perform auto tuning, set *Pr. 83* and *Pr. 84*)
- When *Pr. 11 DC injection brake operation time* = "0" or *Pr.12 DC injection brake operation voltage* = "0," offline auto tuning is performed at the initial value of *Pr. 11* or *Pr. 12*.
- When the positioning control is selected (*Pr. 800* = "3" or "5" (when MC signal is OFF)), offline auto tuning is not performed.

5) Set *Pr. 71 Applied motor* according to the motor used.

| **Motor** | | ***Pr. 71* Setting** * |
|---|---|---|
| Mitsubishi standard motor<br>Mitsubishi high efficiency motor | SF-JR, SF-TH | 3 |
| | SF-JR 4P-1.5kW or lower | 23 |
| | SF-HR | 43 |
| | Others | 3 |
| Mitsubishi constant-torque motor | SF-JRCA 4P,<br>SF-TH (constant-torque) | 13 |
| | SF-HRCA | 53 |
| | Others (SF-JRC, etc.) | 13 |
| Vector control dedicated motor | SF-V5RU (1500r/min series)<br>SF-THY | 33 |
| | SF-V5RU (except for 1500r/min series) | 13 |
| Other manufacturer's standard motor | – | 3 |
| Other manufacturer's constant-torque motor | – | 13 |

* For other settings of *Pr. 71*, refer to *Chapter 4 of* 📖 *the Instruction Manual (Applied)*.

●IPM motor

To perform tuning, set the following parameters about the motor.

| Parameter Number | Name | Setting for an IPM motor other than MM-CF | Setting for MM-CF |
|---|---|---|---|
| 80 | Motor capacity | Motor capacity (kW) | Set by the IPM parameter initialization (Refer to *page 74*.) |
| 81 | Number of motor poles | Number of motor poles | |
| 1(18) | Maximum frequency (High speed maximum frequency) | The maximum motor frequency (Hz) | |
| 9 | Electronic thermal O/L relay | Rated motor current (A) | |
| 84 | Rated motor frequency | Rated motor frequency (Hz) | |
| 83 | Rated motor voltage | Rated motor voltage (V) | Rated motor voltage (V) printed on the motor's rating plate. |
| 707 | Motor inertia (integer) | Motor inertia Jm = $Pr.707 \times 10^{(-Pr.724)}$ (kg·m$^2$) | 9999 (Initial value) |
| 724 | Motor inertia (exponent) | | |
| 725 | Motor protection current level | Maximum current (OCT) level of the motor (%) | 9999 (Initial value) |
| 71 | Applied motor | 8093 | 333 |
| 96 | Auto tuning setting/status | 1 | 11 |

**REMARKS**

· To perform offline auto tuning on an IPM motor other than MM-CF, contact your sales representative.

### (3) Execution of tuning

**CAUTION**

· Before performing tuning, check the monitor display of the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07) if the inverter is in the state ready for tuning. (Refer to 2) below) Turning ON the start command while tuning is unavailable starts the motor.

1)When performing PU operation, press FWD / REV of the operation panel.

For External operation, turn ON the start command (STF signal or STR signal). Tuning starts.

**REMARKS**

· Satisfy the required inverter start conditions to start offline auto tuning. For example, stop the input of MRS signal.

· To force tuning to end, use the MRS or RES signal or press STOP RESET of the operation panel.
(Turning the start signal (STF signal or STR signal) OFF also ends tuning.)

· During offline auto tuning, only the following I/O signals are valid: (initial value)
· Input signals <valid signal> STOP, OH, MRS, RT, RES, STF, STR
· Output terminal RUN, OL, IPF, FM, AM, A1B1C1
Note that the progress status of offline auto tuning is output in fifteen steps from AM and FM when speed and output frequency are selected.

· Do not perform ON/OFF switching of the second function selection signal (RT) during execution of offline auto tuning. Auto tuning is not executed properly.

· Setting offline auto tuning (*Pr. 96 Auto tuning setting/status* = "1, 11, 101") will make pre-excitation invalid.

**CAUTION**

· When selecting offline auto tuning performed with motor running (*Pr. 96 Auto tuning setting/status* = "101"), caution must be taken since the motor runs.

· Since the RUN signal turns ON when tuning is started, caution is required especially when a sequence which releases a mechanical brake by the RUN signal has been designed.

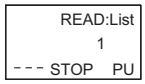
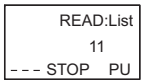
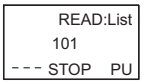
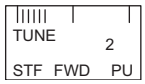
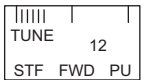
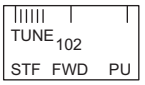
· When executing offline auto tuning, input the run command after switching ON the main circuit power (R/L1, S/L2, T/L3) of the inverter.

· While *Pr. 79* = "7," turn the X12 signal ON to tune in the PU operation mode.

2)Monitor is displayed on the operation panel (FR-DU07) and parameter unit (FR-PU07/FR-PU04) during tuning as below.
Operation Panel (FR-DU07) Display

| | *Pr. 96* setting | | |
|---|---|---|---|
| | 1 | 11 | 101 |
| (1) Setting |  |  |  |
| (2) Tuning in progress |  |  |  |
| (3) Normal end |  Flickering |  Flickering |  Flickering |
| (4) Error end (when the inverter protective function is activated) |  | | |

Parameter Unit (FR-PU07/FR-PU04) Display

| | *Pr. 96* setting | | |
|---|---|---|---|
| | 1 | 11 | 101 |
| (1) Setting |  |  |  |
| (2) Tuning in progress |  |  |  |
| (3) Normal end |  |  |  |
| (4) Error end (when the inverter protective function is activated) |  | | |

· Reference: Offline auto tuning time (when the initial setting is set)

| Offline Auto Tuning Setting | Time |
|---|---|
| Non-rotation mode (*Pr. 96* = "1") | Approximately 25 to 120s<br>(Tuning time differs according to the inverter capacity and motor type.) |
| Rotation mode (*Pr. 96* = "101") | Approximately 40s<br>(Offline auto tuning time varies with the acceleration and deceleration time settings as indicated below. Offline auto tuning time = acceleration time + deceleration time + approx. 30s) |

3)When offline auto tuning ends, press STOP RESET of the operation panel during PU operation. For External operation, turn OFF the start signal (STF signal or STR signal).
This operation resets the offline auto tuning and the PU's monitor display returns to the normal indication. (Without this operation, next operation cannot be started.)

**REMARKS**

- The motor constants measured once in the offline auto tuning are stored as parameters and their data are held until the offline auto tuning is performed again.
- Changing *Pr. 96* setting from "3 or 103" after tuning completion will invalidate the tuning data. In this case, tune again.

4)If offline auto tuning ended in error (see the table below), motor constants are not set.
Perform an inverter reset and restart tuning.

| Error Display | Error Cause | Remedy |
|---|---|---|
| 8 | Forced end | Set "1, 11, 101" in *Pr. 96* and perform tuning again. |
| 9 | Inverter protective function operation | Make setting again. |
| 91 | Current limit (stall prevention) function was activated. | Increase acceleration/deceleration time.<br>Set "1" in *Pr. 156* . |
| 92 | Converter output voltage reached 75% of rated value. | Check for fluctuation of power supply voltage. |
| 93 | Calculation error<br>A motor is not connected. | Check the motor wiring and make setting again. |

5)When tuning is ended forcibly by pressing STOP RESET or turning OFF the start signal (STF or STR) during tuning, offline auto tuning does not end properly. (The motor constants have not been set.)
Perform an inverter reset and restart tuning.

6)When using the motor corresponding to the following specifications and conditions, reset *Pr. 9 Electronic thermal O/L relay* as below after tuning is completed.

a) When the rated power specifications of the motor is 200/220V (400/440V) 60Hz, set 1.1 times rated motor current value in *Pr.9*.

b) When performing motor protection from overheat using a PTC thermistor or motor with temperature detector such as Klixon, set "0" (motor overheat protection by the inverter is invalid) in *Pr. 9*.

**CAUTION**

- An instantaneous power failure occurring during tuning will result in a tuning error.
  After power is restored, the inverter goes into the normal operation mode. Therefore, when STF (STR) signal is ON, the motor runs in the forward (reverse) rotation.
- Any alarm occurring during tuning is handled as in the ordinary mode. Note that if a fault retry has been set, retry is ignored.
- The set frequency monitor displayed during the offline auto tuning is 0Hz.

## ⚠ CAUTION

⚠ Note that the motor may start running suddenly.

⚠ If offline auto tuning with motor rotation is performed for a lift, etc. when a general-purpose motor is used, the lift might fall due to insufficient torque.

### 3.2.13 High accuracy operation unaffected by the motor temperature (online auto tuning) (Pr. 95) Magnetic flux Sensorless Vector

When online auto tuning is selected under Advanced magnetic flux vector control, Real sensorless vector control or vector control, excellent torque accuracy is provided by temperature compensation even if the secondary resistance value of the motor varies with the rise of the motor temperature.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 95 | Online auto tuning selection | 0 | 0 | Online auto tuning is not performed |
| | | | 1 | Start-time online auto tuning |
| | | | 2 | Magnetic flux observer (normal tuning) |

#### (1) Start-time online auto tuning (setting is = "1")

- By quickly tuning the motor constants at a start, high accuracy operation unaffected by the motor temperature and stable operation with high torque down to ultra low speed can be performed.
- Make sure Advanced magnetic flux vector control (*Pr. 80, Pr. 81*), Real sensorless vector control or vector control (*Pr. 800* ) is selected. (*Refer to page 64*.)
- Before performing online auto tuning, perform offline auto tuning without fail.

**<Operation method>**

1) Check that "3" or "103" (offline auto tuning completion) is set in *Pr. 96 Auto tuning setting/status*.
2) Set "1" (start-time online auto tuning) in *Pr. 95 Online auto tuning selection*.
   Online auto tuning is performed from the next starting.
3) When performing PU operation, press FWD / REV of the operation panel.
   For External operation, turn ON the run command (STF signal or STR signal).

**CAUTION**

- For using start-time online auto tuning in elevator, examine the utilization of a brake sequence for the brake opening timing at a start. Though the tuning ends in about a maximum of 500ms after a start, torque is not provided fully during that period. Therefore, note that there may be a possibility of drop due to gravity.It is recommended to perform tuning using a start time tuning signal (X28). *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

#### (2) Magnetic flux observer (normal tuning) (setting value is = "2")

- When exercising vector control using a motor with encoder, it is effective for torque accuracy improvement.
  The current flowing in the motor and the inverter output voltage are used to estimate/observe the magnetic flux in the motor.
  The magnetic flux of the motor is always (including during operation) detected with high accuracy so that an excellent characteristic is provided regardless of the change in the temperature of the secondary resistance.
- Vector control *(Pr. 80, Pr. 81, Pr. 800)* should be selected. *(Refer to page 95.)*

**CAUTION**

- For the SF-V5RU, SF-JR (with encoder), SF-HR (with encoder), SF-JRCA (with encoder) or SF-HRCA (with encoder), it is not necessary to perform offline auto tuning to select adaptive magnetic flux observer. (Note that it is necessary to perform offline auto tuning for the wiring length resistance to be applied on the control when the wiring length is long (30m or longer as reference)).

**REMARKS**

- Online auto tuning does not operate if the MRS signal is input, if the preset speed is less than the *Pr. 13 Starting frequency* (Advanced magnetic flux vector control), or if the starting conditions of the inverter are not satisfied, e.g. inverter error.
- Online auto tuning does not operate during deceleration or at a restart during DC brake operation.
- Invalid for jog operation.
- Automatic restart after instantaneous power failure overrides when automatic restart after instantaneous power failure is selected. (Start-time online auto tuning is not performed at frequency search.)
  Perform online auto tuning at a stop with the X28 signal when using automatic restart after instantaneous power failure together.
  (Refer to *Chapter 4 of the Instruction Manual (Applied)* for details.)
- Zero current detection and output current detection are valid during online auto tuning.
- The RUN signal is not output during online auto tuning. The RUN signal turns ON at a start.
- If the period from an inverter stop to a restart is within 4s, start-time tuning is performed but the tuning results are not applied.

## 3.2.14 To perform high accuracy/fast response operation (gain adjustment of Real sensorless vector control, vector control and PM sensorless vector control) (Pr. 818 to Pr. 821, Pr. 880) Sensorless Vector P M

The ratio of the load inertia to the motor inertia (load inertia moment) is estimated in real time from the torque command and speed during motor operation by vector control. As optimum gain of speed control and position control are automatically set from the load inertia ratio and response level, time and effort of making gain adjustment are reduced. (Easy gain tuning)
Set the control gain by setting the load inertia ratio manually when the load inertia ratio cannot be estimated due to load fluctuation, or under Real sensorless vector control or PM sensorless vector control.
Make a manual input adjustment when vibration, noise or any other unfavorable phenomenon occurs due to large load inertia or gear backlash, for example, or when you want to exhibit the best performance that matches the machine.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **818** | **Easy gain tuning response level setting** | 2 | 1 to 15 | Set the response level.<br>1: Slow response to 15: Fast response |
| **819** | **Easy gain tuning selection** | 0 | 0 | Without easy gain tuning |
| | | | 1 | With load estimation, with gain calculation (valid only during vector control) |
| | | | 2 | With load *(Pr. 880)* manual input, gain calculation |
| **820** | **Speed control P gain 1** | 60%* | 0 to 1000% | Set the proportional gain for speed control. (Increasing the value improves trackability in response to a speed command change and reduces speed variation with disturbance.) |
| **821** | **Speed control integral time 1** | 0.333s* | 0 to 20s | Set the integral time during speed control. (Decrease the value to shorten the time taken for returning to the original speed if speed variation with disturbance occurs.) |
| **880** | **Load inertia ratio** | 7 times | 0 to 200 times | Set the load inertia ratio to the motor. |

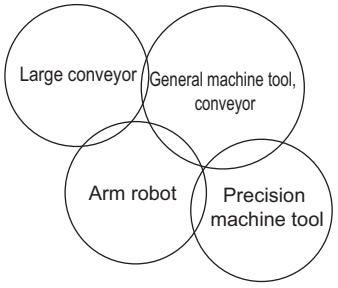
* Performing IPM parameter initialization changes the setting. *(Refer to page 74.)*

### (1) Easy gain tuning execution procedure (*Pr. 819* = "1" load inertia ratio automatic estimation)

Easy gain tuning (load inertia ratio automatic estimation) is valid only in the speed control or position control mode under vector control.
It is invalid under torque control, V/F control, Advanced magnetic flux vector control, Real sensorless vector control, and PM sensorless vector control.

1) Set the response level using *Pr. 818 Easy gain tuning response level setting*.
Refer to the diagram on the right and set the response level.
Increasing the value will improve trackability to the command, but too high value will generate vibration. The relationship between the setting and response level are shown on the right.

| *Pr. 818* setting | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Response level | Slow response ← | | | | | | | | Middle response | | | → Fast response | | | |
| Guideline of mechanical resonance frequency (Hz) | 8 | 10 | 12 | 15 | 18 | 22 | 28 | 34 | 42 | 52 | 64 | 79 | 98 | 122 | 150 |



2) Each control gain is automatically set from the load inertia ratio estimated during acceleration/deceleration operation and the *Pr. 818 Easy gain tuning response level setting* value.
*Pr. 880 Load inertia ratio* is used as the initial value of the load inertia ratio for tuning. Estimated value is set in *Pr. 880* during tuning.
The load inertia ratio may not be estimated well, e.g. it takes a long time for estimation, if the following conditions are not satisfied.
· Time taken for acceleration/deceleration to reach 1500r/min is 5s or less.
· Speed is 150r/min or more.
· Acceleration/deceleration torque is 10% or more of the rated torque.
· Abrupt disturbance is not applied during acceleration/deceleration.
· Load inertia ratio is approx. 30 times or less.
· No gear backlash nor belt looseness is found.

3) Press (FWD) or (REV) to estimate the load inertia ratio or calculate gain any time. (The operation command for External operation is the STF or STR signal.)

### (2) Easy gain tuning execution procedure (*Pr.819* = "2" load inertia manual input)

Easy gain tuning (load inertia ratio manual input) is valid in the speed control mode under Real sensorless vector control, the speed control and position control modes under vector control, and the speed control mode under PM sensorless vector control.

1) Set the load inertia ratio to the motor in *Pr. 880 Load inertia ratio*.
2) Set "2" (with easy gain tuning) in *Pr. 819 Easy gain tuning selection*. Then, *Pr. 820 Speed control P gain 1* and *Pr. 821 Speed control integral time 1* are automatically set by gain calculation.
Operation is performed in a gain adjusted status from the next operation.
3) Perform a test run and set the response level in *Pr. 818 Easy gain tuning response level setting*. Increasing the value will improve trackability to the command, but too high value will generate vibration. (When "2" (parameter write enabled during operation) is set in *Pr. 77 Parameter write selection* , response level adjustment can be made during operation.)

**REMARKS**

· When "1 or 2" is set in *Pr. 819* and then returned the *Pr. 819* setting to "0" after tuning is executed, tuning results which are set in each parameter remain unchanged.
· When good tuning accuracy is not obtained after executing easy gain tuning due to disturbance and such, perform fine adjustment by manual input. Set "0" (without easy gain tuning) in *Pr. 819*.

### (3) Parameters automatically set by easy gain tuning

The following table indicates the relationship between easy gain tuning function and gain adjustment parameter.

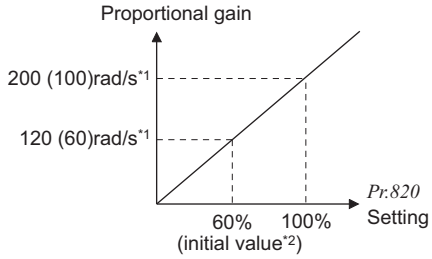
| | **Easy Gain Tuning Selection *(Pr. 819 )* Setting** | | |
|---|---|---|---|
| | **0** | **1** | **2** |
| Load inertia ratio<br>*(Pr. 880)* | Manual input | a) Inertia estimation result (RAM) by easy gain tuning is displayed.<br>b) Set the value in the following cases:<br>• Every hour after power-on<br>• When a value other than "1" is set in *Pr. 819*<br>• When vector control is changed to other control (V/F control etc.) using *Pr. 800*<br>c) Write is enabled only during a stop (manual input) | Manual input |
| Speed control P gain 1<br>*(Pr. 820)*<br>Speed control integral time 1<br>*(Pr. 821)*<br>Model speed control gain<br>*(Pr. 828)*<br>Position loop gain<br>*(Pr. 422)* | Manual input | a) Tuning result (RAM) is displayed.<br>b) Set the value in the following cases:<br>• Every hour after power-on<br>• When a value other than "1" is set in *Pr. 819*<br>• When vector control is changed to other control (V/F control etc.) using *Pr. 800*<br>c) Write (manual input) disabled | a) Gain is calculated when "2" is set in *Pr. 819* and the result is set in the parameter.<br>b) When the value is read, the tuning result (parameter setting value) is displayed.<br>c) Write (manual input) disabled |

**CAUTION**

· Performing easy gain tuning with larger inertia than the specified value during vector control may cause malfunction such as hunting. In addition, when the motor shaft is fixed with servo lock or position control, bearing may be damaged. To prevent these, make gain adjustment by manual input without performing easy gain tuning.

### (4) Manual input speed control gain adjustment (*Pr. 819* = "0" (without the easy gain tuning))

· Make adjustment when any of such phenomena as unusual machine vibration/noise, low response level and overshoot has occurred.



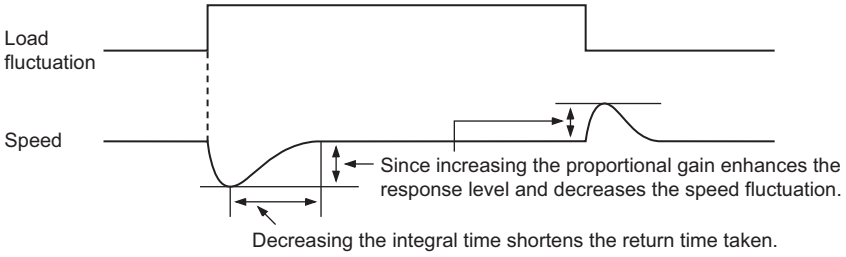

*1 The values for 75K or higher or for Real sensorless vector control are indicated in parentheses.

*2 Performing IPM parameter initialization changes the setting. *(Refer to page 74.)*

· *Pr. 820 Speed control P gain 1* = "60%" (initial value) is equivalent to 120rad/s (speed response of the motor alone). (Half the value for 75K or higher or for Real sensorless vector control.) Increasing the setting value improves the response level, but a too large gain will produce vibration and/or unusual noise.

· Decreasing the *Pr. 821 Speed control integral time 1* shortens the return time taken at a speed change. However, a too short time will generate an overshoot.

· When there is load inertia, the actual speed gain is as given below.




$$\text{Actual speed gain} = \text{speed gain of motor without load} \times \frac{JM}{JM+JL}$$

JM: Inertia of the motor
JL: Motor shaft-equivalent load inertia

· Adjustment procedures are as below:
1)Check the conditions and simultaneously change the *Pr. 820* value.
2)If you cannot make proper adjustment, change the *Pr. 821* value and repeat step 1).

| No. | Phenomenon/ Condition | Adjustment Method | |
|---|---|---|---|
| 1 | Load inertia is large | Set the *Pr. 820* and *Pr. 821* values a little higher. | |
| | | *Pr. 820* | When a speed rise is slow, increase the value 10% by 10% until just before vibration/noise is produced, and set about 0.8 to 0.9 of that value. |
| | | *Pr. 821* | If an overshoot occurs, double the value until an overshoot does not occur, and set about 0.8 to 0.9 of that value. |
| 2 | Vibration/noise generated from mechanical system | Set the *Pr. 820* value a little lower and the *Pr. 821* value a little higher. | |
| | | *Pr. 820* | Decrease the value 10% by 10% until just before vibration/noise is not produced, and set about 0.8 to 0.9 of that value. |
| | | *Pr. 821* | If an overshoot occurs, double the value until an overshoot does not occur, and set about 0.8 to 0.9 of that value. |
| 3 | Slow response | Set the *Pr. 820* value a little higher. | |
| | | *Pr. 820* | When a speed rise is slow, increase the value 5% by 5% until just before vibration/noise is produced, and set about 0.8 to 0.9 of that value. |
| 4 | Long return time (response time) | Set the *Pr. 821* value a little lower. | |
| | | Decrease the *Pr. 821* value by half until just before an overshoot or the unstable phenomenon does not occur, and set about 0.8 to 0.9 of that value. | |
| 5 | Overshoot or unstable phenomenon occurs. | Set the *Pr. 821* value a little higher. | |
| | | Increase the *Pr. 821* value double by double until just before an overshoot or the unstable phenomenon does not occur, and set about 0.8 to 0.9 of that value. | |

**REMARKS**

· When making manual input gain adjustment, set "0" (without easy gain tuning) (initial value) in *Pr. 819 Easy gain tuning selection*.

### (5) When using a multi-pole motor (8 poles or more)

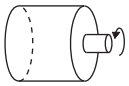
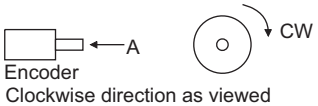
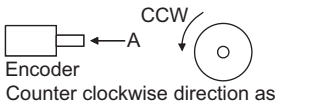
Specially when using a multi-pole motor with more than 8 poles under Real sensorless vector control or vector control, adjust *Pr. 820 Speed control P gain 1* and *Pr. 824 Torque control P gain 1 (current loop proportional gain)* according to the motor referring to the following methods.

- For *Pr. 820 Speed control P gain 1*, increasing the setting value improves the response level, but a too large gain will produce vibration and/or unusual noise.
- For *Pr. 824 Torque control P gain 1 (current loop proportional gain)*, note that a too low value will produce current ripples, causing the motor to generate sound synchronizing the cycle of current ripples.

**Adjustment method**

| No. | Phenomenon/Condition | Adjustment Method |
|---|---|---|
| 1 | The motor rotation is unstable in the low speed range. | Set a higher value in *Pr. 820 Speed control P gain 1* according to the motor inertia.<br>Since the self inertia of a multi-pole motor tends to become large, make adjustment to improve the unstable phenomenon, then make fine adjustment in consideration of the response level using that setting as reference.<br>In addition, when performing vector control, gain adjustment according to the inertia can be easily done using easy gain tuning (*Pr. 819* = 1). |
| 2 | Speed trackability is poor | Set a higher value in *Pr. 820 Speed control P gain 1*.<br>Increase the value 10% by 10% until just before vibration or unusual noise is produced, and set about 0.8 to 0.9 of that value.<br>If you cannot make proper adjustment, increase the value of *Pr. 821 Speed control integral time 1* double by double and make adjustment of *Pr. 820* again. |
| 3 | Speed variation at the load fluctuation is large | |
| 4 | Torque becomes insufficient or torque ripple occurs at starting or in the low speed range under Real sensorless vector control. | Set the speed control gain a little higher. (same as No. 1)<br>If the problem still persists after gain adjustment, increase *Pr. 13 Starting frequency* or set the acceleration time shorter if the inverter is starting to avoid continuous operation in the ultra low speed range. |
| 5 | Unusual motor and machine vibration, noise or overcurrent occurs. | Set a lower value in *Pr. 824 Torque control P gain 1 (current loop proportional gain)*.<br>Decrease the value 10% by 10% until just before the phenomenon is improved, and set about 0.8 to 0.9 of that value. |
| 6 | Overcurrent or overspeed (E.OS) occurs at a start under Real sensorless vector control. | |

## 3.2.15 Troubleshooting during speed control Sensorless Vector PM

<table>
<tr><th>No.</th><th>Phenomenon</th><th>Cause</th><th>Countermeasures</th></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Motor does not rotate.<br>(Vector control)</td><td>(1) The motor wiring is wrong</td><td>(1) Wiring check<br>Select V/F control (set "9999" in Pr. 80 or Pr. 81 ) and check the rotation direction of the motor.<br>For the SF-V5RU (1500r/min series), set "170V(340V)" for 3.7kW or lower and "160V(320V)" for more in Pr. 19 Base frequency voltage, and set "50Hz" in Pr. 3 Base frequency.<br>  <br>When the forward rotation signal is input, the motor running in the counterclockwise direction as viewed from the motor shaft is normal. (If it runs in the clockwise direction, the phase sequence of the inverter secondary side wiring is incorrect.)</td></tr>
<tr><td>(2) Encoder specification selection switch (FR-A7AP/FR-A7AL (option)) is wrong.</td><td>(2) Check the encoder specifications.<br>Check the encoder specifications selection switch (FR-A7AP/FR-A7AL (option)) of differential/complementary</td></tr>
<tr><td>(3) The encoder wiring is wrong.</td><td>(3) Check that FWD is displayed when running the motor in the counter-clockwise direction from outside during a stop of the inverter with vector control setting.<br>If REV is displayed, the encoder phase sequence is wrong. Check that the wiring is correct, and set the rotation direction in Pr.359 Encoder rotation direction according to the motor specification.<br>
<table>
<tr><th>Pr. 359 Setting</th><th colspan="2">Relationship between the Motor and Encoder</th></tr>
<tr><td>0</td><td>  <br>Encoder<br>Clockwise direction as viewed from A is forward rotation</td><td rowspan="2">Set the rotation direction according to the motor specification.</td></tr>
<tr><td>1<br>(Initial value)</td><td>  <br>Encoder<br>Counter clockwise direction as viewed from A is forward rotation</td></tr>
</table></td></tr>
<tr><td>(4) The Pr. 369 Number of encoder pulses setting and the number of encoder used are different.</td><td>(4) The motor will not run if the parameter setting is smaller than the number of encoder pulses used. Set the Pr. 369 Number of encoder pulses correctly.</td></tr>
<tr><td>(5) Encoder power specifications are wrong. Or, power is not input.</td><td>(5) Check the power specifications (5V/12V/15V/24V) of encoder and input the external power supply. When the encoder output is the differential line driver type, only 5V can be input. Make the voltage of the external power supply the same as the encoder output voltage, and connect the external power supply between PG and SD.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Motor does not run at correct speed.<br>(Speed command does not match actual speed)</td><td>(1) The speed command from the command device is incorrect. The speed command is compounded with noise.</td><td>(1) -1 Check that a correct speed command comes from the command device. (Take measures against noises.)<br>(1) -2 Decrease Pr. 72 PWM frequency selection.</td></tr>
<tr><td>(2) The speed command value does not match the inverter-recognized value.</td><td>(2) Readjust speed command bias/gain Pr. 125, Pr. 126, C2 to C7 and C12 to C15.</td></tr>
<tr><td>(3) The number of encoder pulses setting is incorrect.</td><td>(3) Check the setting of Pr. 369 Number of encoder pulses. (vector control)</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Speed does not rise to the speed command.</td><td>(1) Insufficient torque. Torque limit is actuated.</td><td>(1) -1 Increase the torque limit value.<br>(Refer to torque limit of speed control on Chapter 4 of the Instruction Manual (Applied) )<br>(1) -2 Insufficient capacity</td></tr>
<tr><td>(2) Only P (proportional) control is selected.</td><td>(2) When the load is heavy, speed deviation will occur under P (proportional) control. Select PI control.</td></tr>
</table>

| No. | Phenomenon | Cause | Countermeasures |
|---|---|---|---|
| 4 | Motor speed is unstable. | (1) The speed command varies. | (1) -1 Check that a correct speed command comes from the command device. (Take measures against noises.)<br>(1) -2 Decrease *Pr. 72 PWM frequency selection*.<br>(1) -3 Increase *Pr. 822 Speed setting filter 1*. *(Refer to Chapter 4 of the Instruction Manual (Applied))* |
| | | (2) Insufficient torque. | (2) Increase the torque limit value.<br>(Refer to torque limit of speed control on *Chapter 4 of the Instruction Manual (Applied)*) |
| | | (3) The speed control gains do not match the machine. (mechanical resonance) | (3) -1 Perform easy gain tuning. *(Refer to page 84)*<br>(3) -2 Adjust *Pr. 820, Pr. 821*. *(Refer to page 86)*<br>(3) -3 Perform speed feed forward/model adaptive speed control. |
| 5 | Motor or machine hunts (vibration/ noise is produced). | (1) The speed control gain is high. | (1) -1 Perform easy gain tuning. *(Refer to page 84)*<br>(1) -2 Decrease *Pr. 820* and increase *Pr. 821*.<br>(1) -3 Perform speed feed forward control and model adaptive speed control. |
| | | (2) The torque control gain is high. | (2) Decrease the *Pr. 824* value. *(Refer to Chapter 4 of the Instruction Manual (Applied))* |
| | | (3) The motor wiring is wrong. | (3) Check the wiring |
| 6 | Acceleration/ deceleration time does not match the setting. | (1) Insufficient torque. | (1) -1 Increase the torque limit value.<br>(Refer to torque limit of speed control on *Chapter 4 of the Instruction Manual (Applied)*)<br>(1) -2 Perform speed feed forward control. |
| | | (2) Large load inertia. | (2) Set the acceleration/deceleration time that meets the load. |
| 7 | Machine operation is unstable | (1) The speed control gains do not match the machine. | (1) -1 Perform easy gain tuning. *(Refer to page 84)*<br>(1) -2 Adjust *Pr. 820, Pr. 821*. *(Refer to page 86)*<br>(1) -3 Perform speed feed forward control and model adaptive speed control. |
| | | (2) Slow response because of improper acceleration/ deceleration time of the inverter. | (2) Change the acceleration/deceleration time to an optimum value. |
| 8 | Speed fluctuates at low speed. | (1) Adverse effect of high carrier frequency. | (1) Decrease *Pr. 72 PWM frequency selection*. |
| | | (2) Low speed control gain. | (2) Increase *Pr. 820 Speed control P gain 1*. |

# 3.3 Start/stop using the operation panel (PU operation)

**POINT**

From where is the frequency command given?

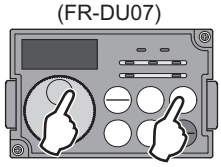
- **Operation at the frequency set in the frequency setting mode of the operation panel** →*Refer to 3.3.1 (Refer to page 90)*
- **Operation using the setting dial as the potentiometer**→*Refer to 3.3.2 (Refer to page 91)*
- **Change of frequency with ON/OFF switches connected to terminals** →*Refer to 3.3.3 (Refer to page 92)*
- **Perform frequency setting using voltage input signal**→*Refer to 3.3.4 (Refer to page 93)*
- **Perform frequency setting using current input signal**→*Refer to 3.3.5 (Refer to page 94)*

## *3.3.1 Setting the frequency to operate (example: performing operation at 30Hz)*

**POINT**

Operation panel (FR-DU07) is used to give both of frequency and start commands in PU operation.

Operation panel
(FR-DU07)



Operation example | Performing operation at 30Hz.

**Operation**

**1.** Screen at power-ON

The monitor display appears.

**2.** Operation mode change

Press (PU/EXT) to choose the PU operation mode. [PU] indicator is lit.

**3.** Frequency setting

Turn  to show the frequency "30.00" (30.00Hz) you want to set. The frequency flickers for about 5s. While the value is flickering, press (SET) to set the frequency. "F" and "30.00" flicker alternately. After the value flickered for about 3s, the display returns to " 0.00" (monitor display).

(If you do not press (SET), the value flickers for about 5s and the display then returns to " 0.00" (0.00Hz). In that case, turn  again, and set the frequency.)

**4.** Start → acceleration → constant speed

Press (FWD) or (REV) to start running. The frequency on the indicator increases by the *Pr. 7 Acceleration time*, and "30.00" (30.00Hz) appears. (To change the set frequency, perform the operation in above step 3. Starting from the previously set frequency.)

**5.** Deceleration → Stop

Press (STOP/RESET) to stop.

The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with " 0.00" (0.00Hz) displayed on the indicator.

**REMARKS**

- Press  to show the set frequency under PU operation mode or External/PU combined operation mode 1 (*Pr. 79* = "3").

-  can also be used like a potentiometer to perform operation. *(Refer to page 91)*

### 3.3.2 Using the setting dial like a potentiometer to perform operation.

**POINT**

Set "1" (setting dial potentiometer mode) in *Pr. 161 Frequency setting/key lock operation selection*.

Operation example | Change the frequency from 0Hz to 60Hz during operation

**Operation**

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

**2.** Operation mode change
Press (PU/EXT) to choose the PU operation mode. [PU] indicator is lit.

**3.** Parameter setting change
Change *Pr. 161* to the setting value " 1 ". *(Refer to page 54* to change the setting.*)*

**4.** Start
Press (FWD) (or (REV)) to start the inverter.

**5.** Frequency setting
Turn  until "60.00" appears. The flickering frequency is the set frequency. (The frequency flickers for about 5s.)
You need not press (SET).

**REMARKS**

· If flickering "60.00" turns to "0.0", the *Pr. 161 Frequency setting/key lock operation selection* setting may not be "1".

· Independently of whether the inverter is running or at a stop, the frequency can be set by merely turning  .

**CAUTION**

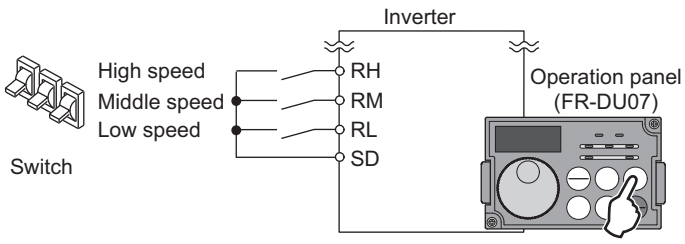
· When setting frequency by turning setting dial, the frequency goes up to the set value of *Pr. 1 Maximum frequency*. Be aware of what frequency *Pr. 1 Maximum frequency* is set to, and adjust the setting of *Pr. 1 Maximum frequency* according to the application.

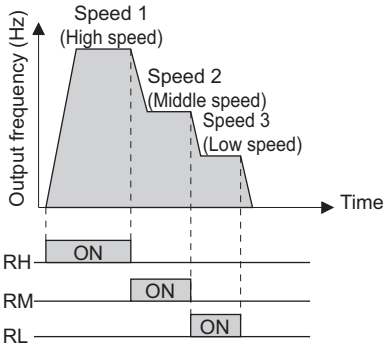
### 3.3.3 Setting the frequency by switches (multi-speed setting)

**POINT**

- Use (FWD) or (REV) on the operation panel (FR-DU07) to give a start command.
- Switch ON the RH, RM, or RL signal to give a frequency command. (Multi-speed setting)
- Set "4" (External/PU combination operation mode 2) in *Pr. 79 Operation mode selection.*

[Connection diagram]




Operation example Operate in low-speed (10Hz).

**Operation**

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

**2.** Operation mode change
Set "4" in *Pr. 79*. [PU] indicator and [EXT] indicator are lit. *(Refer to page 54* to change the setting.*)*

**3.** Frequency setting
Turn ON the low-speed switch (RL).

**4.** Start → Acceleration → constant speed
Press (FWD) or (REV) to start running. The frequency on the indicator increases by the *Pr. 7 Acceleration time*, and "10.00" (10.00Hz) appears.

**5.** Deceleration → stop
Press (STOP RESET) to stop. The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" (0.00Hz) displayed on the indicator. Turn OFF the low-speed switch (RL).

**REMARKS**

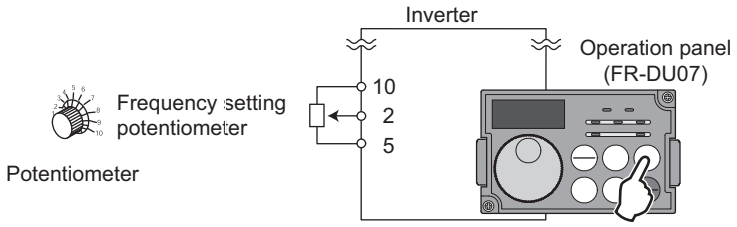
- Initial value of terminal RH, RM, and RL are 60Hz, 30Hz, and 10Hz. (To change, set *Pr. 4*, *Pr. 5*, and *Pr. 6*.)
- In the initial setting, when two or more of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal. For example, when RH and RM signals turn ON, RM signal (*Pr. 5*) has a higher priority.
- Maximum of 15-speed operation can be performed. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

### 3.3.4 Setting the frequency by analog input (voltage input)

**POINT**

- Use (FWD) or (REV) on the operation panel (FR-DU07) to give a start command.
- Use the potentiometer to give a frequency command. (by connecting terminal 2 and 5 (voltage input))
- Set "4" (External/PU combination operation mode 2) in *Pr. 79 Operation mode selection*.

[Connection diagram]
(The inverter supplies 5V of power to the frequency setting potentiometer.(Terminal 10))




Operation example | Performing operation at 60Hz.

**Operation**

| | |
|---|---|
| **1.** | Screen at power-ON<br>The monitor display appears. |
| **2.** | Operation mode change<br>Set "4" in *Pr. 79*. [PU] indicator and [EXT] indicator are lit. *(Refer to page 54* to change the setting.*)* |
| **3.** | Start<br>Press (FWD) or (REV). [FWD] or [REV] is flickering as no frequency command is given. |
| **4.** | Acceleration → constant speed<br>Turn the potentiometer (frequency setting potentiometer) clockwise slowly to full. The frequency value on the indicator increases according to *Pr. 7 Acceleration time* until "60.00"(60Hz) is displayed. |
| **5.** | Deceleration<br>Turn the potentiometer (frequency setting potentiometer) counterclockwise slowly to full. The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with " 0.00" (0.00Hz) displayed on the indicator. [FWD] indicator or [REV] indicator flickers. |
| **6.** | Stop<br>Press (STOP RESET). [FWD] indicator or [REV] indicator turns OFF. |

? Change the frequency (60Hz) of the maximum value of potentiometer (at 5V, initial value)
☞ Adjust the frequency in *Pr. 125 Terminal 2 frequency setting gain frequency. (Refer to page 98.)*

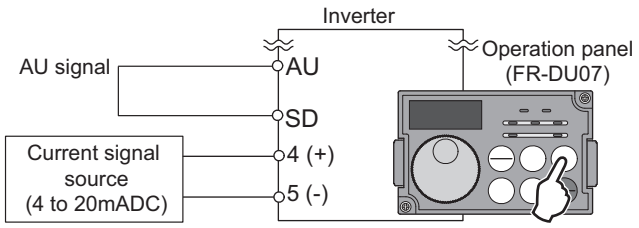
? Change the frequency (0Hz) of the minimum value of potentiometer (at 0V, initial value)
☞ Adjust the frequency in *calibration parameter C2 Terminal 2 frequency setting bias frequency. (Refer to Chapter 4 of the Instruction Manual (Applied).)*

### 3.3.5 Setting the frequency by analog input (current input)

**POINT**

- Use (FWD) or (REV) on the operation panel (FR-DU07) to give a start command.
- Use the current signal source (4 to 20mA) to give a frequency command (by connecting between terminals 4 and 5 (current input)).
- Turn the AU signal ON.
- Set "4" (External/PU combination operation mode 2) in *Pr. 79 Operation mode selection*.

[Connection diagram]




Operation example Performing operation at 60Hz.

**Operation**

| | |
|---|---|
| **1.** | Screen at power-ON<br>The monitor display appears. |
| **2.** | Operation mode change<br>Set "4" in *Pr. 79*. [PU] indicator and [EXT] indicator are lit. *(Refer to page 54* to change the setting.*)* |
| **3.** | Start<br>Check that the terminal 4 input selection signal (AU) is ON. Press (FWD) or (REV). [FWD] or [REV] is flickering as no frequency command is given. |
| **4.** | Acceleration → constant speed<br>Perform 20mA input. The frequency on the indicator increases by the *Pr. 7 Acceleration time* and "60.00" (60.00Hz) appears. |
| **5.** | Deceleration<br>Input 4mA or less. The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with " 0.00" (0.00Hz) displayed on the indicator. [FWD] indicator or [REV] indicator flickers. |
| **6.** | Stop<br>Press (STOP RESET). [FWD] indicator or [REV] indicator turns OFF. |

**REMARKS**

*Pr. 184 AU terminal function selection* must be set to "4" (AU signal) (initial value). *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

? Change the frequency (60Hz) at the maximum value of potentiometer (at 20mA, initial value)
☞ Adjust the frequency in *Pr. 126 Terminal 4 frequency setting gain frequency. (Refer to page 100.)*

? Change the frequency (0Hz) at the minimum value of potentiometer (at 4mA, initial value)
☞ Adjust the frequency in *calibration parameter C5 Terminal 4 frequency setting bias frequency. (Refer to Chapter 4 of the Instruction Manual (Applied).)*

# 3.4 Start and stop using terminals (External operation)

**POINT**

From where is the frequency command given?

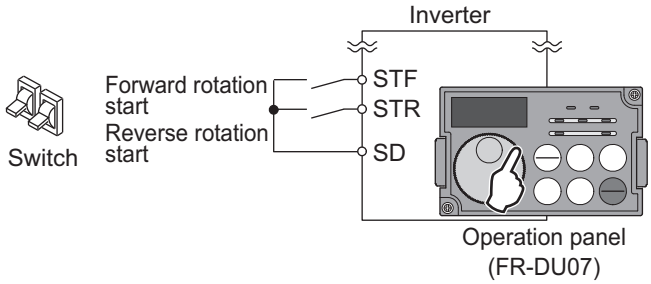
- **Operation at the frequency set in the frequency setting mode of the operation panel** → *Refer to 3.4.1 (Refer to page 95)*
- **Give a frequency command by switch (multi-speed setting)** → *Refer to 3.4.2 (Refer to page 96)*
- **Perform frequency setting using voltage input signal** → *Refer to 3.4.3 (Refer to page 97)*
- **Perform frequency setting using current input signal** → *Refer to 3.4.5 (Refer to page 99)*

## *3.4.1 Setting the frequency by the operation panel (Pr. 79 = 3)*

**POINT**

- Switch ON the STF (STR) signal to give a start command.
- Use ( ) on the operation panel (FR-DU07) to give a frequency command.
- Set "3" (External/PU combination operation mode 1) in *Pr. 79 Operation mode selection*.

[Connection diagram]




Operation example | Performing operation at 30Hz.

**Operation**

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

**2.** Operation mode change
Set "3" in *Pr. 79*. [PU] indicator and [EXT] indicator are lit. *(Refer to page 54* to change the setting.*)*

**3.** Frequency setting
Turn to show the selected frequency, "30.00" (30.00Hz). The frequency flickers for about 5s.
While the value is flickering, press (SET) to set the frequency. "F" and "30.00" flicker alternately.
After about 3s of flickering of the value, the indicator goes back to "0.00" (monitor display).
(If you do not press (SET), the value flickers for about 5s and the display then returns to 0.00 (display) Hz. In that case, turn again, and set the frequency.)

**4.** Start → acceleration → constant speed
Turn ON the start switch (STF or STR). The frequency on the indicator increases by the *Pr. 7 Acceleration time*, and "30.00" (30.00Hz) appears. [FWD] indicator is lit during forward rotation, and [REV] indicator is lit during reverse rotation. (To change the set frequency, perform the operation in above step 3. Starting from the previously set frequency.)

**5.** Deceleration → stop
Turn OFF the start switch (STF or STR). The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" (0.00Hz) displayed on the indicator.

**CAUTION**

When both of STF and STR signals are turned ON, the motor cannot start. If both are turned ON while the motor is running, the motor decelerates to a stop.

**REMARKS**

- *Pr. 178 STF terminal function selection* must be set to "60" (or *Pr. 179 STR terminal function selection* must be set to "61"). (all are initial values)
- When *Pr. 79 Operation mode selection* is set to "3", multi-speed operation (refer to *page 96*) is also valid.

? When the inverter is stopped by (STOP RESET) of the operation panel (FR-DU07), PS and 0.00 (Hz, MON, PU, EXT, FWD) are Flickering displayed alternately.

☞ 1. Turn the start switch (STF or STR) OFF.

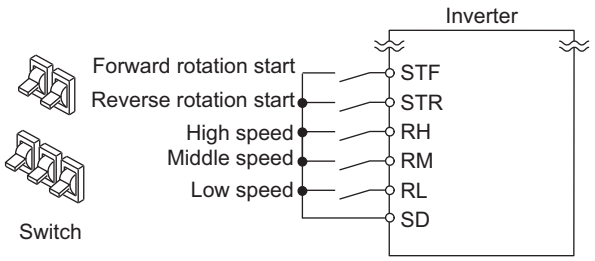
2. The display can be reset by (PU EXT).

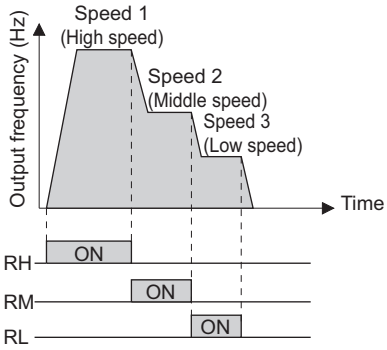
## 3.4.2 Setting the frequency by switches (multi-speed setting) (Pr. 4 to Pr. 6)

**POINT**

- Switch ON the STF (STR) signal to give a start command.
- Switch ON the RH, RM, or RL signal to give a frequency command. (Multi-speed setting)

[Connection diagram]




Changing example | Operation at high speed (60Hz).

**Operation**

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

**2.** Frequency setting
Turn ON the high-speed switch (RH).

**3.** Start → acceleration → constant speed
Turn ON the start switch (STF or STR). The frequency on the indicator increases by the *Pr. 7 Acceleration time*, and "60.00" (60.00Hz) appears. [FWD] indicator is lit during forward rotation, and [REV] indicator is lit during reverse rotation.
- When RM is turned ON, 30Hz is displayed.
  When RL is turned ON, 10Hz is displayed.

**4.** Deceleration → stop
Turn OFF the start switch (STF or STR). The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with "000" (0.00Hz) displayed on the indicator. [FWD] indicator or [REV] indicator turns OFF. Turn OFF the high-speed switch (RH).

**CAUTION**

When both of STF and STR signals are turned ON, the motor cannot start. If both are turned ON while the motor is running, the motor decelerates to a stop.

**REMARKS**

- Initial value of terminal RH, RM, and RL are 60Hz, 30Hz, and 10Hz. (To change, set *Pr. 4*, *Pr. 5*, and *Pr. 6*.)
- In the initial setting, when two or more of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal. For example, when RH and RM signals turn ON, RM signal (*Pr. 5*) has a higher priority.
- Maximum of 15-speed operation can be performed. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

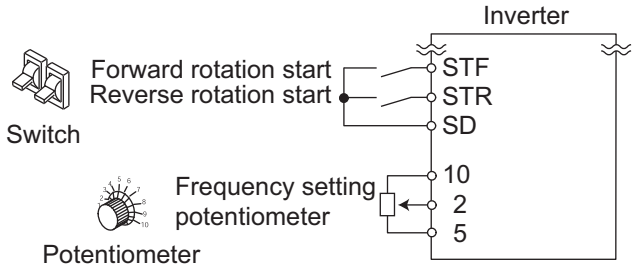
### 3.4.3 Setting the frequency by analog input (voltage input)

**POINT**

- Switch ON the STF (STR) signal to give a start command.
- Use the potentiometer (by connecting terminal 2 and 5 (voltage input)) to give a frequency command.

[Connection diagram]

(The inverter supplies 5V of power to frequency setting potentiometer. (Terminal 10))




Operation example Performing operation at 60Hz.

**Operation**

| | |
|---|---|
| **1.** | Screen at power-ON<br>The monitor display appears. |
| **2.** | Start<br>Turn the start switch (STF or STR) on. [FWD] or [REV] is flickering as no frequency command is given. |
| **3.** | Acceleration → constant speed<br>Turn the potentiometer (frequency setting potentiometer) clockwise slowly to full.<br>The frequency on the indicator increases by the *Pr. 7 Acceleration time*, and "60.00" (60.00Hz) appears.<br>[FWD] indicator is lit during forward rotation, and [REV] indicator is lit during reverse rotation. |
| **4.** | Deceleration<br>Turn the potentiometer (frequency setting potentiometer) counterclockwise slowly to full.<br>The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with " 0.00" (0.00Hz) displayed on the indicator. [FWD] indicator or [REV] indicator flickers. |
| **5.** | Stop<br>Turn the start switch (STF or STR) off. [FWD] indicator or [REV] indicator turns OFF. |

**CAUTION**

When both of STF and STR signals are turned ON, the motor cannot start. If both are turned ON while the motor is running, the motor decelerates to a stop.

**REMARKS**

*Pr. 178 STF terminal function selection* must be set to "60" (or *Pr. 179 STR terminal function selection* must be set to "61").
(all are initial values)

### 3.4.4 Changing the output frequency (60Hz, initial value) at the maximum voltage input (5V, initial value)

**<How to change the maximum frequency>**

Changing example

When you use the 0 to 5VDC input and want to change the frequency at 5V from 60Hz (initial value) to 50Hz, set "50Hz" in *Pr. 125*.

**Operation**

**1.** Selecting the parameter number

Turn ◎ until P. 125 (*Pr. 125*) appears.

Press (SET) to show the present set value. (60.00Hz)

**2.** Changing the maximum frequency

Turn ◎ to change the set value to "50.00". (50.00Hz).

Press (SET) to set. "50.00" and "P. 125" flicker alternately.

**3.** Mode/monitor check

Press (MODE) twice to choose the monitor/frequency monitor.

**4.** Start

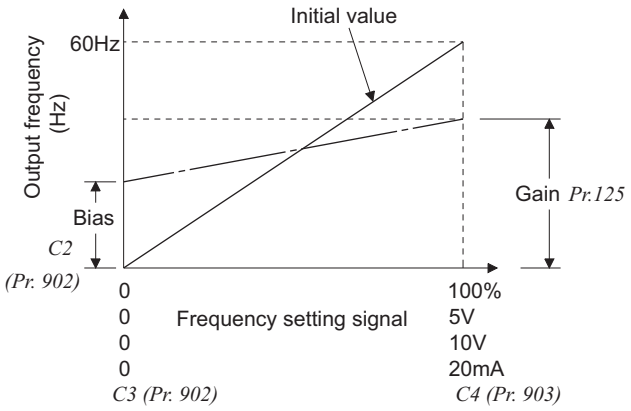
To check the setting, turn the start switch (STF or STR) ON and input 5V (turn the potentiometer clockwise slowly to full.) (Refer to 3.4.3 steps 2 and 3)

? The frequency meter (indicator) connected across terminals FM and SD does not indicate exactly 50Hz ... Why?

☞ The meter can be adjusted by *calibration parameter C0 FM terminal calibration*. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

? Set frequency at 0V using *calibration parameter C2* and adjust the indicator using *calibration parameter C0*.

*(Refer to Chapter 4 of the Instruction Manual (Applied).)*




**REMARKS**

As other adjustment methods of frequency setting voltage gain, there are methods to adjust with a voltage applied across terminals 2 and 5 or adjust at any point without a voltage applied.

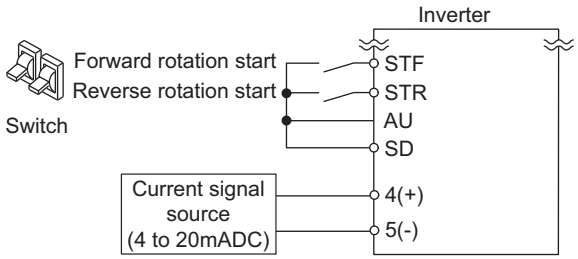
(Refer to *Chapter 4 of the Instruction Manual (Applied)* for the setting method of *calibration parameter C4*.)

### 3.4.5 Setting the frequency by analog input (current input)

**POINT**

- Switch ON the STF (STR) signal to give a start command.
- Turn the AU signal ON.
- Set "2" (External operation mode) in *Pr. 79 Operation mode selection.*

[Connection diagram]




Operation example Performing operation at 60Hz.

**Operation**

| | |
|---|---|
| **1.** | Screen at power-ON<br>The monitor display appears. |
| **2.** | Start<br>Check that the terminal 4 input selection signal (AU) is ON.<br>Turn the start switch (STF or STR) ON. [FWD] or [REV] is flickering as no frequency command is given |
| **3.** | Acceleration → constant speed<br>Perform 20mA input. The frequency on the indicator increases by the *Pr. 7 Acceleration time*, and "60.00" (60.00Hz) appears.<br>[FWD] indicator is lit during forward rotation, and [REV] indicator is lit during reverse rotation. |
| **4.** | Deceleration<br>Input 4mA or less.<br>The frequency on the indicator decreases by the *Pr. 8 Deceleration time*, and the motor stops rotating with " 0.00" (0.00Hz) displayed on the indicator.<br>[FWD] indicator or [REV] indicator flickers. |
| **5.** | Stop<br>Turn the start switch (STF or STR) OFF.<br>[FWD] indicator or [REV] indicator turns OFF. |

**CAUTION**

When both of STF and STR signals are turned ON, the motor cannot start. If both are turned ON while the motor is running, the motor decelerates to a stop.

**REMARKS**

*Pr. 184 AU terminal function selection* must be set to "4" (AU signal) (initial value). *(Refer to Chapter 4 of the Instruction Manual (Applied).)*

### 3.4.6 Changing the output frequency (60Hz, initial value) at the maximum current input (at 20mA, initial value)

**<How to change the maximum frequency?>**

Changing example

When you use the 4 to 20mA input and want to change the frequency at 20mA from 60Hz (initial value) to 50Hz, set "50Hz" in *Pr. 126*.

**Operation**

**1.** Selecting the parameter number

Turn ◎ until P. 126 (*Pr. 126*) appears.

Press (SET) to show the present set value. (60.00Hz)

**2.** Changing the maximum frequency

Turn ◎ to change the set value to "50.00". (50.00Hz)

Press (SET) to set the value. "50.00" and "P. 126" flicker alternately.

**3.** Mode/monitor check

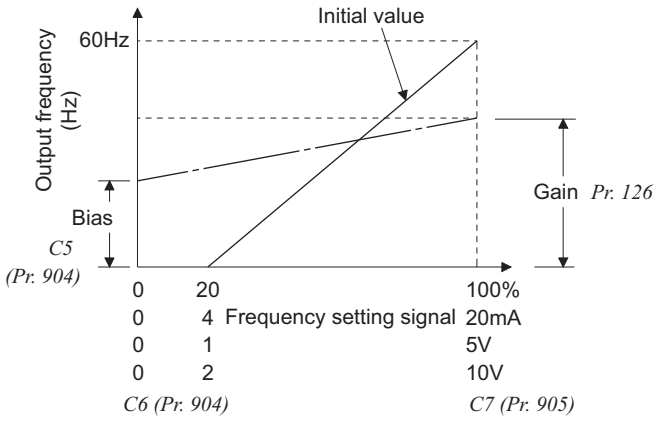
Press (MODE) twice to choose the monitor/frequency monitor.

**4.** Start

To check the setting, turn the start switch (STF or STR) ON and input 20mA. (Refer to 3.4.5 steps 2 and 3)

? Set frequency at 4mA using *calibration parameter C5* and adjust the indicator using *calibration parameter C0*.

*(Refer to Chapter 4 of the Instruction Manual (Applied).)*




**REMARKS**

As other adjustment methods of frequency setting voltage gain, there are methods to adjust with a voltage applied across terminals 4 and 5 or adjust at any point without a voltage applied.

(Refer to *Chapter 4 of the Instruction Manual (Applied)* for the setting method of *calibration parameter C7*.)

# 3.5 Parameter List

· ◎ indicates simple mode parameters.
· "○" indicates enabled and "×" indicates disabled of "parameter copy", "parameter clear", and "all parameter clear".
· "○*" indicates a communication parameter which is not cleared by parameter clear (all clear) from the RS-485 communication. (For the RS-485 communication, refer to *Chapter 4 in the Instruction Manual (Applied)*.)

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Adjusting the output torque (current) of the motor — Manual torque boost (Pr.0, Pr.46, Pr.112)** | | | | | | | | | |
| 0 ◎ | | Torque boost | 0.1% | 6/4/3/2/1% * | 0 to 30% | Set the output voltage at 0Hz as %. | ○ | ○ | ○ |
| | 46 | Second torque boost | 0.1% | 9999 | 0 to 30% | Set the torque boost when the RT signal is on. | ○ | ○ | ○ |
| | | | | | 9999 | Without second torque boost | | | |
| | 112 | Third torque boost | 0.1% | 9999 | 0 to 30% | Set the torque boost when the X9 signal is on. | ○ | ○ | ○ |
| | | | | | 9999 | Without third torque boost | | | |
| * The initial value differs according to the inverter capacity. (0.4K, 0.75K / 1.5K to 3.7K / 5.5K, 7.5K / 11K to 55K / 75K or higher ) | | | | | | | | | |
| **Limiting the output frequency — Maximum/minimum frequency (Pr.1, Pr.2, Pr.18)** | | | | | | | | | |
| 1 ◎ | | Maximum frequency | 0.01Hz | 120/60Hz *1*2 | 0 to 120Hz | Set the upper limit of the output frequency. | ○ | ○ | ○ |
| 2 ◎ | | Minimum frequency | 0.01Hz | 0Hz | 0 to 120Hz | Set the lower limit of the output frequency. | ○ | ○ | ○ |
| | 18 | High speed maximum frequency | 0.01Hz | 120/60Hz *1*2 | 120 to 400Hz *3 | Set when performing the operation at 120Hz or more. | ○ | ○ | ○ |
| *1 The initial value differs according to the inverter capacity. (55K or lower/75K or higher)<br>*2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*)<br>*3 Even if a value higher than the maximum motor frequency (Refer to *page 75*) is set in *Pr. 18* under PM sensorless vector control, the high speed maximum frequency is limited to the maximum motor frequency. | | | | | | | | | |
| **V/F pattern setting — Base frequency and voltage (Pr.3, Pr.19, Pr.47, Pr.113)** | | | | | | | | | |
| 3 ◎ | | Base frequency | 0.01Hz | 60Hz | 0 to 400Hz | Set the frequency when the motor rated torque is generated. (50Hz/60Hz) | ○ | ○ | ○ |
| | 19 | Base frequency voltage | 0.1V | 9999 | 0 to 1000V | Set the base voltage. | ○ | ○ | ○ |
| | | | | | 8888 | 95% of power supply voltage | | | |
| | | | | | 9999 | Same as power supply voltage | | | |
| | 47 | Second V/F (base frequency) | 0.01Hz | 9999 | 0 to 400Hz | Set the base frequency when the RT signal is on. | ○ | ○ | ○ |
| | | | | | 9999 | Second V/F is invalid | | | |
| | 113 | Third V/F (base frequency) | 0.01Hz | 9999 | 0 to 400Hz | Set the base frequency when the X9 signal is ON. | ○ | ○ | ○ |
| | | | | | 9999 | Third V/F is invalid | | | |
| **Frequency setting with terminals (contact input) — Multi-speed setting operation (Pr.4 to Pr.6, Pr.24 to Pr.27, Pr.232 to Pr.239)** | | | | | | | | | |
| 4 ◎ | | Multi-speed setting (high speed) | 0.01Hz | 60Hz * | 0 to 400Hz | Set the frequency which is applied when RH turns ON. | ○ | ○ | ○ |
| 5 ◎ | | Multi-speed setting (middle speed) | 0.01Hz | 30Hz | 0 to 400Hz | Set the frequency which is applied when RM turns ON. | ○ | ○ | ○ |
| 6 ◎ | | Multi-speed setting (low speed) | 0.01Hz | 10Hz | 0 to 400Hz | Set the frequency which is applied when RL turns ON. | ○ | ○ | ○ |
| | 24 to 27 | Multi-speed setting (4 speed to 7 speed) | 0.01Hz | 9999 | 0 to 400Hz, 9999 | Frequency from 4 speed to 15 speed can be set according to the combination of the RH, RM, RL and REX signals.<br>9999: not selected | ○ | ○ | ○ |
| | 232 to 239 | Multi-speed setting (8 speed to 15 speed) | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Acceleration/deceleration time/pattern adjustment — Acceleration/deceleration time setting (Pr.7, Pr.8, Pr.20, Pr.21, Pr.44, Pr.45, Pr.110, Pr.111, Pr.147, Pr.791, Pr.792)** | | | | | | | | | |
| 7 ◎ | | Acceleration time | 0.1/ 0.01s | 5/15s *1 | 0 to 3600/ 360s | Set the motor acceleration time. | ○ | ○ | ○ |
| 8 ◎ | | Deceleration time | 0.1/ 0.01s | 5/15s *1 | 0 to 3600/ 360s | Set the motor deceleration time. | ○ | ○ | ○ |
| | *20* | Acceleration/ deceleration reference frequency | 0.01Hz | 60Hz *2 | 1 to 400Hz | Set the frequency referenced as acceleration/ deceleration time. Set the frequency change time from stop to *Pr. 20* for acceleration/deceleration time. | ○ | ○ | ○ |
| | *21* | Acceleration/ deceleration time increments | 1 | 0 | 0 | Increments: 0.1s Range: 0 to 3600s | The increments and setting range of acceleration/ deceleration time setting can be changed. | ○ | ○ | ○ |
| | | | | | 1 | Increments: 0.01s Range: 0 to 360s | | | | |
| | *44* | Second acceleration/ deceleration time | 0.1/ 0.01s | 5s | 0 to 3600/ 360s | Set the acceleration/deceleration time when the RT signal is on. | ○ | ○ | ○ |
| | *45* | Second deceleration time | 0.1/ 0.01s | 9999 | 0 to 3600/ 360s | Set the deceleration time when the RT signal is on. | ○ | ○ | ○ |
| | | | | | 9999 | Acceleration time = deceleration time | | | |
| | *110* | Third acceleration/ deceleration time | 0.1/ 0.01Hz | 9999 | 0 to 3600/ 360s | Set the acceleration/deceleration time when the X9 signal is on. | ○ | ○ | ○ |
| | | | | | 9999 | Function invalid | | | |
| | *111* | Third deceleration time | 0.1/ 0.01Hz | 9999 | 0 to 3600/ 360s | Set the deceleration time when the X9 signal is on. | ○ | ○ | ○ |
| | | | | | 9999 | Acceleration time = deceleration time | | | |
| | *147* | Acceleration/ deceleration time switching frequency | 0.01Hz | 9999 | 0 to 400Hz | Frequency when automatically switching to the acceleration/deceleration time of *Pr. 44* and *Pr. 45*. | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| | *791* PM | Acceleration time in low-speed range | 0.1/ 0.01s | 9999 | 0 to 3600/ 360s | Set the acceleration time in a low-speed range (less than 1/10 of the rated motor frequency). | ○ | ○ | ○ |
| | | | | | 9999 | The acceleration time set in *Pr.7* is applied. (When the second functions are enabled, the settings are applied.) | | | |
| | *792* PM | Deceleration time in low-speed range | 0.1/ 0.01s | 9999 | 0 to 3600/ 360s | Set the deceleration time in a low-speed range (less than 1/10 of the rated motor frequency). | ○ | ○ | ○ |
| | | | | | 9999 | The deceleration time set in *Pr.8* is applied. (When the second functions are enabled, the settings are applied.) | | | |

*1 The initial value differs according to the inverter capacity. (7.5K or lower/11K or higher)
*2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Selection and protection of a motor — Motor protection from overheat (electronic thermal relay function) (Pr.9, Pr.51)** | | | | | | | | | |
| 9 ◎ | | Electronic thermal O/L relay | 0.01/ 0.1A *1 | Inverter rated current *2 | 0 to 500/ 0 to 3600A *1 | Set the rated motor current. | ○ | ○ | ○ |
| | *51* V/F Magnetic flux Sensorless Vector | Second electronic thermal O/L relay | 0.01/ 0.1A *1 | 9999 | 0 to 500/ 0 to 3600A *1 | Valid when the RT signal is on. Set the rated motor current. | ○ | ○ | ○ |
| | | | | | 9999 | Second electronic thermal O/L relay invalid | | | |

*1 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)
*2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*)

| Parameter (Related parameters) | Name | Incre-ments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| **Motor brake and stop operation — DC injection brake and Pre-excitation (Pr.10 to Pr.12, Pr.802, Pr.850)** | | | | | | | | |
| 10 | DC injection brake operation frequency | 0.01Hz | 3/0.5Hz *1 | 0 to 120Hz | Set the operation frequency of the DC injection brake. | ○ | ○ | ○ |
| | | | | 9999 | Operate when the output frequency becomes less than or equal to *Pr. 13 Starting frequency*. | | | |
| 11 | DC injection brake operation time | 0.1s | 0.5s | 0 | DC injection brake disabled | ○ | ○ | ○ |
| | | | | 0.1 to 10s | Set the operation time of the DC injection brake. | | | |
| | | | | 8888 | Operated while the X13 signal is on. | | | |
| 12 V/F Magnetic flux | DC injection brake operation voltage | 0.1% | 4/2/1% *2 | 0 | DC injection brake disabled | ○ | ○ | ○ |
| | | | | 0.1 to 30% | Set the DC injection brake voltage (torque). | | | |
| *802* Vector P_M | Pre-excitation selection | 1 | 0 | 0 | Zero speed control | ○ | ○ | ○ |
| | | | | 1 | Servo lock | | | |
| *850* Vector | Brake operation selection | 1 | 0 | 0 | DC injection brake | ○ | ○ | ○ |
| | | | | 1 | Zero speed control (under Real sensorless vector control) | | | |
| | | | | 2 | Magnetic flux decay output shutoff (under Real sensorless vector control) | | | |

*1 The initial value changes from 3Hz to 0.5Hz when a control mode other than vector is changed to vector control.
*2 The initial value differs according to the inverter capacity. (7.5K or lower/11K to 55K/75K or higher)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Acceleration/deceleration time/pattern adjustment — Starting frequency (Pr.13, Pr.571)** | | | | | | | | |
| 13 | Starting frequency | 0.01Hz | 0.5Hz * | 0 to 60Hz | Starting frequency can be set. If the set frequency is set higher than the start frequency under PM sensorless vector control, the output starts at 0.01Hz. | ○ | ○ | ○ |
| *571* V/F Magnetic flux Sensorless Vector | Holding time at a start | 0.1s | 9999 | 0.0 to 10.0s | Set the holding time of *Pr. 13 Starting frequency*. | ○ | ○ | ○ |
| | | | | 9999 | Holding function at a start is invalid | | | |

* Performing IPM parameter initialization changes the settings. (Refer to *page 74*)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **V/F pattern setting — V/F pattern suitable for the application (Pr.14)** V/F | | | | | | | | |
| 14 | Load pattern selection | 1 | 0 | 0 | For constant-torque load | ○ | ○ | ○ |
| | | | | 1 | For variable-torque load | | | |
| | | | | 2 | For constant-torque lift — Boost for reverse rotation 0% | | | |
| | | | | 3 | For constant-torque lift — Boost for forward rotation 0% | | | |
| | | | | 4 | RT signal ON.....For constant-torque load (Same as in setting 0)<br>RT signal OFF ..For constant-torque lift Boost for reverse rotation 0% (Same as in setting 2) | | | |
| | | | | 5 | RT signal ON.....For constant-torque load (Same as in setting 0)<br>RT signal OFF ..For constant-torque lift Boost for forward rotation 0% (Same as in setting 3) | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Frequency setting with terminals (contact input) — Jog operation (Pr.15, Pr.16)** | | | | | | | | | |
| 15 | | Jog frequency | 0.01Hz | 5Hz * | 0 to 400Hz | Set the frequency for jog operation. | ○ | ○ | ○ |
| 16 | | Jog acceleration/ deceleration time | 0.1/ 0.01s | 0.5s | 0 to 3600/ 360s | Set the acceleration/deceleration time for jog operation. Set the time taken to reach the frequency set in *Pr. 20 Acceleration/deceleration reference frequency* for acceleration/deceleration time. (Initial value is 60Hz)<br>In addition, acceleration/deceleration time can not be set separately. | ○ | ○ | ○ |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |
| **Function assignment of external terminal and control — Logic selection of the output stop signal (MRS) (Pr.17)** | | | | | | | | | |
| 17 | | MRS input selection | 1 | 0 | 0 | Open input always | ○ | ○ | ○ |
| | | | | | 2 | Normally closed input (NC contact input specifications) | | | |
| | | | | | 4 | External terminal:Normally closed input (NC contact input specifications)<br>Communication :Normally open input | | | |
| 18 | | Refer to *Pr. 1 and Pr. 2*. | | | | | | | |
| 19 | | Refer to *Pr. 3*. | | | | | | | |
| 20, 21 | | Refer to *Pr. 7 and Pr. 8*. | | | | | | | |
| **Adjusting the output torque (current) of the motor — Stall prevention (Pr.22, Pr.23, Pr.48, Pr.49, Pr.66, Pr.114, Pr.115, Pr.148, Pr.149, Pr.154, Pr.156, Pr.157, Pr.858, Pr.868)** V/F Magnetic flux | | | | | | | | | |
| 22 | | Stall prevention operation level | 0.1% | 150% | 0 | Stall prevention operation selection becomes invalid. | ○ | ○ | ○ |
| | | | | | 0.1 to 400% | Function as stall prevention operation under V/F control and Advanced magnetic flux vector control. Set the current value at which stall prevention operation is started.<br>Refer to *page 105* for torque limit level. | | | |
| 23 | | Stall prevention operation level compensation factor at double speed | 0.1% | 9999 | 0 to 200% | The stall operation level can be reduced when operating at a high speed above the rated frequency. | ○ | ○ | ○ |
| | | | | | 9999 | Constant according to *Pr. 22* | | | |
| | *48* | Second stall prevention operation current | 0.1% | 150% | 0 | Second stall prevention operation invalid | ○ | ○ | ○ |
| | | | | | 0.1 to 220% | The stall prevention operation level can be set. | | | |
| | *49* | Second stall prevention operation frequency | 0.01Hz | 0Hz | 0 | Second stall prevention operation invalid | ○ | ○ | ○ |
| | | | | | 0.01 to 400Hz | Set the frequency at which stall prevention operation of *Pr. 48* is started. | | | |
| | | | | | 9999 | *Pr.48* is valid when the RT signal is on. | | | |
| | *66* | Stall prevention operation reduction starting frequency | 0.01Hz | 60Hz | 0 to 400Hz | Set the frequency at which the stall operation level starts being reduced. | ○ | ○ | ○ |
| | *114* | Third stall prevention operation current | 0.1% | 150% | 0 | Third stall prevention operation invalid | ○ | ○ | ○ |
| | | | | | 0.1 to 220% | The stall prevention operation level can be set. | | | |
| | *115* | Third stall prevention operation frequency | 0.01Hz | 0 | 0 | Third stall prevention operation invalid | ○ | ○ | ○ |
| | | | | | 0.01 to 400Hz | Set the frequency at which stall prevention operation of *Pr. 114* is started. | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|---|
| | *148* | Stall prevention level at 0V input | 0.1% | 150% | 0 to 220% | When "4" is set in *Pr. 868* (*Pr. 858*), stall prevention operation level can be changed by the analog signal input to terminal 1 (terminal 4). | | ○ | ○ | ○ |
| | *149* | Stall prevention level at 10V input | 0.1% | 200% | 0 to 220% | | | ○ | ○ | ○ |
| | *154* | Voltage reduction selection during stall prevention operation | 1 | 1 | 0 | With output voltage reduction | You can select whether to use output voltage reduction during stall prevention operation or not. | ○ | ○ | ○ |
| | | | | | 1 | Without output voltage reduction | | | | |
| | | | | | 10 | With output voltage reduction | Use these settings when the overvoltage protective function (E.OV□) activates during stall prevention operation in an application with large load inertia. | | | |
| | | | | | 11 | Without output voltage reduction | | | | |
| | *156* | Stall prevention operation selection | 1 | 0 | 0 to 31, 100, 101 | *Pr. 156* allows you to select whether to use stall prevention or not according to the acceleration/deceleration status. | | ○ | ○ | ○ |
| | *157* | OL signal output timer | 0.1s | 0s | 0 to 25s | Set the output start time of the OL signal output when stall prevention is activated. | | ○ | ○ | ○ |
| | | | | | 9999 | Without the OL signal output | | | | |
| | *858* | Terminal 4 function assignment | Refer to *page 144*. | | | | | | | |
| | *868* | Terminal 1 function assignment | | | | | | | | |

## Speed control — Torque limit level (Pr.22, Pr.157, Pr.803, Pr.810 to Pr.817, Pr.874)

Sensorless Vector PM

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 22 | Torque limit level | 0.1% | 150/200% * | 0 to 400% | This functions as torque limit level under Real sensorless vector control, vector control, PM sensorless vector control. Refer to *page 104* for stall prevention operation level. | | ○ | ○ | ○ |
| | *157* | OL signal output timer | 0.1s | 0s | 0 to 25s | Set the output start time of the OL signal output when torque limit is activated. | | ○ | ○ | ○ |
| | | | | | 9999 | Without the OL signal output | | | | |
| | *803* Sensorless Vector | Constant power range torque characteristic selection | 1 | 0 | 0 | Constant output limit (torque current limit and control) | | ○ | ○ | ○ |
| | | | | | 1 | Constant torque limit (torque limit and control) | | | | |
| | *810* | Torque limit input method selection | 1 | 0 | 0 | Internal torque limit<br>Parameter-set torque limit operation is performed. | | ○ | ○ | ○ |
| | | | | | 1 | External torque limit<br>Torque limit based on the analog input to terminal 1 and 4 | | | | |
| | *811* | Set resolution switchover | 1 | 0 | | **Running speed increments** | **Torque limit increments** | ○ | ○ | ○ |
| | | | | | 0 | 1r/min | 0.1% increments | | | |
| | | | | | 1 | 0.1r/min | | | | |
| | | | | | 10 | 1r/min | 0.01% increments | | | |
| | | | | | 11 | 0.1r/min | | | | |

* For the 3.7K or lower, the initial value changes from 150% to 200% when V/F control or Advanced magnetic flux vector is changed to Real sensorless vector control or vector control.

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| | *812* | Torque limit level (regeneration) | 0.1% | 9999 | 0 to 400% | Set the torque limit level for forward rotation regeneration. | ○ | ○ | ○ |
| | | | | | 9999 | Limit at the value of *Pr. 22* or analog terminal | | | |
| | *813* | Torque limit level (3rd quadrant) | 0.1% | 9999 | 0 to 400% | Set the torque limit level for reverse rotation driving. | ○ | ○ | ○ |
| | | | | | 9999 | Limit at the value of *Pr. 22* or analog terminal | | | |
| | *814* | Torque limit level (4th quadrant) | 0.1% | 9999 | 0 to 400% | Set the torque limit level for reverse rotation regeneration. | ○ | ○ | ○ |
| | | | | | 9999 | Limit at the value of *Pr. 22* or analog terminal | | | |
| | *815* | Torque limit level 2 | 0.1% | 9999 | 0 to 400% | When the torque limit selection (TL) signal is on, the *Pr. 815* value is a torque limit value regardless of *Pr. 810*. | ○ | ○ | ○ |
| | | | | | 9999 | The torque limit set to.*Pr. 810* is active. | | | |
| | *816* | Torque limit level during acceleration | 0.1% | 9999 | 0 to 400% | Set the torque limit value during acceleration. | ○ | ○ | ○ |
| | | | | | 9999 | Same torque limit as at constant speed | | | |
| | *817* | Torque limit level during deceleration | 0.1% | 9999 | 0 to 400% | Set the torque limit value during deceleration. | ○ | ○ | ○ |
| | | | | | 9999 | Same torque limit as at constant speed | | | |
| | *874* | OLT level setting | 0.1% | 150% | 0 to 200% | This function can make an inverter trip if the torque limit is activated to stall the motor. Set the output torque at which an inverter trip is made in *Pr. 874*. | ○ | ○ | ○ |
| 24 to 27 | | Refer to *Pr. 4 to Pr. 6*. | | | | | | | |
| **Frequency setting with terminals (contact input) — Compensation of multi speed and remote setting inputs (Pr.28)** | | | | | | | | | |
| 28 | | Multi-speed input compensation selection | 1 | 0 | 0 | Without compensation | ○ | ○ | ○ |
| | | | | | 1 | With compensation | | | |
| **Acceleration/deceleration time/pattern adjustment — Acceleration/deceleration patterns and backlash measures (Pr.29, Pr.140 to Pr.143, Pr.380 to Pr.383, Pr.516 to Pr.519)** | | | | | | | | | |
| 29 | | Acceleration/ deceleration pattern selection | 1 | 0 | 0 | Linear acceleration/ deceleration | ○ | ○ | ○ |
| | | | | | 1 | S-pattern acceleration/deceleration A | | | |
| | | | | | 2 | S-pattern acceleration/deceleration B | | | |
| | | | | | 3 | Backlash measures | | | |
| | | | | | 4 | S-pattern acceleration/deceleration C | | | |
| | | | | | 5 | S-pattern acceleration/deceleration D | | | |
| | *140* | Backlash acceleration stopping frequency | 0.01Hz | 1Hz | 0 to 400Hz | Set the stopping frequency and time for backlash measures. Valid when *Pr. 29* = "3" | ○ | ○ | ○ |
| | *141* | Backlash acceleration stopping time | 0.1s | 0.5s | 0 to 360s | | ○ | ○ | ○ |
| | *142* | Backlash deceleration stopping frequency | 0.01Hz | 1Hz | 0 to 400Hz | | ○ | ○ | ○ |
| | *143* | Backlash deceleration stopping time | 0.1s | 0.5s | 0 to 360s | | ○ | ○ | ○ |

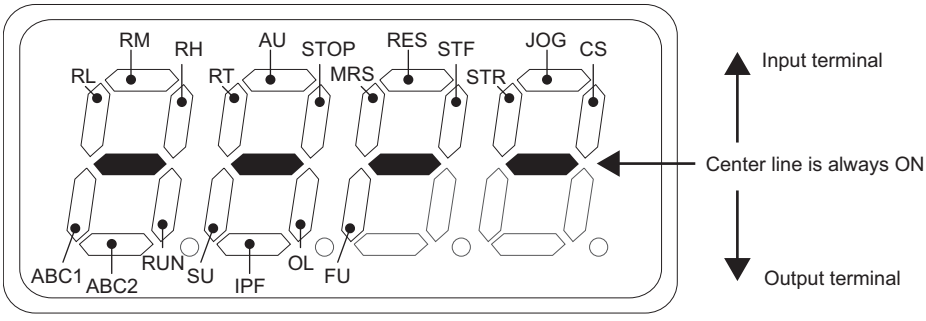
| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| | *380* | Acceleration S-pattern 1 | 1% | 0% | 0 to 50% | Valid when S-pattern acceleration/deceleration C (*Pr. 29* = 4) is set.<br>Set the time taken for S-pattern from starting of acceleration/deceleration to linear acceleration as % to the acceleration/deceleration time (*Pr. 7*, *Pr. 8*, etc.)<br>An acceleration/deceleration pattern can be changed with the X20 signal. | ○ | ○ | ○ |
| | *381* | Deceleration S-pattern 1 | 1% | 0% | 0 to 50% | | ○ | ○ | ○ |
| | *382* | Acceleration S-pattern 2 | 1% | 0% | 0 to 50% | | ○ | ○ | ○ |
| | *383* | Deceleration S-pattern 2 | 1% | 0% | 0 to 50% | | ○ | ○ | ○ |
| | *516* | S-pattern time at a start of acceleration | 0.1s | 0.1s | 0.1 to 2.5s | Valid when S-pattern acceleration/deceleration D (*Pr. 29* = 5) is set.<br>Set the time taken for S-pattern acceleration/deceleration (S-pattern operation). | ○ | ○ | ○ |
| | *517* | S-pattern time at a completion of acceleration | 0.1s | 0.1s | 0.1 to 2.5s | | ○ | ○ | ○ |
| | *518* | S-pattern time at a start of deceleration | 0.1s | 0.1s | 0.1 to 2.5s | | ○ | ○ | ○ |
| | *519* | S-pattern time at a completion of deceleration | 0.1s | 0.1s | 0.1 to 2.5s | | ○ | ○ | ○ |
| **Motor brake and stop operation — Regeneration unit selection (Pr.30, Pr.70)** | | | | | | | | | |
| | 30 | Regenerative function selection | 1 | 0 | 0 | Built-in brake, brake unit (FR-BU2 *1, FR-BU, BU) | ○ | ○ | ○ |
| | | | | | 1 | High-duty brake resistor (FR-ABR), Brake unit (FR-BU2 *2, MT-BU5), Power regeneration converter (MT-RC) | | | |
| | | | | | 2 | High power factor converter (FR-HC2), Power regeneration common converter (FR-CV) | | | |
| | | | | | 10 | Built-in brake unit, brake unit (FR-BU2 *1, FR-BU, BU) — DC feeding mode 1 (operated by DC feeding only) | | | |
| | | | | | 11 | High-duty brake resistor (FR-ABR), brake unit (FR-BU2 *2, MT-BU5) — DC feeding mode 1 (operated by DC feeding only) | | | |
| | | | | | 20 | Built-in brake unit, brake unit (FR-BU2 *1, FR-BU, BU) — DC feeding mode 2 (operated by switching between AC and DC) | | | |
| | | | | | 21 | High-duty brake resistor (FR-ABR), brake unit (FR-BU2 *2, MT-BU5) — DC feeding mode 2 (operated by switching between AC and DC) | | | |
| | *70* | Special regenerative brake duty | 0.1% | 0% | 0 to 30/ 0 to 10% *3 | Set this parameter when a brake unit or power regeneration converter is used. | ○ | ○ | ○ |
| **Limiting the output frequency — Avoiding the mechanic resonance points (frequency jump) (Pr.31 to Pr.36)** | | | | | | | | | |
| | 31 | Frequency jump 1A | 0.01Hz | 9999 | 0 to 400Hz, 9999 | 1A to 1B, 2A to 2B, 3A to 3B is frequency jumps<br>9999: Function invalid | ○ | ○ | ○ |
| | 32 | Frequency jump 1B | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| | 33 | Frequency jump 2A | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| | 34 | Frequency jump 2B | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| | 35 | Frequency jump 3A | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| | 36 | Frequency jump 3B | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |

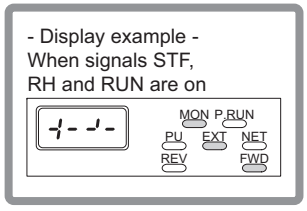
*1 Used in combination with GZG, GRZG, or FR-BR.
*2 Used in combination with MT-BR5.
*3 Range differ according to the inverter capacity. (55K or lower/75K or higher)

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Monitor display and monitor output signal — Speed display and speed setting (Pr.37, Pr.144, Pr.505, Pr.811)** | | | | | | | | | |
| 37 | | Speed display | 1 | 0 | 0 | Frequency display, setting | ○ | ○ | ○ |
| | | | | | 1 to 9998 | Set the machine speed for *Pr.505* Set frequency. | | | |
| | *144* | Speed setting switchover | 1 | 4 * | 0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110 | Set the number of motor poles when displaying the motor speed. A setting value is automatically changed depending on the *Pr.81* setting. | ○ | ○ | ○ |
| | *505* | Speed setting reference | 0.01Hz | 60Hz * | 1 to 400Hz | Set the frequency that will be the basis of machine speed display. | ○ | ○ | ○ |
| | *811* | Easy gain tuning response level setting | 1 | 0 | | **Running speed increments** / **Torque limit increments** | ○ | ○ | ○ |
| | | | | | 0 | 1r/min / 0.1% increments | | | |
| | | | | | 1 | 0.1r/min | | | |
| | | | | | 10 | 1r/min / 0.01% increments | | | |
| | | | | | 11 | 0.1r/min | | | |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |
| **Detection of output frequency, current, and torque — Detection of output frequency and motor rotations per minute (SU, FU, FU2, FU3, FB, FB2, FB3 and LS signals) (Pr.41 to Pr.43, Pr.50, Pr.116, Pr.865, Pr.870)** | | | | | | | | | |
| 41 | | Up-to-frequency sensitivity | 0.1% | 10% | 0 to 100% | Set the level where the SU signal turns on. | ○ | ○ | ○ |
| 42 | | Output frequency detection | 0.01Hz | 6Hz | 0 to 400Hz | Set the frequency where the FU (FB) signal turns on. | ○ | ○ | ○ |
| 43 | | Output frequency detection for reverse rotation | 0.01Hz | 9999 | 0 to 400Hz | Set the frequency where the FU (FB) signal turns on in reverse rotation. | ○ | ○ | ○ |
| | | | | | 9999 | Same as *Pr. 42* setting | | | |
| | *50* | Second output frequency detection | 0.01Hz | 30Hz | 0 to 400Hz | Set the frequency where the FU2 (FB2) signal turns on. | ○ | ○ | ○ |
| | *116* | Third output frequency detection | 0.01Hz | 60Hz | 0 to 400Hz | Set the frequency where the FU3 (FB3) signal turns on. | ○ | ○ | ○ |
| | *865* | Low speed detection | 0.01Hz | 1.5Hz | 0 to 400Hz | Set the frequency where the LS signal turns on. | ○ | ○ | ○ |
| | *870* | Speed detection hysteresis | 0.01Hz | 0Hz * | 0 to 5Hz | Set the hysteresis width for the detected frequency. | ○ | ○ | ○ |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |
| 44, 45 | | Refer to *Pr. 7 and Pr. 8*. | | | | | | | |
| 46 | | Refer to *Pr. 0*. | | | | | | | |
| 47 | | Refer to *Pr. 3*. | | | | | | | |
| 48, 49 | | Refer to *Pr. 22 and Pr. 23*. | | | | | | | |
| 50 | | Refer to *Pr. 41 to Pr. 43*. | | | | | | | |
| 51 | | Refer to *Pr. 9*. | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Monitor display and monitor output signal — Changing DU/PU monitored items and clearing cumulative monitors (Pr.52, Pr.54, Pr.158, Pr.170, Pr.171, Pr.268, Pr.563, Pr.564, Pr.867 Pr.891)** | | | | | | | | | |
| 52 | | DU/PU main display data selection | 1 | 0 | 0, 5 to 14, 17 to 20, 22 to 25, 32 to 35, 39, 46, 50 to 57, 100 | Select monitor to be displayed on the operation panel and parameter unit and monitor to be output to the terminal FM and AM.<br>0 : Output frequency *(Pr. 52)*<br>1 : Output frequency *(Pr. 54, Pr. 158)*<br>2 : Output current *(Pr. 54, Pr. 158)*<br>3 : Output voltage *(Pr. 54, Pr. 158)*<br>5 : Frequency setting value<br>6 : Running speed<br>7 : Motor torque<br>8 : Converter output voltage<br>9 : Regenerative brake duty<br>10 : Electronic thermal relay function load factor<br>11 : Output current peak value<br>12 : Converter output voltage peak value<br>13 : Input power<br>14 : Output power<br>17 : Load meter<br>18 : Motor excitation current<br>19 : Position pulse *(Pr. 52)* *1<br>20 : Cumulative energization time *(Pr. 52)*<br>21 : Reference voltage output *(Pr. 54, Pr. 158)*<br>22 : Orientation status *(Pr. 52)* *1<br>23 : Actual operation time *(Pr. 52)*<br>24 : Motor load factor<br>25 : Cumulative power *(Pr. 52)*<br>32 : Torque command<br>33 : Torque current command<br>34 : Motor output<br>35 : Feedback pulse *1 *(Pr. 52)*<br>39 : SSCNET III communication status *2<br>46 : Motor temperature *3<br>50 : Power saving effect<br>51 : Cumulative saving power *(Pr. 52)*<br>52 : PID set point<br>53 : PID measured value<br>54 : PID deviation (*Pr. 52*)<br>55 : Input/output terminal status *(Pr. 52)* *4<br>56 : Option input terminal status *(Pr. 52)*<br>57 : Option output terminal status *(Pr. 52)*<br>100 : Set frequency is displayed during a stop and output frequency is displayed during operation *(Pr. 52)* | ○ | ○ | ○ |
| | 54 | FM terminal function selection | 1 | 1 | 1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 46, 50, 52, 53 | | ○ | ○ | ○ |
| | *158* | AM terminal function selection | 1 | 1 | 1 to 3, 5 to 14, 17, 18, 21, 24, 32 to 34, 46, 50, 52, 53 | | ○ | ○ | ○ |

*1 Available only when FR-A7AP/FR-A7AL is mounted.
*2 Available only when FR-A7NS is mounted.
*3 Available only when FR-A7AZ is mounted and SFV5RU□□□□□T/A is used.
*4 On the unit I/O terminal monitor (*Pr. 52* = "55"), the upper LEDs denote the input terminal states and the lower the output terminal states.



| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| | 170 | Watt-hour meter clear | 1 | 9999 | 0 | Set "0" to clear the watt-hour meter monitor. | ○ | × | ○ |
| | | | | | 10 | Sets the maximum value for the monitoring from communication to 9999kWh. | | | |
| | | | | | 9999 | Sets the maximum value for the monitoring from communication to 65535kWh. | | | |
| | 171 | Operation hour meter clear | 1 | 9999 | 0, 9999 | Set "0" to clear the operation time monitor.<br>Setting "9999" has no effect. | × | × | × |
| | 268 | Monitor decimal digits selection | 1 | 9999 | 0 | Displays the monitor as integral value. | ○ | ○ | ○ |
| | | | | | 1 | Displays the monitor in increments of 0.1. | | | |
| | | | | | 9999 | No fixed decimal position | | | |
| | 563 | Energization time carrying-over times | 1 | 0 | (0 to 65535) | The numbers of cumulative energization time monitor exceeded 65535h is displayed.<br>Reading only | × | × | × |
| | 564 | Operating time carrying-over times | 1 | 0 | (0 to 65535) | The numbers of operation time monitor exceeded 65535h is displayed.<br>Reading only | × | × | × |
| | 867 | AM output filter | 0.01s | 0.01s | 0 to 5s | Set the output filter of terminal AM. | ○ | ○ | ○ |
| | 891 | Cumulative power monitor digit shifted times | 1 | 9999 | 0 to 4 | Set the number of times to shift the cumulative power monitor digit.<br>Clamps the monitor value at maximum. | ○ | ○ | ○ |
| | | | | | 9999 | No shift<br>Clears the monitor value when it exceeds the maximum value. | | | |
| **Monitor display and monitor output signal — Reference for monitor value output from terminal FM or AM (Pr.55, Pr.56, Pr.866)** | | | | | | | | | |
| 55 | | Frequency monitoring reference | 0.01Hz | 60Hz *1 | 0 to 400Hz | Set the full-scale value to output the output frequency monitor value to terminal FM and AM. | ○ | ○ | ○ |
| 56 | | Current monitoring reference | 0.01/ 0.1A *2 | Inverter rated current *1 | 0 to 500/ 0 to 3600A *2 | Set the full-scale value to output the output current monitor value to terminal FM and AM. | ○ | ○ | ○ |
| | 866 Magnetic flux Sensorless Vector PM | Torque monitoring reference | 0.1% | 150% | 0 to 400% | Set the full-scale value to output the torque monitor value to terminal FM and AM. | ○ | ○ | ○ |
| *1 Performing IPM parameter initialization changes the settings. (Refer to *page 74*)<br>*2 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher) | | | | | | | | | |
| **Operation selection at power failure and instantaneous power failure — Automatic restart after instantaneous power failure/flying start (Pr.57, Pr.58, Pr.162 to Pr.165, Pr.299, Pr.611)** | | | | | | | | | |
| 57 | | Restart coasting time | 0.1s | 9999 | 0 | **Induction motor control**: The coasting time is as follows:<br>1.5K or lower... 0.5s,<br>2.2K to 7.5K .... 1.0s,<br>11K to 55K..... 3.0s,<br>75K or higher .. 5.0s<br>**PM sensorless vector control**: No waiting time | ○ | ○ | ○ |
| | | | | | 0.1 to 5s/ 0.1 to 30s * | Set the waiting time for inverter-triggered restart after an instantaneous power failure. | | | |
| | | | | | 9999 | No restart | | | |
| 58 V/F Magnetic flux | | Restart cushion time | 0.1s | 1s | 0 to 60s | Set a voltage starting time at restart. | ○ | ○ | ○ |
| * The setting range differs according to the inverter capacity (55K or lower/75K or higher) | | | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| | 162 | Automatic restart after instantaneous power failure selection | 1 | 0 | 0 | Frequency search only performed at the first start | ○ | ○ | ○ |
| | | | | | 1 | Reduced voltage start only performed at the first start (no frequency search) *1 | | | |
| | | | | | 2 | Encoder detection frequency search | | | |
| | | | | | 10 | Frequency search at every start | | | |
| | | | | | 11 | Reduced voltage system at every start (no frequency search) *1 | | | |
| | | | | | 12 | Encoder detection frequency search at every start | | | |
| | 163 V/F Magnetic flux | First cushion time for restart | 0.1s | 0s | 0 to 20s | Set a voltage starting time at restart. Consider according to the magnitude of load (inertia moment/torque). | ○ | ○ | ○ |
| | 164 V/F Magnetic flux | First cushion voltage for restart | 0.1% | 0% | 0 to 100% | | ○ | ○ | ○ |
| | 165 V/F Magnetic flux | Stall prevention operation level for restart | 0.1% | 150% | 0 to 220% | Consider the rated inverter current as 100% and set the stall prevention operation level during restart operation. | ○ | ○ | ○ |
| | 299 V/F Magnetic flux Sensorless | Rotation direction detection selection at restarting | 1 | 0 | 0 | Without rotation direction detection | ○ | ○ | ○ |
| | | | | | 1 | With rotation direction detection | | | |
| | | | | | 9999 | When *Pr. 78* = "0", the rotation direction is detected. When *Pr. 78* = "1", "2", the rotation direction is not detected. | | | |
| | 611 | Acceleration time at a restart | 0.1s | 5/15s *2 | 0 to 3600s | Set the acceleration time to reach *Pr.20 Acceleration/deceleration reference frequency* at a restart. | ○ | ○ | ○ |
| | | | | | 9999 | Acceleration time for restart is the normal acceleration time (e.g. *Pr. 7* ). | | | |

*1 The frequency search is available during PM sensorless vector control.
*2 The initial value according to the inverter capacity (55K or lower/75K or higher)

**Frequency setting with terminals (contact input) — Remote setting function (Pr.59)**

| | | | | | RH, RM, RL signal function | Frequency setting storage function | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59 | Remote function selection | 1 | 0 | 0 | Multi-speed setting | — | ○ | ○ | ○ |
| | | | | 1 | Remote setting | Yes | | | |
| | | | | 2 | Remote setting | No | | | |
| | | | | 3 | Remote setting | No (Turning STF/STR off clears remotely- set frequency.) | | | |

**Energy saving operation — Energy saving control selection (Pr.60)** V/F

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 60 | Energy saving control selection | 1 | 0 | 0 | Normal operation mode | | ○ | ○ | ○ |
| | | | | 4 | Energy saving operation mode | | | | |

**Acceleration/deceleration time/pattern adjustment — Automatic acceleration/deceleration (Pr.61 to Pr.64, Pr.292, Pr.293)** V/F Magnetic flux Sensorless Vector

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 61 | Reference current | 0.01/ 0.1A * | 9999 | 0 to 500/ 0 to 3600A * | Setting value (rated motor current) is referenced | | ○ | ○ | ○ |
| | | | | 9999 | Rated inverter current is referenced | | | | |

* The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| 62 | Reference value at acceleration | 0.1% | 9999 | 0 to 220% | Setting value is a limit value | Shortest acceleration/ deceleration mode | ○ | ○ | ○ |
| | | | | | Setting value is an optimum value | Optimum acceleration/ deceleration mode | | | |
| | | | | 9999 | 150% is a limit value | Shortest acceleration/ deceleration mode | | | |
| | | | | | 100% is an optimum value | Optimum acceleration/ deceleration mode | | | |
| 63 | Reference value at deceleration | 0.1% | 9999 | 0 to 220% | Setting value is a limit value | Shortest acceleration/ deceleration mode | ○ | ○ | ○ |
| | | | | | Setting value is an optimum value | Optimum acceleration/ deceleration mode | | | |
| | | | | 9999 | 150% is a limit value | Shortest acceleration/ deceleration mode | | | |
| | | | | | 100% is an optimum value | Optimum acceleration/ deceleration mode | | | |
| 64 | Starting frequency for elevator mode | 0.01Hz | 9999 | 0 to 10Hz | 0 to 10Hz are starting frequency | | ○ | ○ | ○ |
| | | | | 9999 | 2Hz is starting frequency | | | | |
| *292* Magnetic flux Sensorless Vector | Automatic acceleration/ deceleration | 1 | 0 | 0 | Normal operation mode | | ○ | ○ | ○ |
| | | | | 1 | Shortest acceleration/ deceleration mode | Without brake | | | |
| | | | | 11 | | With brake | | | |
| | | | | 3 | Optimum acceleration/deceleration mode | | | | |
| | | | | 5 | Elevator mode 1 | | | | |
| | | | | 6 | Elevator mode 2 | | | | |
| | | | | 7 | Brake sequence mode 1 | Disabled when the second or third function is selected | | | |
| | | | | 8 | Brake sequence mode 2 | | | | |
| | | | | 17 | Brake sequence mode 1 | Enabled even if the second or third function is selected | | | |
| | | | | 18 | Brake sequence mode 2 | | | | |
| *293* Magnetic flux Sensorless Vector | Acceleration/ deceleration separate selection | 1 | 0 | 0 | Calculate acceleration/deceleration time of both acceleration and deceleration for the shortest and optimum acceleration/deceleration mode. | | ○ | ○ | ○ |
| | | | | 1 | Calculate only acceleration time for the shortest and optimum acceleration/deceleration mode | | | | |
| | | | | 2 | Calculate only deceleration time for the shortest and optimum acceleration/deceleration mode | | | | |
| **Operation setting at fault occurrence — Retry at fault occurrence (Pr.65, Pr.67 to Pr.69)** | | | | | | | | | |
| 65 | Retry selection | 1 | 0 | 0 to 5 | A fault for retry can be selected. | | ○ | ○ | ○ |
| *67* | Number of retries at fault occurrence | 1 | 0 | 0 | No retry function | | ○ | ○ | ○ |
| | | | | 1 to 10 | Set the number of retries at fault occurrence. A fault output is not provided during retry operation. | | | | |
| | | | | 101 to 110 | Set the number of retries at fault occurrence. (The setting value minus 100 is the number of retries.) A fault output is provided during retry operation. | | | | |
| *68* | Retry waiting time | 0.1s | 1s | 0 to 10s | Set the waiting time from when an inverter fault occurs until a retry is made. | | ○ | ○ | ○ |
| *69* | Retry count display erase | 1 | 0 | 0 | Clear the number of restarts succeeded by retry. | | ○ | ○ | ○ |
| 66 | Refer to *Pr. 22 and Pr. 23*. | | | | | | | | |
| 67 to 69 | Refer to *Pr. 65*. | | | | | | | | |
| 70 | Refer to *Pr. 30*. | | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|---|
| **Selection and protection of a motor — Motor selection (applied motor) (Pr.71, Pr.450)** | | | | | | | | | | |
| 71 | | Applied motor | 1 | 0 *1 | 0 | Thermal characteristics of a standard motor | | ○ | ○ | ○ |
| | | | | | 1 | Thermal characteristics of the Mitsubishi constant-torque motor | | | | |
| | | | | | 2 | Thermal characteristic of standard motor Adjustable 5 points V/F | | | | |
| | | | | | 20 | Mitsubishi standard motor (SF-JR 4P 1.5kW or lower) | | | | |
| | | | | | 30 | Thermal characteristics of the Mitsubishi vector motor SF-V5RU (1500r/min series) | | | | |
| | | | | | 40 | Thermal characteristic of Mitsubishi high efficiency motor (SF-HR) | | | | |
| | | | | | 50 | Thermal characteristic of Mitsubishi constant-torque motor (SF-HRCA) | | | | |
| | | | | | 330 *2 | IPM motor MM-CF | | | | |
| | | | | | 3 | Standard motor | Select "offline auto tuning setting" | | | |
| | | | | | 13 | Constant-torque motor Mitsubishi vector motor SF-V5RU (except for 1500 r/min series) | | | | |
| | | | | | 23 | Mitsubishi standard motor (SF-JR 4P 1.5kW or lower) | | | | |
| | | | | | 33 | Mitsubishi vector motor SF-V5RU (1500r/min series), SF-THY | | | | |
| | | | | | 43 | Mitsubishi high efficiency motor (SF-HR) | | | | |
| | | | | | 53 | Mitsubishi constant-torque motor (SF-HRCA) | | | | |
| | | | | | 333 *2 | IPM motor MM-CF | | | | |
| | | | | | 8093 | IPM motor (other than MM-CF) | | | | |
| | | | | | 4 | Standard motor | Auto tuning data can be read, changed, and set. | | | |
| | | | | | 14 | Constant-torque motor Mitsubishi vector motor SF-V5RU (except for 1500 r/min series) | | | | |
| | | | | | 24 | Mitsubishi standard motor (SF-JR 4P 1.5kW or lower) | | | | |
| | | | | | 34 | Mitsubishi vector motor SF-V5RU (1500r/min series), SF-THY | | | | |
| | | | | | 44 | Mitsubishi high efficiency motor (SF-HR) | | | | |
| | | | | | 54 | Mitsubishi constant-torque motor (SF-HRCA) | | | | |
| | | | | | 334 *2 | IPM motor MM-CF | | | | |
| | | | | | 8094 | IPM motor (other than MM-CF) | | | | |
| | | | | | 5 | Standard motor | Star connection Direct input of motor constants is enabled | | | |
| | | | | | 15 | Constant-torque motor | | | | |
| | | | | | 6 | Standard motor | Delta connection Direct input of motor constants is enabled | | | |
| | | | | | 16 | Constant-torque motor | | | | |
| | | | | | 7 | Standard motor | Star connection Motor constants direct input +Offline auto tuning | | | |
| | | | | | 17 | Constant-torque motor | | | | |
| | | | | | 8 | Standard motor | Delta connection Motor constants direct input +Offline auto tuning | | | |
| | | | | | 18 | Constant-torque motor | | | | |
| | *450* | Second applied motor | 1 | 9999 | 0 to 8, 13 to 18, 20, 23, 24, 30, 33, 34, 40, 43, 44, 50, 53, 54 | Set when using the second motor. (same specifications as *Pr. 71*) | | ○ | ○ | ○ |
| | | | | | 9999 | Second motor is invalid | | | | |

*1 Performing IPM parameter initialization changes the settings. (Refer to *page 74*)
*2 The setting is available for the FR-A720-11K or lower.

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|---|
| **Reduction of the motor noise, measures against noise and leakage current — Carrier frequency and Soft-PWM selection (Pr.72, Pr.240)** | | | | | | | | | | |
| 72 | | PWM frequency selection | 1 | 2 | 0 to 15/ 0 to 6, 25 *1 | PWM carrier frequency can be changed. | | ○ | ○ | ○ |
| | | | | | | The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz, 15 indicates 14.5kHz, and 25 indicates 2.5kHz. (The setting value "25" is for the sine wave filter.) | V/F control, Advanced magnetic flux vector control | | | |
| | | | | | | 0 to 5: 2kHz 6 to 9: 6kHz, 10 to 13: 10kHz 14, 15: 14kHz | Real sensorless vector control, vector control, PM sensorless vector control (current synchronization operation) | | | |
| | | | | | | 0 to 9: 6kHz, 10 to 13: 10kHz 14, 15: 14kHz | PM sensorless vector control (high frequency superposition control) | | | |
| | 240 | Soft-PWM operation selection | 1 | 1 *2 | 0 | Soft-PWM invalid | | ○ | ○ | ○ |
| | | | | | 1 | When *Pr. 72* = "0 to 5" ("0 to 4" for the 75K or higher), Soft-PWM is valid. Invalid during PM sensorless vector control (high frequency superposition control). | | | | |
| *1 The setting range differs according to the inverter capacity. (55K or lower/75K or higher) *2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | | |
| **Frequency and torque setting by analog input — Analog input selection, override function, analog input compensation (Pr.73, Pr.242, Pr.243, Pr.252, Pr.253, Pr.267)** | | | | | | | | | | |
| 73 | | Analog input selection | 1 | 1 | 0 to 7, 10 to 17 | You can select the input specifications of terminal 2 (0 to 5V, 0 to 10V, 0 to 20mA) and input specifications of terminal 1 (0 to ±5V, 0 to ±10V). To change the terminal 2 to the voltage input specification (0 to 5V/ 0 to 10V), turn OFF (initial status) the voltage/current input switch 2. To change it to the current input (0 to 20mA), turn ON the voltage/current input switch 2. Override and reversible operation can be selected. | | ○ | × | ○ |
| | 242 | Terminal 1 added compensation amount (terminal 2) | 0.1% | 100% | 0 to 100% | Set the ratio of added compensation amount when terminal 2 is the main speed. | | ○ | ○ | ○ |
| | 243 | Terminal 1 added compensation amount (terminal 4) | 0.1% | 75% | 0 to 100% | Set the ratio of added compensation amount when terminal 4 is the main speed. | | ○ | ○ | ○ |
| | 252 | Override bias | 0.1% | 50% | 0 to 200% | Set the bias side compensation value of override function. | | ○ | ○ | ○ |
| | 253 | Override gain | 0.1% | 150% | 0 to 200% | Set the gain side compensation value of override function. | | ○ | ○ | ○ |
| | 267 | Terminal 4 input selection | 1 | 0 | 0 | Terminal 4 input 4 to 20mA | Turn ON the voltage/ current input switch 1(initial status). | ○ | × | ○ |
| | | | | | 1 | Terminal 4 input 0 to 5V | Turn OFF the voltage/ current input switch 1. | | | |
| | | | | | 2 | Terminal 4 input 0 to 10V | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Frequency and torque setting by analog input — Response level of analog input and noise elimination (Pr.74, Pr.822, Pr.826, Pr.832, Pr.836, Pr.849)** | | | | | | | | | |
| 74 | | Input filter time constant | 1 | 1 | 0 to 8 | The primary delay filter time constant for the analog input can be set.<br>A larger setting results in slower response. | ○ | ○ | ○ |
| | *822* Sensorless Vector P M | Speed setting filter 1 | 0.001s | 9999 | 0 to 5s, 9999 | Set the time constant of the primary delay filter relative to the external speed command (analog input command). | ○ | ○ | ○ |
| | *826* Sensorless Vector | Torque setting filter 1 | 0.001s | 9999 | 0 to 5s, 9999 | Set the time constant of the primary delay filter relative to the external torque command (analog input command). | ○ | ○ | ○ |
| | *832* Sensorless Vector P M | Speed setting filter 2 | 0.001s | 9999 | 0 to 5s, 9999 | Second function of *Pr. 822* (valid when the RT terminal is on) | ○ | ○ | ○ |
| | *836* Sensorless Vector | Torque setting filter 2 | 0.001s | 9999 | 0 to 5s, 9999 | Second function of *Pr. 826* (valid when the RT terminal is on) | ○ | ○ | ○ |
| | *849* | Analog input offset adjustment | 0.1% | 100% | 0 to 200% | This function provides speed command by analog input (terminal 2) with offset and avoids frequency command to be given due to noise under 0 speed command. | ○ | ○ | ○ |
| **Misoperation prevention and parameter setting restriction — Reset selection and disconnected PU detection (Pr.75)** | | | | | | | | | |
| 75 | | Reset selection/ disconnected PU detection/PU stop selection | 1 | 14 | 0 to 3, 14 to 17 | You can select the reset input acceptance, disconnected PU (FR-DU07/FR-PU07/FR-PU04) connector detection function and PU stop function. For the initial value, reset always enabled, without disconnected PU detection, and with PU stop function are set. | ○ | × | × |
| **Operation setting at fault occurrence — Output function of fault code (Pr.76)** | | | | | | | | | |
| 76 | | Fault code output selection | 1 | 0 | 0 | Without fault code output | ○ | ○ | ○ |
| | | | | | 1 | With fault code output | | | |
| | | | | | 2 | Fault code output at fault occurrence only | | | |
| **Misoperation prevention and parameter setting restriction — Prevention of parameter rewrite (Pr.77)** | | | | | | | | | |
| 77 | | Parameter write selection | 1 | 0 | 0 | Write is enabled only during a stop | ○ | ○ | ○ |
| | | | | | 1 | Parameter write is disabled. | | | |
| | | | | | 2 | Parameter write is enabled in any operation mode regardless of operating status. | | | |
| **Misoperation prevention and parameter setting restriction — Reverse motor rotation prevention (Pr.78)** | | | | | | | | | |
| 78 | | Reverse rotation prevention selection | 1 | 0 | 0 | Both forward and reverse rotations allowed | ○ | ○ | ○ |
| | | | | | 1 | Reverse rotation disallowed | | | |
| | | | | | 2 | Forward rotation disallowed | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Selection of operation mode and command source — Operation mode selection (Pr.79) Selection of operation mode and command source — Operation mode at power-ON (Pr.79, Pr.340)** | | | | | | | | | |
| 79 ◎ | | Operation mode selection | 1 | 0 | 0 | External/PU switchover mode | ○ | ○ | ○ |
| | | | | | 1 | Fixed to PU operation mode | | | |
| | | | | | 2 | Fixed to External operation mode | | | |
| | | | | | 3 | External/PU combined operation mode 1 | | | |
| | | | | | 4 | External/PU combined operation mode 2 | | | |
| | | | | | 6 | Switchover mode | | | |
| | | | | | 7 | External operation mode (PU operation interlock) | | | |
| | *340* | Communication startup mode selection | 1 | 0 | 0 | As set in *Pr. 79*. | ○ | ○* | ○* |
| | | | | | 1, 2 | Started in the Network operation mode. When the setting is "2", it will resume the pre-instantaneous power failure operation mode after an instantaneous power failure occurs. | | | |
| | | | | | 10, 12 | Started in the Network operation mode. Operation mode can be changed between the PU operation mode and Network operation mode from the operation panel. When the setting is "12", it will resume the pre-instantaneous power failure operation mode after an instantaneous power failure occurs. | | | |
| **Control mode — Selection of control method (Pr.80, Pr.81, Pr.89, Pr.451, Pr.453, Pr.454, Pr.569, Pr.800)** Magnetic flux Sensorless Vector P M | | | | | | | | | |
| 80 | | Motor capacity | 0.01/ 0.1kW *1 | 9999 *2 | 0.4 to 55/ 0 to 3600kW *1 | Set the applied motor capacity. | ○ | ○ | ○ |
| | | | | | 9999 | V/F control is performed | | | |
| 81 | | Number of motor poles | 1 | 9999 *2 | 2, 4, 6, 8, 10 | Set the number of motor poles. | ○ | ○ | ○ |
| | | | | | 12, 14, 16, 18, 20 | X18 signal-ON:V/F control — Set 10 + number of motor poles. | | | |
| | | | | | 9999 | V/F control is performed | | | |
| | *89* Magnetic flux | Speed control gain (Advanced magnetic flux vector) | 0.1% | 9999 | 0 to 200% | Motor speed fluctuation due to load fluctuation is adjusted during Advanced magnetic flux vector control. 100% is a referenced value. | ○ | × | ○ |
| | | | | | 9999 | Gain matching with the motor set in *Pr.71*. | | | |
| | *451* Magnetic flux Sensorless | Second motor control method selection | 1 | 9999 | 10, 11, 12 | Select the method of controlling the second motor. (same as *Pr.800*) | ○ | ○ | ○ |
| | | | | | 20, 9999 | V/F Control (Advanced magnetic flux vector control) | | | |
| | *453* Magnetic flux Sensorless | Second motor capacity | 0.01/ 0.1kW *1 | 9999 | 0.4 to 55/ 0 to 3600kW *1 | Set the capacity of the second motor. | ○ | ○ | ○ |
| | | | | | 9999 | V/F control is performed | | | |
| | *454* Magnetic flux Sensorless | Number of second motor poles | 1 | 9999 | 2, 4, 6, 8, 10 | Set the number of poles of the second motor. | ○ | ○ | ○ |
| | | | | | 9999 | V/F control is performed | | | |

*1 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)
*2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*)

| Parameter (Related parameters) | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 569 (Magnetic flux) | Second motor speed control gain | 0.1% | 9999 | 0 to 200% | Second motor speed fluctuation due to load fluctuation is adjusted during Advanced magnetic flux vector control.<br>100% is a referenced value. | ○ | × | ○ |
| | | | | 9999 | Gain matching with the motor set in *Pr.450*. | | | |
| 800 | Control method selection | 1 | 20 | 0 | Speed control — Vector control (FR-A7AP/FR-A7AL) | ○ | ○ | ○ |
| | | | | 1 | Torque control | | | |
| | | | | 2 | MC signal-ON: torque<br>MC signal-OFF: speed | | | |
| | | | | 3 | Position control | | | |
| | | | | 4 | MC signal-ON: position<br>MC signal-OFF: speed | | | |
| | | | | 5 | MC signal-ON: torque<br>MC signal-OFF: position | | | |
| | | | | 9 | Vector control / PM sensorless vector control test operation<br>Test operation of vector control / PM sensorless vector control (speed control) can be performed without connecting a motor. | | | |
| | | | | 10 | Speed control — Real sensorless vector control | | | |
| | | | | 11 | Torque control | | | |
| | | | | 12 | MC signal-ON: torque<br>MC signal-OFF: speed | | | |
| | | | | 13 | Position control — PM sensorless vector control | | | |
| | | | | 14 | MC signal-ON: position<br>MC signal-OFF: speed | | | |
| | | | | 20 | V/F Control (Advanced magnetic flux vector control) | | | |

**Selection and protection of a motor — Offline auto tuning (Pr.82 to Pr.84, Pr.90 to Pr.94, Pr.96, Pr.684, Pr.706, Pr.707, Pr.711, Pr.712, Pr.721, Pr.724, Pr.725, Pr.859)** (Magnetic flux / Sensorless / Vector / PM)

| Parameter (Related parameters) | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 82 (Magnetic flux / Sensorless / Vector) | Motor excitation current | 0.01/ 0.1A *1 | 9999 | 0 to 500/ 0 to 3600A *1 | Tuning data (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |
| 83 | Rated motor voltage | 0.1V | 200/ 400V *2 | 0 to 1000V | Set the rated motor voltage(V). | ○ | ○ | ○ |
| 84 | Rated motor frequency | 0.01Hz | 60Hz *3 | 10 to 300Hz | Set the rated motor frequency (Hz). (Limited at 120Hz when *Pr. 71* is set to a motor other than IPM) | ○ | ○ | ○ |
| 90 | Motor constant (R1) | 0.001Ω/ 0.01mΩ *1 | 9999 | 0 to 50Ω/ 0 to 400mΩ *1 | Tuning data (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, MM-CF, etc.) constants | | | |
| 91 (Magnetic flux / Sensorless / Vector) | Motor constant (R2) | 0.001Ω /0.01mΩ *1 | 9999 | 0 to 50Ω/ 0 to 400mΩ *1 | Tuning data (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, MM-CF, etc.) constants | | | |

*1 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)
*2 The initial values differ according to the voltage level. (200V/400V)
*3 Performing IPM parameter initialization changes the settings. (Refer to *page 74*)

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| | 92 | Motor constant (L1)/ d-shaft inductance | 0.001Ω (0.1mH) /0.1mΩ (0.01mH) *1 | 9999 | 0 to 50Ω (0 to 1000mH)/ 0 to 3600mΩ (0 to 400mH) *1 | Tuning data (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, MM-CF, etc.) constants | | | |
| | 93 | Motor constant (L2)/ q-shaft inductance | 0.001Ω (0.1mH) /0.1mΩ (0.01mH) *1 | 9999 | 0 to 50Ω (0 to 1000mH)/ 0 to 3600mΩ (0 to 400mH) *1 | Tuning data (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, MM-CF, etc.) constants | | | |
| | 94 Magnetic flux Sensorless Vector | Motor constant (X) | 0.01Ω (0.1%)/ 0.01Ω (0.01%) *1 | 9999 | 0 to 500Ω (0 to 100%)/ 0 to 100Ω (0 to 100%) *1 | Tuning data (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, MM-CF, etc.) constants | | | |
| | 96 | Auto tuning setting/ status | 1 | 0 | 0 | Offline auto tuning is not performed | ○ | × | ○ |
| | | | | | 1 | Offline auto tuning is performed without motor running (other than MM-CF) | | | |
| | | | | | 11 | Offline auto tuning is performed without motor running (MM-CF) | | | |
| | | | | | 101 | Offline auto tuning by rotating an induction motor (no tuning during PM sensorless vector control) | | | |
| | 684 | Tuning data unit switchover | 1 | 0 | 0 | Internal data converter value | ○ | ○ | ○ |
| | | | | | 1 | Displayed in "A, Ω, mH, %". | | | |
| | 706 PM | Induced voltage constant (phi f) | 0.1mV·s/rad | 9999 | 0 to 5000mV·s/rad | Adjust the constant if the current fluctuates during operation after tuning. | ○ | × | ○ |
| | | | | | 9999 | Constant value calculated based on the tuning data | | | |
| | 707 PM | Motor inertia (integer) | 1 | 9999 | 10 to 999 | Set the motor inertia. | ○ | ○ | ○ |
| | | | | | 9999 | Uses the inertia of the MM-CF IPM motor | | | |
| | 711 PM | Motor Ld decay ratio | 0.1% | 9999 | 0 to 100%, 9999 | Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Motor constant of the MM-CF IPM motor. (Except 9999, the set value is the motor constant.) | ○ | × | ○ |
| | 712 PM | Motor Lq decay ratio | 0.1% | 9999 | 0 to 100%, 9999 | | ○ | × | ○ |
| | 721 PM | Starting magnetic pole position detection pulse width | 1μsec | 9999 | 0 to 6000μs, 9999 | | ○ | × | ○ |
| | 724 PM | Motor inertia (exponent) | 1 | 9999 | 1 to 7 | Set the motor inertia. | ○ | ○ | ○ |
| | | | | | 9999 | Uses the inertia of the MM-CF IPM motor | | | |
| | 725 PM | Motor protection current level | 0.1% | 9999 | 0 to 500% | Set the maximum current (OCT) level of the motor (%). | ○ | ○ | ○ |
| | | | | | 9999 | Uses the maximum current of MM-CF | | | |
| | 859 | Torque current | 0.01/ 0.1A *1 | 9999 | 0 to 500/ 0 to 3600A *1 | Tuning data (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, MM-CF, etc.) constants | | | |

*1 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)

| | |
|---|---|
| 89 | Refer to *Pr. 80, Pr. 81*. |
| 90 to 94 | Refer to *Pr. 82 to Pr. 84*. |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Selection and protection of a motor — Online auto tuning (Pr.95, Pr.574)** | | | | | | | | | |
| 95 | | Online auto tuning selection | 1 | 0 | 0 | Online auto tuning is not performed | ○ | ○ | ○ |
| | | | | | 1 | Start-time tuning (at start-up) | | | |
| | | | | | 2 | Magnetic flux observer (normal) | | | |
| | *574* Magnetic flux Sensorless | Second motor online auto tuning | 1 | 0 | 0, 1 | Select the second motor online auto tuning. (same as *Pr. 95*) | ○ | ○ | ○ |
| 96 | | Refer to *Pr. 82* to *Pr. 84*. | | | | | | | |
| **V/F pattern setting — Adjustable 5 points V/F (Pr.71, Pr.100 to Pr.109)** | | | | | | | | | |
| 100 | | V/F1(first frequency) | 0.01Hz | 9999 | 0 to 400Hz, 9999 | Set each points (frequency, voltage) of V/F pattern.<br>9999: No V/F setting | ○ | ○ | ○ |
| 101 | | V/F1(first frequency voltage) | 0.1V | 0V | 0 to 1000V | | ○ | ○ | ○ |
| 102 | | V/F2(second frequency) | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| 103 | | V/F2(second frequency voltage) | 0.1V | 0V | 0 to 1000V | | ○ | ○ | ○ |
| 104 | | V/F3(third frequency) | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| 105 | | V/F3(third frequency voltage) | 0.1V | 0V | 0 to 1000V | | ○ | ○ | ○ |
| 106 | | V/F4(fourth frequency) | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| 107 | | V/F4(fourth frequency voltage) | 0.1V | 0V | 0 to 1000V | | ○ | ○ | ○ |
| 108 | | V/F5(fifth frequency) | 0.01Hz | 9999 | 0 to 400Hz, 9999 | | ○ | ○ | ○ |
| 109 | | V/F5(fifth frequency voltage) | 0.1V | 0V | 0 to 1000V | | ○ | ○ | ○ |
| | *71* | Refer to *page 113*. | | | | | | | |
| 110, 111 | | Refer to *Pr. 7*, *Pr. 8*. | | | | | | | |
| 112 | | Refer to *Pr. 0*. | | | | | | | |
| 113 | | Refer to *Pr. 3*. | | | | | | | |
| 114, 115 | | Refer to *Pr. 22*, *Pr. 23*. | | | | | | | |
| 116 | | Refer to *Pr. 41 to Pr. 43*. | | | | | | | |
| **Communication operation and setting — Initial setting for the RS-485 communication with the PU connector (Pr.117 to Pr.124, Pr.551)<br>Communication operation and setting — Control of parameter write by communication (Pr.342)** | | | | | | | | | |
| 117 | | PU communication station number | 1 | 0 | 0 to 31 | Specify the inverter station number.<br>Set the inverter station numbers when two or more inverters are connected to one personal computer. | ○ | ○* | ○* |
| 118 | | PU communication speed | 1 | 192 | 48, 96, 192, 384 | Set the communication speed.<br>The setting value × 100 equals the communication speed.<br>For example, the communication speed is 19200bps when the setting value is "192". | ○ | ○* | ○* |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| 119 | | PU communication stop bit length | 1 | 1 | 0 | Stop bit length: 1bit data length: 8bit | ○ | ○* | ○* |
| | | | | | 1 | Stop bit length: 2bit data length: 8bit | | | |
| | | | | | 10 | Stop bit length: 1bit data length: 7bit | | | |
| | | | | | 11 | Stop bit length: 2bit data length: 7bit | | | |
| 120 | | PU communication parity check | 1 | 2 | 0 | Without parity check | ○ | ○* | ○* |
| | | | | | 1 | With odd parity check | | | |
| | | | | | 2 | With even parity check | | | |
| 121 | | Number of PU communication retries | 1 | 1 | 0 to 10 | Set the permissible number of retries at occurrence of a data receive error.<br>If the number of consecutive errors exceeds the permissible value, the inverter trips. | ○ | ○* | ○* |
| | | | | | 9999 | If a communication error occurs, the inverter will not trip. | | | |
| 122 | | PU communication check time interval | 0.1s | 9999 | 0 | No PU connector communication | ○ | ○* | ○* |
| | | | | | 0.1 to 999.8s | Set the communication check time interval.<br>If a no-communication state persists for longer than the permissible time, the inverter trips. | | | |
| | | | | | 9999 | No communication check (signal loss detection) | | | |
| 123 | | PU communication waiting time setting | 1 | 9999 | 0 to 150ms | Set the waiting time between data transmission to the inverter and response. | ○ | ○* | ○* |
| | | | | | 9999 | Set with communication data. | | | |
| 124 | | PU communication CR/LF selection | 1 | 1 | 0 | Without CR/LF | ○ | ○* | ○* |
| | | | | | 1 | With CR | | | |
| | | | | | 2 | With CR/LF | | | |
| | *342* | Communication EEPROM write selection | 1 | 0 | 0 | Parameter values written by communication are written to the EEPROM and RAM. | ○ | ○ | ○ |
| | | | | | 1 | Parameter values written by communication are written to the RAM. | | | |
| | *551* | PU mode operation command source selection | 1 | 9999 | 1 | Select the RS-485 terminals as the PU operation mode control source. | ○ | ○* | ○* |
| | | | | | 2 | Select the PU connector as the PU operation mode control source. | | | |
| | | | | | 3 | Select the USB connector as the PU operation mode control source. | | | |
| | | | | | 9999 | USB automatic recognition<br>Normally, the PU connector is the command source when in the PU operation mode.<br>When the USB is connected, the USB connector is the command source. | | | |
| **Frequency and torque setting by analog input — Bias and gain for the frequency setting voltage (current) (Pr.125, Pr.126, Pr.241, C2(Pr.902) to C7(Pr.905))** | | | | | | | | | |
| 125 ◎ | | Terminal 2 frequency setting gain frequency | 0.01Hz | 60Hz * | 0 to 400Hz | Set the frequency of terminal 2 input gain (maximum). | ○ | × | ○ |
| 126 ◎ | | Terminal 4 frequency setting gain frequency | 0.01Hz | 60Hz * | 0 to 400Hz | Set the frequency of terminal 4 input gain (maximum).<br>(Valid when *Pr. 858* = 0 (initial value)) | ○ | × | ○ |
| | *241* | Analog input display unit switchover | 1 | 0 | 0 | Displayed in % | Select the unit for analog input display. | ○ | ○ | ○ |
| | | | | | 1 | Displayed in V/mA | | | |

* Performing IPM parameter initialization changes the settings. (Refer to *page 74*)

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| | C2 (902) | Terminal 2 frequency setting bias frequency | 0.01Hz | 0Hz | 0 to 400Hz | Set the frequency on the bias side of terminal 2 input. | ○ | × | ○ |
| | C3 (902) | Terminal 2 frequency setting bias | 0.1% | 0% | 0 to 300% | Set the converted % of the bias side voltage (current) of terminal 2 input. | ○ | × | ○ |
| | C4 (903) | Terminal 2 frequency setting gain | 0.1% | 100% | 0 to 300% | Set the converted % of the gain side voltage of terminal 2 input. | ○ | × | ○ |
| | C5 (904) | Terminal 4 frequency setting bias frequency | 0.01Hz | 0Hz | 0 to 400Hz | Set the frequency on the bias side of terminal 4 input. (Valid when *Pr. 858* = 0 (initial value)) | ○ | × | ○ |
| | C6 (904) | Terminal 4 frequency setting bias | 0.1% | 20% | 0 to 300% | Set the converted % of the bias side current (voltage) of terminal 4 input. (Valid when *Pr. 858* = 0 (initial value)) | ○ | × | ○ |
| | C7 (905) | Terminal 4 frequency setting gain | 0.1% | 100% | 0 to 300% | Set the converted % of the gain side current (voltage) of terminal 4 input. (Valid when *Pr. 858* = 0 (initial value)) | ○ | × | ○ |
| The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07). | | | | | | | | | |
| **Special operation and frequency control — PID control (Pr.127 to Pr.134, Pr.575 to Pr.577)** | | | | | | | | | |
| 127 | | PID control automatic switchover frequency | 0.01Hz | 9999 | 0 to 400Hz | Set the frequency at which the control is automatically changed to PID control. | ○ | ○ | ○ |
| | | | | | 9999 | Without PID automatic switchover function | | | |
| 128 | | PID action selection | 1 | 10 | 10 | PID reverse action — Deviation value signal (terminal 1) | ○ | ○ | ○ |
| | | | | | 11 | PID forward action — Deviation value signal (terminal 1) | | | |
| | | | | | 20 | PID reverse action — Measured value input (terminal 4) Set value (terminal 2 or *Pr. 133*) | | | |
| | | | | | 21 | PID forward action — Measured value input (terminal 4) Set value (terminal 2 or *Pr. 133*) | | | |
| | | | | | 50 | PID reverse action — Deviation value signal input (LONWORKS, CC-Link communication) | | | |
| | | | | | 51 | PID forward action — Deviation value signal input (LONWORKS, CC-Link communication) | | | |
| | | | | | 60 | PID reverse action — Measured value, set value input (LONWORKS, CC-Link communication) | | | |
| | | | | | 61 | PID forward action — Measured value, set value input (LONWORKS, CC-Link communication) | | | |
| 129 | | PID proportional band | 0.1% | 100% | 0.1 to 1000% | If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the measured value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain K = 1/proportional band | ○ | ○ | ○ |
| | | | | | 9999 | No proportional control | | | |
| 130 | | PID integral time | 0.1s | 1s | 0.1 to 3600s | When deviation step is input, time (Ti) is the time required for integral (I) action to provide the same manipulated variable as the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily. | ○ | ○ | ○ |
| | | | | | 9999 | No integral control. | | | |
| 131 | | PID upper limit | 0.1% | 9999 | 0 to 100% | Set the upper limit value. If the feedback value exceeds the setting, the FUP signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%. | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| 132 | | PID lower limit | 0.1% | 9999 | 0 to 100% | Set the lower limit value. If the measured value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%. | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| 133 | | PID action set point | 0.01% | 9999 | 0 to 100% | Used to set the set point for PID control. | ○ | ○ | ○ |
| | | | | | 9999 | Terminal 2 input voltage is the set point. | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| 134 | | PID differential time | 0.01s | 9999 | 0.01 to 10.00s | For deviation lamp input, time (Td) required for providing only the manipulated variable for the proportional (P) action. As the differential time increases, greater response is made to a deviation change. | ○ | ○ | ○ |
| | | | | | 9999 | No differential control. | | | |
| | *575* | Output interruption detection time | 0.1s | 1s | 0 to 3600s | If the output frequency after PID operation remains lower than the *Pr. 576* setting for longer than the time set in *Pr. 575*, the inverter stops operation. | ○ | ○ | ○ |
| | | | | | 9999 | Without output interruption function | | | |
| | *576* | Output interruption detection level | 0.01Hz | 0Hz | 0 to 400Hz | Set the frequency at which the output interruption processing is performed. | ○ | ○ | ○ |
| | *577* | Output interruption cancel level | 0.1% | 1000% | 900 to 1100% | Set the level (*Pr. 577* minus 1000%) to release the PID output interruption function. | ○ | ○ | ○ |
| **Special operation and frequency control — Switching between the inverter and the bypass operation (Pr.135 to Pr.139, Pr.159)** | | | | | | | | | |
| 135 | | Electronic bypass sequence selection | 1 | 0 | 0 | Without electronic bypass sequence | ○ | ○ | ○ |
| | | | | | 1 | With electronic bypass sequence | | | |
| 136 | | MC switchover interlock time | 0.1s | 1s | 0 to 100s | Set the operation interlock time of MC2 and MC3. | ○ | ○ | ○ |
| 137 | | Start waiting time | 0.1s | 0.5s | 0 to 100s | Set the time slightly longer (0.3 to 0.5s or so) than the time from when the ON signal enters MC3 until it actually turns on. | ○ | ○ | ○ |
| 138 | | Bypass selection at a fault | 1 | 0 | 0 | Inverter output is stopped (motor coast) at inverter fault. | ○ | ○ | ○ |
| | | | | | 1 | Operation is automatically switched to bypass operation at inverter fault (Not switched when an external thermal relay operation (E.OHT) or CPU fault (E.CPU) occurs) | | | |
| 139 | | Automatic switchover frequency from inverter to bypass operation | 0.01Hz | 9999 | 0 to 60Hz | Set the frequency to switch inverter operation to bypass operation. | ○ | ○ | ○ |
| | | | | | 9999 | Without automatic switchover | | | |
| | *159* | Automatic switchover frequency range from bypass to inverter operation | 0.01Hz | 9999 | 0 to 10Hz | Valid during automatic switchover operation (*Pr. 139* ≠ 9999)<br>When the frequency command decreases below (*Pr. 139* - *Pr. 159*) after operation is switched from inverter operation to bypass operation, the inverter automatically switches operation to inverter operation and operates at the frequency of frequency command.<br>When the inverter start command (STF/STR) is turned off, operation is switched to inverter operation also. | ○ | ○ | ○ |
| | | | | | 9999 | Valid during automatic switchover operation (*Pr. 139* ≠ 9999)<br>When the inverter start command (STF/STR) is turned off after operation is switched from inverter operation to bypass operation, operation is switched to inverter operation and the motor decelerates to stop. | | | |
| 140 to 143 | | Refer to *Pr. 29*. | | | | | | | |
| 144 | | Refer to *Pr. 37*. | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Setting of the parameter unit and operation panel — Parameter unit language switchover (Pr.145)** | | | | | | | | | |
| 145 | | PU display language selection | 1 | 0 | 0 | Japanese | ○ | × | × |
| | | | | | 1 | English | | | |
| | | | | | 2 | Germany | | | |
| | | | | | 3 | French | | | |
| | | | | | 4 | Spanish | | | |
| | | | | | 5 | Italian | | | |
| | | | | | 6 | Swedish | | | |
| | | | | | 7 | Finnish | | | |
| 147 | | Refer to *Pr. 7, Pr. 8*. | | | | | | | |
| 148,149 | | Refer to *Pr. 22, Pr. 23*. | | | | | | | |
| **Detection of output frequency, current, and torque — Detection of output current (Y12 signal) and zero current (Y13 signal) (Pr.150 to Pr.153, Pr.166, Pr.167)** | | | | | | | | | |
| 150 | | Output current detection level | 0.1% | 150% | 0 to 220% | Set the output current detection level.<br>100% is the rated inverter current. | ○ | ○ | ○ |
| 151 | | Output current detection signal delay time | 0.1s | 0s | 0 to 10s | Set the output current detection period.<br>Set the time from when the output current has risen above the setting until the output current detection signal (Y12) is output. | ○ | ○ | ○ |
| 152 | | Zero current detection level | 0.1% | 5% | 0 to 220% | Set the zero current detection level.<br>Suppose that the rated inverter current is 100%. | ○ | ○ | ○ |
| 153 | | Zero current detection time | 0.01s | 0.5s | 0 to 1s | Set this parameter to define the period from when the output current drops below the *Pr. 152* value until the zero current detection signal (Y13) is output. | ○ | ○ | ○ |
| | *166* | Output current detection signal retention time | 0.1s | 0.1s | 0 to 10s | Set the retention time when the Y12 signal is on. | ○ | ○ | ○ |
| | | | | | 9999 | The Y12 signal on status is retained.<br>The signal is turned off at the next start. | | | |
| | *167* | Output current detection operation selection | 1 | 0 | 0 | Operation continues when the Y12 signal is on | ○ | ○ | ○ |
| | | | | | 1 | The inverter trips when the Y12 signal is on. (E.CDO) | | | |
| 154 | | Refer to *Pr. 22, Pr. 23*. | | | | | | | |
| **Function assignment of external terminal and control — Selection of action conditions of the second/third function (RT/X9 signal) (Pr.155)** | | | | | | | | | |
| 155 | | RT signal function validity condition selection | 1 | 0 | 0 | Second (third) function is immediately valid with ON of the RT (X9) signal. | ○ | ○ | ○ |
| | | | | | 10 | Second (third) function is valid only during the RT (X9) signal is on and constant speed operation. (invalid during acceleration/deceleration) | | | |
| 156, 157 | | Refer to *Pr. 22, Pr. 23*. | | | | | | | |
| 158 | | Refer to *Pr. 52, Pr. 54*. | | | | | | | |
| 159 | | Refer to *Pr. 135 to Pr. 139*. | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|---|
| **Misoperation prevention and parameter setting restriction — Displaying necessary parameters only (user group) (Pr.160, Pr.172 to Pr.174)** | | | | | | | | | | |
| 160 ◎ | | User group read selection | 1 | 0 | 0 | All parameters can be displayed. | | ○ | ○ | ○ |
| | | | | | 1 | Only the parameters registered in the user group can be displayed. | | | | |
| | | | | | 9999 | Only the simple mode parameters can be displayed. | | | | |
| | *172* | User group registered display/ batch clear | 1 | 0 | (0 to 16) | Displays the number of cases registered as a user group (reading only). | | ○ | × | × |
| | | | | | 9999 | Batch clear the user group registration | | | | |
| | *173* | User group registration | 1 | 9999 | 0 to 999, 9999 | Set the parameter numbers to be registered to the user group. Read value is always "9999". | | × | × | × |
| | *174* | User group clear | 1 | 9999 | 0 to 999, 9999 | Set the parameter numbers to be cleared from the user group. Read value is always "9999". | | × | × | × |
| **Setting of the parameter unit and operation panel — Operation selection of the operation panel (Pr.161)** | | | | | | | | | | |
| 161 | | Frequency setting/ key lock operation selection | 1 | 0 | 0 | Setting dial frequency setting mode | Key lock invalid | ○ | × | ○ |
| | | | | | 1 | Setting dial potentiometer mode | | | | |
| | | | | | 10 | Setting dial frequency setting mode | Key lock valid | | | |
| | | | | | 11 | Setting dial potentiometer mode | | | | |
| 162 to 165 | Refer to *Pr. 57, Pr. 58*. | | | | | | | | | |
| 166, 167 | Refer to *Pr. 150 to Pr. 153*. | | | | | | | | | |
| 168, 169 | Parameter for manufacturer setting. Do not set. | | | | | | | | | |
| 170, 171 | Refer to *Pr. 52, Pr. 54*. | | | | | | | | | |
| 172 to 174 | Refer to *Pr. 160*. | | | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Function assignment of external terminal and control — Function assignment of input terminals (Pr.178 to Pr.189)** | | | | | | | | | |
| 178 | | STF terminal function selection | 1 | 60 | 0 to 20, 22 to 28, 42 to 44, 60, 62, 64 to 71, 74, 83, 9999 | 0: Low-speed operation command (RL)<br>1: Middle-speed operation command (RM)<br>2: High-speed operation command (RH)<br>3: Second function selection (RT)<br>4: Terminal 4 input selection (AU)<br>5: Jog operation selection (JOG)<br>6: Selection of automatic restart after instantaneous power failure, flying start (CS)<br>7: External thermal relay input (OH)<br>8: 15-speed selection (REX)<br>9: Third function selection (X9)<br>10: Inverter run enable signal (FR-HC2, FR-CV connection) (X10)<br>11: FR-HC2 connection, instantaneous power failure detection (X11)<br>12: PU operation external interlock (X12)<br>13: External DC injection brake start (X13)<br>14: PID control valid terminal (X14)<br>15: Brake opening completion signal (BRI)<br>16: PU/External operation switchover (X16)<br>17: Load pattern selection forward/reverse rotation boost (X17)<br>18: V/F switchover (X18)<br>19: Load torque high-speed frequency (X19)<br>20: S-pattern acceleration/deceleration C switchover (X20)<br>22: Orientation command (X22) *1<br>23: Pre-excitation/servo ON (LX)<br>24: Output stop (MRS)<br>25: Start self-holding selection (STOP)<br>26: Control mode switchover (MC)<br>27: Torque limit selection (TL)<br>28: Start time tuning (X28)<br>42: Torque bias selection 1 (X42) *1<br>43: Torque bias selection 2 (X43) *1<br>44: P/PI control switchover (X44)<br>60: Forward rotation command (STF) (assigned to STF terminal (*Pr. 178*) only)<br>61: Reverse rotation command (STR) (assigned to STR terminal (*Pr. 179*) only)<br>62: Inverter reset (RES)<br>63: PTC thermistor input (PTC) (assigned to AU terminal (*Pr. 184*) only)<br>64: PID forward/reverse action switchover (X64)<br>65: PU/NET operation switchover (X65)<br>66: External/NET operation switchover (X66)<br>67: Command source switchover (X67)<br>68: Simple position pulse train sign (NP)<br>69: Simple position droop pulse clear (CLR)<br>70: DC feeding operation permission (X70)<br>71: DC feeding cancel (X71)<br>74: Magnetic flux decay output shutoff (X74)<br>76: Proximity dog (X76) (assigned to JOG terminal (*Pr. 185*) only) *2<br>83: 0V voltage calibration request (X83) *3<br>85: SSCNET III communication disabled (X85) (cannot be assigned to STF/STR terminal *(Pr. 178/Pr. 179)*) *2<br>88: Upper stroke limit (LSP) (cannot be assigned to STF/STR terminal *(Pr. 178/Pr. 179)*) *2<br>89: Lower stroke limit (LSN) (cannot be assigned to STF/STR terminal *(Pr. 178/Pr. 179)*) *2<br>9999:No function | ○ | × | ○ |
| 179 | | STR terminal function selection | 1 | 61 | 0 to 20, 22 to 28, 42 to 44, 61, 62, 64 to 71, 74, 83, 9999 | | ○ | × | ○ |
| 180 | | RL terminal function selection | 1 | 0 | 0 to 20, 22 to 28, 42 to 44, 62, 64 to 71, 74, 83, 85, 88, 89, 9999 | | ○ | × | ○ |
| 181 | | RM terminal function selection | 1 | 1 | | | ○ | × | ○ |
| 182 | | RH terminal function selection | 1 | 2 | | | ○ | × | ○ |
| 183 | | RT terminal function selection | 1 | 3 | | | ○ | × | ○ |
| 184 | | AU terminal function selection | 1 | 4 | 0 to 20, 22 to 28, 42 to 44, 62 to 71, 74, 83, 85, 88, 89, 9999 | | ○ | × | ○ |
| 185 | | JOG terminal function selection | 1 | 5 | 0 to 20, 22 to 28, 42 to 44, 62, 64 to 71, 74, 76, 83, 85, 88, 89, 9999 | | ○ | × | ○ |
| 186 | | CS terminal function selection | 1 | 6 | 0 to 20, 22 to 28, 42 to 44, 62, 64 to 71, 74, 83, 85, 88, 89, 9999 | | ○ | × | ○ |
| 187 | | MRS terminal function selection | 1 | 24 | | | ○ | × | ○ |
| 188 | | STOP terminal function selection | 1 | 25 | | | ○ | × | ○ |
| 189 | | RES terminal function selection | 1 | 62 | | | ○ | × | ○ |

*1 Available only when used with the FR-A7AP/FR-A7AL.
*2 Available only when used with the FR-A7NS.
*3 Available only when used with the FR-A7AD.

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| **Function assignment of external terminal and control — Function assignment of output terminals (Pr.190 to Pr.196)** | | | | | | | | |
| 190 | RUN terminal function selection | 1 | 0 | 0 to 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 55, 57, 64, 70, 83 to 85, 90 to 99, 100 to 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 155, 157, 164, 170, 183 to 185, 190 to 199, 9999 | 0, 100: Inverter running (RUN)<br>1, 101: Up to frequency (SU)<br>2, 102: Instantaneous power failure/undervoltage (IPF)<br>3, 103: Overload alarm (OL)<br>4, 104: Output frequency detection (FU)<br>5, 105: Second output frequency detection (FU2)<br>6, 106: Third output frequency detection (FU3)<br>7, 107: Regenerative brake pre-alarm (RBP)<br>8, 108: Electronic thermal O/L relay pre-alarm (THP)<br>10, 110:PU operation mode (PU)<br>11, 111: Inverter operation ready (RY)<br>12, 112:Output current detection (Y12)<br>13, 113:Zero current detection (Y13)<br>14, 114:PID lower limit (FDN)<br>15, 115:PID upper limit (FUP)<br>16, 116:PID forward/reverse rotation output (RL)<br>17, —: Electronic bypass MC1 (MC1)<br>18, —: Electronic bypass MC2 (MC2)<br>19, —: Electronic bypass MC3 (MC3)<br>20, 120:Brake opening request (BOF)<br>25, 125:Fan fault output (FAN)<br>26, 126:Heatsink overheat pre-alarm (FIN)<br>27, 127:Orientation complete (ORA) *1<br>28, 128:Orientation fault (ORM) *1<br>30, 130:Forward rotation output (Y30) *1<br>31, 131:Reverse rotation output (Y31) *1<br>32, 132:Regenerative status output (Y32) *1<br>33, 133:Operation ready 2 (RY2)<br>34, 134:Low speed detection (LS)<br>35, 135:Torque detection (TU)<br>36, 136:In-position (Y36)<br>39, 139:Start time tuning completion (Y39)<br>41, 141:Speed detection (FB)<br>42, 142:Second speed detection (FB2)<br>43, 143:Third speed detection (FB3)<br>44, 144:Inverter running 2 (RUN2)<br>45, 145:Inverter running and start command is ON (RUN3)<br>46, 146:During deceleration at occurrence of power failure (retained until release) (Y46)<br>47, 147:During PID control activated (PID)<br>55, 155:Motor temperature detection (Y55) *2<br>57, 157:PM sensorless vector control (IPM)<br>64, 164:During retry (Y64)<br>70, 170:PID output interruption (SLEEP)<br>83, 183:During 0V voltage calibration (Y83) *3<br>84, 184:Preparation ready signal (RDY)<br>85, 185:DC current feeding (Y85)<br>90, 190:Life alarm (Y90)<br>91, 191:Fault output 3 (power-off signal) (Y91)<br>92, 192:Energy saving average value updated timing (Y92)<br>93, 193:Current average value monitor signal (Y93)<br>94, 194:Fault output 2 (ALM2)<br>95, 195:Maintenance timer signal (Y95)<br>96, 196:Remote output (REM)<br>97, 197:Alarm output 2 (ER)<br>98, 198:Alarm output (LF)<br>99, 199:Fault output (ALM)<br>9999: No function<br>0 to 99: Positive logic<br>100 to 199: Negative logic | ○ | × | ○ |
| 191 | SU terminal function selection | 1 | 1 | | | ○ | × | ○ |
| 192 | IPF terminal function selection | 1 | 2 | | | ○ | × | ○ |
| 193 | OL terminal function selection | 1 | 3 | | | ○ | × | ○ |
| 194 | FU terminal function selection | 1 | 4 | | | ○ | × | ○ |
| 195 | ABC1 terminal function selection | 1 | 99 | 0 to 8, 10 to 20, 25 to 28, 30 to 36, 39, 41 to 47, 55, 57, 64, 70, 83 to 85, 90, 91, 94 to 99, 100 to 108, 110 to 116, 120, 125 to 128, 130 to 136, 139, 141 to 147, 155, 157, 164, 170, 183 to 185, 190, 191, 194 to 199, 9999 | | ○ | × | ○ |
| 196 | ABC2 terminal function selection | 1 | 9999 | | | ○ | × | ○ |

*1 Available only when used with the FR-A7AP/FR-A7AL.
*2 Available only when FR-A7AZ is mounted and SFV5RU□□□□□T/A is used.
*3 Available only when used with the FR-A7AD.

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| 232 to 239 | | Refer to *Pr. 4 to Pr. 6*. | | | | | | | |
| 240 | | Refer to *Pr. 72*. | | | | | | | |
| 241 | | Refer to *Pr. 125 and Pr. 126*. | | | | | | | |
| 242, 243 | | Refer to *Pr. 73*. | | | | | | | |
| **Useful functions — Lifespan extension of the cooling fan (Pr.244)** | | | | | | | | | |
| 244 | | Cooling fan operation selection | 1 | 1 | 0 | Operates at power on<br>Cooling fan on/off control invalid (The cooling fan is always on at power on) | ○ | ○ | ○ |
| | | | | | 1 | Cooling fan on/off control valid<br>The fan is normally on during inverter operation. The fan switches on/off according to the temperature during a stop of the inverter whose status is monitored. | | | |
| **Adjusting the output torque (current) of the motor — Slip compensation (Pr.245 to Pr.247)** V/F | | | | | | | | | |
| 245 | | Rated slip | 0.01% | 9999 | 0 to 50% | Used to set the rated motor slip. | ○ | ○ | ○ |
| | | | | | 9999 | No slip compensation | | | |
| 246 | | Slip compensation time constant | 0.01s | 0.5s | 0.01 to 10s | Used to set the response time of slip compensation. When the value is made smaller, response will be faster. However, as load inertia is greater, a regenerative overvoltage (E.OV□) error is more liable to occur. | ○ | ○ | ○ |
| 247 | | Constant-power range slip compensation selection | 1 | 9999 | 0 | Slip compensation is not made in the constant power range (frequency range above the frequency set in *Pr. 3*) | ○ | ○ | ○ |
| | | | | | 9999 | Slip compensation is made in the constant power range. | | | |
| **Motor brake and stop operation — Motor stop method and start signal selection (Pr.250)**<br>**Function assignment of external terminal and control — Start signal selection (Pr.250)** | | | | | | | | | |
| 250 | | Stop selection | 0.1s | 9999 | 0 to 100s | The motor is coasted to a stop when the preset time elapses after the start signal is turned off. | STF signal: Forward rotation start<br>STR signal: Reverse rotation start | ○ | ○ | ○ |
| | | | | | 1000 to 1100s | The motor is coasted to a stop (*Pr. 250* - 1000)s after the start signal is turned off. | STF signal: Start signal<br>STR signal: Forward/ reverse signal | | | |
| | | | | | 9999 | When the start signal is turned off, the motor decelerates to stop. | STF signal: Forward rotation start<br>STR signal: Reverse rotation start | | | |
| | | | | | 8888 | | STF signal: Start signal<br>STR signal: Forward/ reverse signal | | | |
| **Operation setting at fault occurrence — Input phase failure protection selection (Pr.251, Pr.872)** | | | | | | | | | |
| 251 | | Output phase loss protection selection | 1 | 1 | 0 | Without output phase loss protection | | ○ | ○ | ○ |
| | | | | | 1 | With output phase loss protection | | | | |
| | *872* | Input phase loss protection selection | 1 | 0 | 0 | Without input phase loss protection | | ○ | ○ | ○ |
| | | | | | 1 | With input phase loss protection | | | | |
| 252, 253 | | Refer to *Pr. 73*. | | | | | | | |
| **Useful functions — To display life of inverter parts (Pr.255 to Pr.259)** | | | | | | | | | |
| 255 | | Life alarm status display | 1 | 0 | (0 to 15) | Display whether the control circuit capacitor, main circuit capacitor, cooling fan, and each parts of the inrush current limit circuit has reached the life alarm output level or not. Reading only | × | × | × |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| 256 | | Inrush current limit circuit life display | 1% | 100% | (0 to 100%) | Display the deterioration degree of the inrush current limit circuit. Reading only | × | × | × |
| 257 | | Control circuit capacitor life display | 1% | 100% | (0 to 100%) | Display the deterioration degree of the control circuit capacitor. Reading only | × | × | × |
| 258 | | Main circuit capacitor life display | 1% | 100% | (0 to 100%) | Display the deterioration degree of the main circuit capacitor. Reading only<br>The value measured by *Pr. 259* is displayed. | × | × | × |
| 259 | | Main circuit capacitor life measuring | 1 | 0 | 0, 1 | Setting "1" and turning the power supply off starts the measurement of the main circuit capacitor life.<br>When the *Pr.259* value is "3" after powering on again, the measuring is completed. Read the deterioration degree in *Pr.258*. | ○ | ○ | ○ |
| **Motor brake and stop operation — Decelerate the motor to a stop at instantaneous power failure (Pr.261 to Pr.266, Pr.294)**<br>**Operation selection at power failure and instantaneous power failure — Decelerate the motor to a stop at instantaneous power failure (Pr.261 to Pr.266, Pr.294)** | | | | | | | | | |
| 261 | | Power failure stop selection | 1 | 0 | 0 | Coasting to stop<br>When undervoltage or power failure occurs, the inverter output is shut off. | ○ | ○ | ○ |
| | | | | | 1 | Without undervoltage avoidance — When undervoltage or a power failure occurs, the inverter can be decelerated to a stop. | | | |
| | | | | | 11 | With undervoltage avoidance | | | |
| | | | | | 2 | Without undervoltage avoidance — When undervoltage or a power failure occurs, the inverter can be decelerated to a stop. If power is restored during a power failure, the inverter accelerates again. | | | |
| | | | | | 12 | With undervoltage avoidance | | | |
| 262 | | Subtracted frequency at deceleration start | 0.01Hz | 3Hz | 0 to 20Hz | Normally operation can be performed with the initial value unchanged. But adjust the frequency according to the magnitude of the load specifications (moment of inertia, torque). | ○ | ○ | ○ |
| 263 | | Subtraction starting frequency | 0.01Hz | 60Hz * | 0 to 400Hz | When output frequency ≥ *Pr. 263*<br>Decelerate from the speed obtained from output frequency minus *Pr. 262*.<br>When output frequency < *Pr. 263*<br>Decelerate from output frequency | ○ | ○ | ○ |
| | | | | | 9999 | Decelerate from the speed obtained from output frequency minus *Pr. 262*. | | | |
| 264 | | Power-failure deceleration time 1 | 0.1/ 0.01s | 5s | 0 to 3600/ 360s | Set a deceleration slope down to the frequency set in *Pr. 266*. | ○ | ○ | ○ |
| 265 | | Power-failure deceleration time 2 | 0.1/ 0.01s | 9999 | 0 to 3600/ 360s | Set a deceleration slope below the frequency set in *Pr. 266*. | ○ | ○ | ○ |
| | | | | | 9999 | Same slope as in *Pr. 264* | | | |
| 266 | | Power failure deceleration time switchover frequency | 0.01Hz | 60Hz * | 0 to 400Hz | Set the frequency at which the deceleration slope is switched from the *Pr. 264* setting to the *Pr. 265* setting. | ○ | ○ | ○ |
| | *294* | UV avoidance voltage gain | 0.1% | 100% | 0 to 200% | Adjust response level at undervoltage avoidance operation. A larger setting will improve responsiveness to the bus voltage change. | ○ | ○ | ○ |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |
| 267 | | Refer to *Pr. 73*. | | | | | | | |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 268 | Refer to *Pr. 52, Pr. 54*. | | | | | | | |
| 269 | Parameter for manufacturer setting. Do not set. | | | | | | | |
| **Special operation and frequency control — Load torque high speed frequency control (Pr.270 to Pr.274)** | | | | | | | | |
| 270 | Stop-on contact/ load torque high-speed frequency control selection | 1 | 0 | 0 | Without stop-on contact control and load torque high-speed frequency control | ○ | ○ | ○ |
| | | | | 1 | Stop-on contact control | | | |
| | | | | 2 | Load torque high speed frequency control | | | |
| | | | | 3 | Stop-on contact + load torque high speed frequency control | | | |
| | | | | 11 | Stop-on contact control; E.OLT invalid under stop-on-contact control | | | |
| | | | | 13 | Stop-on contact + load torque high speed frequency control; E.OLT invalid under stop-on-contact control | | | |
| 271 | High-speed setting maximum current | 0.1% | 50% | 0 to 220% | Set the upper and lower limits of the current at high and middle speeds. | ○ | ○ | ○ |
| 272 | Middle-speed setting minimum current | 0.1% | 100% | 0 to 220% | | ○ | ○ | ○ |
| 273 | Current averaging range | 0.01Hz | 9999 | 0 to 400Hz | Average current during acceleration from (*Pr. 273* × 1/2)Hz to (*Pr. 273* )Hz can be achieved. | ○ | ○ | ○ |
| | | | | 9999 | Average current during acceleration from (*Pr. 5* × 1/2)Hz to (*Pr. 5* )Hz is achieved. | | | |
| 274 | Current averaging filter time constant | 1 | 16 | 1 to 4000 | Set the time constant of the primary delay filter relative to the output current. (The time constant [ms] is 0.75 × *Pr. 274* and the initial value is 12ms.) A larger setting provides higher stability but poorer response. | ○ | ○ | ○ |
| **Motor brake and stop operation — Stop-on contact control (Pr.270, Pr.275, Pr.276)** Magnetic flux Sensorless | | | | | | | | |
| 275 | Stop-on contact excitation current low-speed multiplying factor | 0.1% | 9999 | 0 to 1000% | Usually set a value between 130% and 180%. Set the force (holding torque) for stop-on-contact control. | ○ | ○ | ○ |
| | | | | 9999 | No compensation. | | | |
| 276 | PWM carrier frequency at stop-on contact | 1 | 9999 | 0 to 9/ 0 to 4 * | Set a PWM carrier frequency for stop-on-contact control. (Valid at the output frequency of 3Hz or less.) | ○ | ○ | ○ |
| | | | | 9999 | As set in *Pr. 72 PWM frequency selection*. | | | |
| *270* | Refer to *Pr. 270 to Pr. 274*. | | | | | | | |
| * The setting range differs according to the inverter capacity. (55K or lower/75K or higher) | | | | | | | | |
| **Motor brake and stop operation — Brake sequence function (Pr.278 to Pr.285, Pr.292)** Magnetic flux Sensorless Vector | | | | | | | | |
| 278 | Brake opening frequency | 0.01Hz | 3Hz | 0 to 30Hz | Set to the rated slip frequency of the motor + about 1.0Hz. This parameter may be only set if *Pr. 278* ≤ *Pr. 282*. | ○ | ○ | ○ |
| 279 | Brake opening current | 0.1% | 130% | 0 to 220% | Generally, set this parameter to about 50 to 90%. If the setting is too low, the load is liable to drop due to gravity at start. Suppose that the rated inverter current is 100%. | ○ | ○ | ○ |
| 280 | Brake opening current detection time | 0.1s | 0.3s | 0 to 2s | Generally, set this parameter to about 0.1 to 0.3s. | ○ | ○ | ○ |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 281 | Brake operation time at start | 0.1s | 0.3s | 0 to 5s | *Pr. 292* = 7 or 17: Set the mechanical delay time until the brake is loosened.<br>*Pr. 292* = 8 or 18: Set the mechanical delay time until the brake is loosened + about 0.1 to 0.2s. | ○ | ○ | ○ |
| 282 | Brake operation frequency | 0.01Hz | 6Hz | 0 to 30Hz | At this frequency, the brake opening request signal (BOF) is switched off. Generally, set this parameter to the *Pr. 278* setting + 3 to 4Hz.<br>Setting is enabled only when *Pr. 282* ≥ *Pr. 278*. | ○ | ○ | ○ |
| 283 | Brake operation time at stop | 0.1s | 0.3s | 0 to 5s | *Pr. 292* = 7 or 17: Set the mechanical delay time until the brake is closed + 0.1s.<br>*Pr. 292* = 8 or 18: Set the mechanical delay time until the brake is closed + about 0.2 to 0.3s. | ○ | ○ | ○ |
| 284 Magnetic flux Vector | Deceleration detection function selection | 1 | 0 | 0 | Deceleration is not detected. | ○ | ○ | ○ |
| | | | | 1 | If deceleration is not normal during deceleration operation, the inverter fault (E.MB2) is provided to trip the inverter and turn off the brake opening request signal (BOF). | | | |
| 285 | Overspeed detection frequency | 0.01Hz | 9999 | 0 to 30Hz | When brake sequence function is valid under encoder feedback control<br>If (detected frequency) - (output frequency) > *Pr. 285* under encoder feedback control, the inverter fault (E.MB1) is provided to trip the inverter and turn off the brake opening request signal (BOF). | ○ | ○ | ○ |
| | | | | 9999 | Overspeed is not detected. | | | |
| *292* | Automatic acceleration/ deceleration | 1 | 0 | 0 | Normal operation mode | Refer to *Pr. 61 to Pr. 64*. | ○ | ○ | ○ |
| | | | | 1, 11 | Shortest acceleration/ deceleration mode | | | |
| | | | | 3 | Optimum acceleration/ deceleration mode | | | |
| | | | | 5, 6 | Elevator mode | | | |
| | | | | 7 | Brake sequence mode 1 (with BRI signal) | Disabled when the second or third function is selected | | |
| | | | | 8 | Brake sequence mode 2 (without BRI signal) | | | |
| | | | | 17 | Brake sequence mode 1 (with BRI signal) | Enabled even if the second or third function is selected | | |
| | | | | 18 | Brake sequence mode 2 (without BRI signal) | | | |
| **Speed control — Avoiding motor overrunning (Pr.285, Pr.853)** Vector | | | | | | | | |
| 285 | Overspeed detection frequency | 0.01Hz | 9999 | 9999 | Without speed deviation excessive | ○ | ○ | ○ |
| | | | | 0 to 30Hz | If the difference (absolute value) between the speed command value and actual speed exceeds the *Pr. 285 Overspeed detection frequency* setting for longer than the time set in *Pr. 853 Speed deviation time* during speed control under vector control, speed deviation excessive occurs and error "E. OSD" appears, resulting in a stop. | | | |
| *853* | Speed deviation time | 0.1s | 1s | 0 to 100s | | ○ | ○ | ○ |
| **Special operation and frequency control — Droop control (Pr.286 to Pr.288, Pr.994, Pr.995)** Magnetic flux Sensorless Vector PM | | | | | | | | |
| 286 | Droop gain | 0.1% | 0% | 0 | Droop control is invalid | ○ | ○ | ○ |
| | | | | 0.1 to 100% | Set the drooping amount at the rated torque as a percentage with respect to the rated frequency. | | | |
| 287 | Droop filter time constant | 0.01s | 0.3s | 0 to 1s | Set the time constant of the primary delay filter applied to the torque current. | ○ | ○ | ○ |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|---|
| 288 | | Droop function activation selection | 1 | 0 | | **Real sensor less vector/ vector/PM sensorless vector control** | **Advanced magnetic flux vector control** | ○ | ○ | ○ |
| | | | | | 0, 10 | Droop control is not exercised during acceleration/deceleration. (When *Pr.288* = 10, droop compensation amount is determined using the motor speed as reference.) | Droop control is not exercised during acceleration/ deceleration. Droop compensation amount is determined using the rated motor frequency as reference. | | | |
| | | | | | 1, 11 | Droop control is always exercised during operation. (with 0 limit) (When *Pr.288* = 11, droop compensation amount is determined using the motor speed as reference.) | | | | |
| | | | | | 2 | Droop control is always exercised during operation. (without 0 limit) | | | | |
| | *994* | Droop break point gain | 0.1% | 9999 | 0.1 to 100% | Set the changing droop amount as a percentage value of the rated motor frequency. | | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | | |
| | *995* | Droop break point torque | 0.1% | 100% | 0.1 to 100% | Set the torque where the droop amount is changed. | | ○ | ○ | ○ |
| **Special operation and frequency control — Pulse train I/O (Pr.291, Pr.384 to Pr.386)** | | | | | | | | | | |
| 291 | | Pulse train I/O selection | 1 | 0 | | **Input** | **Output** | ○ | × | ○ |
| | | | | | 0 | JOG terminal | FM output | | | |
| | | | | | 1 | Pulse train input | FM output | | | |
| | | | | | 10 | JOG terminal | Pulse train open collector output (50% duty) | | | |
| | | | | | 11 | Pulse train input | | | | |
| | | | | | 20 | JOG terminal | Pulse train open collector output (ON width is always same) | | | |
| | | | | | 21 | Pulse train input | | | | |
| | | | | | 100 | | Pulse train open collector output (ON width is always same (independently of *Pr. 54*)) | | | |
| | *384* | Input pulse division scaling factor | 1 | 0 | 0 to 250 | Indicates division scaling factor to the input pulse and the frequency resolution to the input pulse changes according to the value. | | ○ | ○ | ○ |
| | *385* | Frequency for zero input pulse | 0.01Hz | 0 | 0 to 400Hz | Set the frequency when the input pulse is 0 (bias). | | ○ | ○ | ○ |
| | *386* | Frequency for maximum input pulse | 0.01Hz | 60Hz * | 0 to 400Hz | Set the frequency when the input pulse is maximum (gain). | | ○ | ○ | ○ |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | | |
| 292, 293 | | Refer to *Pr. 61 to Pr. 64*. | | | | | | | | |
| 294 | | Refer to *Pr. 261 to Pr. 266*. | | | | | | | | |
| **Misoperation prevention and parameter setting restriction — Password function (Pr.296, Pr.297)** | | | | | | | | | | |
| 296 | | Password lock level | 1 | 9999 | 0 to 6, 99, 100 to 106, 199 | Select restriction level of parameter reading/ writing when a password is registered. | | ○ | × | ○ |
| | | | | | 9999 | No password lock | | | | |

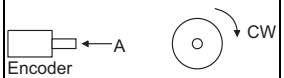
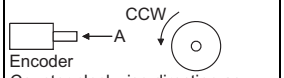
| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 297 | Password lock/ unlock | 1 | 9999 | 1000 to 9998 | Register a 4-digit password | ○ | × | ○ |
| | | | | (0 to 5) * | Displays password unlock error count. (Reading only) (Valid when *Pr. 296* = "100" to "106, 199") | | | |
| | | | | 9999 * | No password lock | | | |
| * "0 or 9999" can be set in *Pr. 297* at any time although the setting is invalid (the displayed value does not change). | | | | | | | | |
| 299 | Refer to *Pr. 57, Pr. 58*. | | | | | | | |
| **Communication operation and setting — Initial setting for the RS-485 communication with the RS-485 terminals (Pr.331 to Pr.339, Pr.341 to Pr.343, Pr.539, Pr.549 to Pr.551) Communication operation and setting — Control of parameter write by communication (Pr.342) Communication operation and setting — Modbus-RTU communication protocol (communication protocol selection) (Pr.549) Selection of operation mode and command source — Operation command source and speed command source during communication operation (Pr.338, Pr.339) Selection of operation mode and command source — Selection of the NET operation mode command source (Pr.550) Selection of operation mode and command source — Selection of the PU operation mode command source (Pr.551)** | | | | | | | | |
| 331 | RS-485 communication station number | 1 | 0 | 0 to 31 (0 to 247) | Set the inverter station number. (same specifications as *Pr. 117* ) When "1" (Modbus-RTU protocol) is set in *Pr. 551*, the setting range within parenthesis is applied. | ○ | ○* | ○* |
| 332 | RS-485 communication speed | 1 | 96 | 3, 6, 12, 24, 48, 96, 192, 384 | Used to select the communication speed. (same specifications as *Pr. 118*) | ○ | ○* | ○* |
| 333 | RS-485 communication stop bit length | 1 | 1 | 0, 1, 10, 11 | Select stop bit length and data length. (same specifications as *Pr. 119*) | ○ | ○* | ○* |
| 334 | RS-485 communication parity check selection | 1 | 2 | 0, 1, 2 | Select the parity check specifications. (same specifications as *Pr. 120*) | ○ | ○* | ○* |
| 335 | RS-485 communication retry count | 1 | 1 | 0 to 10, 9999 | Set the permissible number of retries at occurrence of a data receive error. (same specifications as *Pr. 121*) | ○ | ○* | ○* |
| 336 | RS-485 communication check time interval | 0.1s | 0s | 0 | RS-485 communication can be made, but the inverter trips in the NET operation mode. | ○ | ○* | ○* |
| | | | | 0.1 to 999.8s | Set the communication check time interval. (same specifications as *Pr. 122*) | | | |
| | | | | 9999 | No communication check (signal loss detection) | | | |
| 337 | RS-485 communication waiting time setting | 1 | 9999 | 0 to 150ms, 9999 | Set the waiting time between data transmission to the inverter and response. (same specifications as *Pr. 123*) | ○ | ○* | ○* |
| 338 | Communication operation command source | 1 | 0 | 0 | Operation command source communication | ○ | ○* | ○* |
| | | | | 1 | Operation command source external | | | |
| 339 | Communication speed command source | 1 | 0 | 0 | Frequency command source communication | ○ | ○* | ○* |
| | | | | 1 | Frequency command source external | | | |
| | | | | 2 | Frequency command source external (When there is no external input, the frequency command via communication is valid, and the frequency command from terminal 2 is invalid.) | | | |

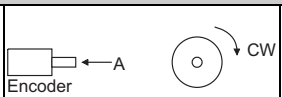
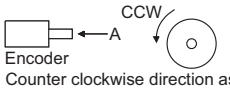
| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 341 | RS-485 communication CR/LF selection | 1 | 1 | 0, 1, 2 | Select presence/absence of CR/LF. (same specifications as *Pr. 124*) | ○ | ○* | ○* |
| 342 | Communication EEPROM write selection | 1 | 0 | 0 | Parameter values written by communication are written to the EEPROM and RAM. | ○ | ○ | ○ |
| | | | | 1 | Parameter values written by communication are written to the RAM. | | | |
| 343 | Communication error count | 1 | 0 | — | Display the number of communication errors during Modbus-RTU communication. Read only. Displayed only when Modbus-RTU protocol is selected. | × | × | × |
| *539* | Modbus-RTU communication check time interval | 0.1s | 9999 | 0 | Modbus-RTU communication can be made, but the inverter trips in the NET operation mode. | ○ | ○* | ○* |
| | | | | 0.1 to 999.8s | Set the communication check time interval. (same specifications as *Pr. 122*) | | | |
| | | | | 9999 | No communication check (signal loss detection) | | | |
| *549* | Protocol selection | 1 | 0 | 0 | Mitsubishi inverter (computer link) protocol | ○ | ○* | ○* |
| | | | | 1 | Modbus-RTU protocol | | | |
| | | | | | After setting change, reset (switch power off, then on) the inverter. The setting change is reflected after a reset. | | | |
| *550* | NET mode operation command source selection | 1 | 9999 | 0 | Communication option valid | ○ | ○* | ○* |
| | | | | 1 | Inverter RS-485 terminal valid | | | |
| | | | | 9999 | Automatic recognition of the communication option Normally, the RS-485 terminals are valid. Communication option is valid when the communication option is mounted. | | | |
| *551* | PU mode operation command source selection | 1 | 9999 | 1 | Select the RS-485 terminals as the PU operation mode control source. | ○ | ○* | ○* |
| | | | | 2 | Select the PU connector as the PU operation mode control source. | | | |
| | | | | 3 | Select the USB connector as the PU operation mode control source. | | | |
| | | | | 9999 | USB automatic recognition Normally, the PU connector is the command source when in the PU operation mode. When the USB is connected, the USB connector is the command source. | | | |
| 340 | Refer to *Pr. 79*. | | | | | | | |

## Motor brake and stop operation — Orientation control (Pr.350 to Pr.366, Pr.369, Pr.393, Pr.396 to Pr.399)

V/F Magnetic flux Vector

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 350 | Stop position command selection | 1 | 9999 | 0 | Internal stop position command *(Pr.356)* | ○ | ○ | ○ |
| | | | | 1 | External stop position command (FR-A7AX 16-bit data) | | | |
| | | | | 9999 | Orientation control invalid | | | |
| 351 | Orientation speed | 0.01Hz | 2Hz | 0 to 30Hz | Decrease the motor speed to the set value when the orientation command (X22) is given. | ○ | ○ | ○ |
| 352 | Creep speed | 0.01Hz | 0.5Hz | 0 to 10Hz | As soon as the current position pulse reaches the creep switchover position set in *Pr.353* after the speed has reached the orientation speed, the speed decelerates down to the creep speed set in *Pr.352*. | ○ | ○ | ○ |
| 353 | Creep switchover position | 1 | 511 | 0 to 16383 | | ○ | ○ | ○ |
| 354 | Position loop switchover position | 1 | 96 | 0 to 8191 | As soon as the current position pulse reaches the set position loop switchover position, control is changed to position loop. | ○ | ○ | ○ |
| 355 | DC injection brake start position | 1 | 5 | 0 to 255 | After changed to position loop, DC injection brake is applied and the motor stops as soon as the current position pulse reaches the set DC injection brake start position. | ○ | ○ | ○ |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 356 | Internal stop position command | 1 | 0 | 0 to 16383 | When "0" is set in *Pr. 350*, the internal position command is activated and the setting value of *Pr. 356* becomes a stop position. | ○ | ○ | ○ |
| 357 | Orientation in-position zone | 1 | 5 | 0 to 255 | Set the in-position zone at a stop of the orientation. | ○ | ○ | ○ |
| 358 | Servo torque selection | 1 | 1 | 0 to 13 | Functions at orientation completion can be selected. | ○ | ○ | ○ |
| 359 | Encoder rotation direction | 1 | 1 | 0 |  Encoder Clockwise direction as viewed from A is forward rotation | Set the rotation direction according to the motor specification. | ○ | ○ | ○ |
| | | | | 1 |  Encoder Counter clockwise direction as viewed from A is forward rotation | | | |
| 360 | 16-bit data selection | 1 | 0 | 0 | Speed command | When 1 is set in *Pr.350* and the option FR-A7AX is mounted, set a stop position using 16-bit data. Stop position command is input as binary regardless of the *Pr.304* setting. | ○ | ○ | ○ |
| | | | | 1 | Position command 16 bit data is used as external position command as is. | | | | |
| | | | | 2 to 127 | Set the stop position dividing up to 128 stop positions at regular intervals. | | | | |
| 361 | Position shift | 1 | 0 | 0 to 16383 | Shift the origin using a compensation value without changing the origin of the encoder. The stop position is a position obtained by adding the setting value of *Pr. 361* to the position command. | | ○ | ○ | ○ |
| 362 | Orientation position loop gain | 0.1 | 1 | 0.1 to 10 | When servo torque function is selected using *Pr.358*, output frequency for generating servo torque increases to the creep speed of *Pr.352* gradually according to the slope set in *Pr.362*. Although the operation becomes faster when the value is increased, a machine may hunt, etc. | | ○ | ○ | ○ |
| 363 | Completion signal output delay time | 0.1s | 0.5s | 0 to 5s | The orientation complete signal (ORA) is output delaying the set time after in-position zone is entered. Also, the signal turns off delaying the set time after in-position zone is out. | | ○ | ○ | ○ |
| 364 | Encoder stop check time | 0.1s | 0.5s | 0 to 5s | Orientation fault signal (ORM) is output when the encoder remains stopped for the set time without orientation completion in the state where no orientation complete signal (ORA) is output. ORM signal is output when orientation is not completed again in the set time in the state where ORA signal is output. | | ○ | ○ | ○ |
| 365 | Orientation limit | 1s | 9999 | 0 to 60s | Measure the time taken after passing the creep switchover position and output the orientation fault signal (ORM) if orientation is not completed within the set time. | | ○ | ○ | ○ |
| | | | | 9999 | Set to 120s. | | | | |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 366 | Recheck time | 0.1s | 9999 | 0 to 5s | Turning off the start signal with orientation command (X22) on after stopping the motor by orientation control, the present position is checked again after the set time elapses and the orientation complete signal (ORA) or orientation fault signal (ORM) is output. | ○ | ○ | ○ |
| | | | | 9999 | Not checked. | | | |
| 369 | Number of encoder pulses | 1 | 1024 | 0 to 4096 | Set the number of pulses of the encoder. Set the number of pulses before multiplied by four. | ○ | ○ | ○ |
| 393 Vector | Orientation selection | 1 | 0 | 0 | Orientation is executed from the current rotation direction. | ○ | ○ | ○ |
| | | | | 1 | Orientation is executed from the forward rotation direction. | | | |
| | | | | 2 | Orientation is executed from the reverse rotation direction. | | | |
| 396 Vector | Orientation speed gain (P term) | 1 | 60 | 0 to 1000 | Servo rigidity is (response level during position control loop) at orientation stop can be adjusted. | ○ | ○ | ○ |
| 397 Vector | Orientation speed integral time | 0.001s | 0.333s | 0 to 20.0s | | ○ | ○ | ○ |
| 398 Vector | Orientation speed gain (D term) | 0.1% | 1% | 0 to 100.0% | Lag/advance compensation gain can be adjusted. | ○ | ○ | ○ |
| 399 Vector | Orientation deceleration ratio | 1 | 20 | 0 to 1000 | Make adjustment when the motor runs back at orientation stop or the orientation time is long. | ○ | ○ | ○ |
| **Special operation and frequency control — Encoder feedback control (Pr.359, Pr.367 to Pr.369)** V/F Magnetic flux | | | | | | | | |
| 359 | Encoder rotation direction | 1 | 1 | 0 |  Clockwise direction as viewed from A is forward rotation | Set the rotation direction according to the motor specification. | ○ | ○ | ○ |
| | | | | 1 |  Counter clockwise direction as viewed from A is forward rotation | | | |
| 367 | Speed feedback range | 0.01Hz | 9999 | 0 to 400Hz | Set the range of speed feedback control. | ○ | ○ | ○ |
| | | | | 9999 | Encoder feedback control is invalid | | | |
| 368 | Feedback gain | 0.1 | 1 | 0 to 100 | Set when the rotation is unstable or response is slow. | ○ | ○ | ○ |
| 369 | Number of encoder pulses | 1 | 1024 | 0 to 4096 | Set the number of pulses of the encoder. Set the number of pulses before multiplied by four. | ○ | ○ | ○ |
| **Operation setting at fault occurrence — Overspeed detection (Pr.374)** | | | | | | | | |
| 374 | Overspeed detection level | 0.01Hz | 140Hz * | 0 to 400Hz | When the motor speed exceeds the speed set in *Pr.374* during encoder feedback control, Real sensorless vector control, vector control, or PM sensorless vector control, over speed (E.OS) occurs and stops the inverter output. | ○ | ○ | ○ |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | |
| **Operation setting at fault occurrence — Encoder signal cable breakage detection (Pr.376)** V/F Magnetic flux Vector | | | | | | | | |
| 376 | Encoder signal loss detection enable/ disable selection | 1 | 0 | 0 | Signal loss detection is invalid | ○ | ○ | ○ |
| | | | | 1 | Signal loss detection is valid When the cable of the encoder signal is broken during encoder feedback control, orientation control, or vector control, signal loss detection (E.ECT) is activated to stop the inverter output. | | | |
| 380 to 383 | Refer to *Pr. 29*. | | | | | | | |
| 384 to 386 | Refer to *Pr. 291*. | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Position control — Position control setting (Pr.419 to Pr.430, Pr.464)** | | | | | | | | | Vector P M |
| 419 | | Position command source selection | 1 | 0 | 0 | Simple position control function by contact input | ○ | ○ | ○ |
| | | | | | 1 | Position command using pulse train input (FR-A7AL) | | | |
| | | | | | 2 | Simple position pulse train command by pulse train input from the JOG terminal | | | |
| 420 | | Command pulse scaling factor numerator | 1 | 1 | 0 to 32767 | Set the electronic gear. *Pr. 420* is a numerator and *Pr. 421* is a denominator. | ○ | ○ | ○ |
| 421 | | Command pulse scaling factor denominator | 1 | 1 | 0 to 32767 | | ○ | ○ | ○ |
| 422 | | Position loop gain | $1s^{-1}$ | $25s^{-1}$ | 0 to $150s^{-1}$ | Set the gain of the position loop. | ○ | ○ | ○ |
| 423 | | Position feed forward gain | 1% | 0% | 0 to 100% | Function to cancel a delay caused by the droop pulses of the deviation counter. | ○ | ○ | ○ |
| 424 | | Position command acceleration/ deceleration time constant | 0.001s | 0s | 0 to 50s | Used when rotation has become unsmooth at a large electronic gear ratio (about 10 times or more) and low speed. | ○ | ○ | ○ |
| 425 | | Position feed forward command filter | 0.001s | 0s | 0 to 5s | Enters the primary delay filter in response to the feed forward command. | ○ | ○ | ○ |
| 426 | | In-position width | 1 pulse | 100 pulse | 0 to 32767 pulse | The in-position signal (Y36) turns on when the droop pulses become less than the setting. | ○ | ○ | ○ |
| 427 | | Excessive level error | 1 | 40K | 0 to 400K | A position error excessive (E.OD) occurs when the droop pulses exceed the setting. | ○ | ○ | ○ |
| | | | | | 9999 | Function invalid | | | |
| 428 | | Command pulse selection | 1 | 0 | 0 to 2 | Pulse train + rotation signal sign — Negative logic | ○ | ○ | ○ |
| | | | | | 3 to 5 | Pulse train + rotation signal sign — Positive logic | | | |
| 429 | | Clear signal selection | 1 | 1 | 0 | Deviation counter is cleared at trailing edge (at the moment when H level is changed to L level) | ○ | ○ | ○ |
| | | | | | 1 | Deviation counter is cleared at L level | | | |
| 430 | | Pulse monitor selection | 1 | 9999 | | **Description** / **FR-DU07 (FR-PU04/FR-PU07) display** | ○ | ○ | ○ |
| | | | | | 0 | The cumulative command pulse value is displayed. — Lower 4(5) digits | | | |
| | | | | | 1 | Upper 4(5) digits | | | |
| | | | | | 2 | The cumulative feedback pulse value is displayed. — Lower 4(5) digits | | | |
| | | | | | 3 | Upper 4(5) digits | | | |
| | | | | | 4 | The droop pulses are monitored. — Lower 4(5) digits | | | |
| | | | | | 5 | Upper 4(5) digits | | | |
| | | | | | 9999 | Frequency monitor is displayed. | | | |
| | *464* | Digital position control sudden stop deceleration time | 0.1s | 0 | 0 to 360.0s | Set the time until the inverter stops when the forward rotation (reverse rotation) command is turned off with the position feed forward function. | ○ | ○ | ○ |
| 450 | | Refer to *Pr. 71*. | | | | | | | |
| 451 | | Refer to *Pr. 80, Pr. 81*. | | | | | | | |
| 453, 454 | | Refer to *Pr. 80, Pr. 81*. | | | | | | | |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| **Selection and protection of a motor — Second motor offline auto tuning (Pr.455 to Pr.463, Pr.860)** | | | | | | | Magnetic flux Sensorless | |
| 455 | Second motor excitation current | 0.01/ 0.1A *1 | 9999 | 0 to 500/ 0 to 3600A *1 | Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |
| 456 | Rated second motor voltage | 0.1V | 200/ 400V *2 | 0 to 1000V | Set the rated voltage (V) of the second motor. | ○ | ○ | ○ |
| 457 | Rated second motor frequency | 0.01Hz | 60Hz | 10 to 120Hz | Set the rated frequency (Hz) of the second motor. | ○ | ○ | ○ |
| 458 | Second motor constant (R1) | 0.001Ω/ 0.01mΩ *1 | 9999 | 0 to 50Ω/ 0 to 400mΩ *1 | Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |
| 459 | Second motor constant (R2) | 0.001Ω /0.01mΩ *1 | 9999 | 0 to 50Ω/ 0 to 400mΩ *1 | Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |
| 460 | Second motor constant (L1) | 0.001Ω (0.1mH)/ 0.1mΩ (0.01mH) *1 | 9999 | 0 to 50Ω (0 to 1000mH)/ 0 to 3600mΩ (0 to 400mH) *1 | Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |
| 461 | Second motor constant (L2) | 0.001Ω (0.1mH) /0.1mΩ (0.01mH) *1 | 9999 | 0 to 50Ω (0 to 1000mH)/ 0 to 3600mΩ (0 to 400mH) *1 | Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |
| 462 | Second motor constant (X) | 0.01Ω (0.1%)/ 0.01mΩ (0.01%) *1 | 9999 | 0 to 500Ω (0 to 100%)/ 0 to 100Ω (0 to 100%) *1 | Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |
| 463 | Second motor auto tuning setting/status | 1 | 0 | 0, 1, 101 | Set the tuning mode of the second motor. (same as *Pr. 96*) | ○ | × | ○ |
| *860* | Second motor torque current | 0.01/ 0.1A *1 | 9999 | 0 to 500/ 0 to 3600A *1 | Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) | ○ | × | ○ |
| | | | | 9999 | Use the Mitsubishi motor (SF-JR, SF-HRCA, etc.) constants | | | |

*1 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)
*2 The initial values differ according to the voltage level. (200V/400V)

| | |
|---|---|
| 464 | Refer to *Pr. 419 to Pr. 430*. |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Position control — Simple position feed function (Pr.465 to Pr.494)** | | | | | | | | | |
| | | | | | **Selection Method** | **Position Feed Speed** | | | |
| 465 | First position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | RH | High speed *(Pr.4)* | ○ | ○ | ○ |
| 466 | First position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 467 | Second position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | RM | Middle speed *(Pr.5)* | ○ | ○ | ○ |
| 468 | Second position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 469 | Third position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | RL | Low speed *(Pr.6)* | ○ | ○ | ○ |
| 470 | Third position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 471 | Fourth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | RM, RL | Speed 4 *(Pr.24)* | ○ | ○ | ○ |
| 472 | Fourth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 473 | Fifth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | RH, RL | Speed 5 *(Pr.25)* | ○ | ○ | ○ |
| 474 | Fifth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 475 | Sixth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | RH, RM | Speed 6 *(Pr.26)* | ○ | ○ | ○ |
| 476 | Sixth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 477 | Seventh position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | RH, RM, RL | Speed 7 *(Pr.27)* | ○ | ○ | ○ |
| 478 | Seventh position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 479 | Eighth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX | Speed 8 *(Pr.232)* | ○ | ○ | ○ |
| 480 | Eighth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 481 | Ninth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX, RL | Speed 9 *(Pr.233)* | ○ | ○ | ○ |
| 482 | Ninth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| 483 | Tenth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX, RM | Speed 10 *(Pr.234)* | ○ | ○ | ○ |
| 484 | Tenth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 485 | Eleventh position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX, RM, RL | Speed 11 *(Pr.235)* | ○ | ○ | ○ |
| 486 | Eleventh position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 487 | Twelfth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX, RH | Speed 12 *(Pr.236)* | ○ | ○ | ○ |
| 488 | Twelfth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 489 | Thirteenth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX, RH, RL | Speed 13 *(Pr.237)* | ○ | ○ | ○ |
| 490 | Thirteenth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 491 | Fourteenth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX, RH, RM | Speed 14 *(Pr.238)* | ○ | ○ | ○ |
| 492 | Fourteenth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| 493 | Fifteenth position feed amount lower 4 digits | 1 | 0 | 0 to 9999 | REX, RH, RM, RL | Speed 15 *(Pr.239)* | ○ | ○ | ○ |
| 494 | Fifteenth position feed amount upper 4 digits | 1 | 0 | 0 to 9999 | | | ○ | ○ | ○ |
| **Function assignment of external terminal and control — Remote output function (REM signal) (Pr.495 to Pr.497)** | | | | | | | | | |
| 495 | Remote output selection | 1 | 0 | 0 | Remote output data clear at powering off | Remote output data is cleared during an inverter reset | ○ | ○ | ○ |
| | | | | 1 | Remote output data held at powering off | | | | |
| | | | | 10 | Remote output data clear at powering off | Remote output data is retained during an inverter reset | | | |
| | | | | 11 | Remote output data held at powering off | | | | |
| 496 | Remote output data 1 | 1 | 0 | 0 to 4095 | Output terminal can be switched on and off. | | × | × | × |
| 497 | Remote output data 2 | 1 | 0 | 0 to 4095 | | | × | × | × |
| **Useful functions — Maintenance of parts (Pr.503, Pr.504)** | | | | | | | | | |
| 503 | Maintenance timer | 1 | 0 | 0 (1 to 9998) | Display the cumulative energization time of the inverter in 100h increments.<br>(Reading only)<br>When *Pr. 503* = "1 to 9998", writing the setting value of "0" clears the cumulative energization time.<br>(Writing is disabled when *Pr. 503* = "0".) | | × | × | × |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 504 | Maintenance timer alarm output set time | 1 | 9999 | 0 to 9998 | Set the time taken until when the maintenance timer alarm output signal (Y95) is output. | ○ | × | ○ |
| | | | | 9999 | No function | | | |
| 505 | Refer to *Pr. 37*. | | | | | | | |
| 516 to 519 | Refer to *Pr. 29*. | | | | | | | |
| 539 | Refer to *Pr. 331 to Pr. 339, Pr. 341 to Pr. 343*. | | | | | | | |
| **Communication operation and setting — Inverter setup using USB communication (Pr.547, Pr.548)** | | | | | | | | |
| 547 | USB communication station number | 1 | 0 | 0 to 31 | Specify the inverter station number. | ○ | ○* | ○* |
| 548 | USB communication check time interval | 0.1s | 9999 | 0 | USB communication is enabled. However, the inverter will come to an alarm stop (E. USB) if operation is changed to PU operation mode. | ○ | ○* | ○* |
| | | | | 0.1 to 999.8s | Set the interval of communication check time. | | | |
| | | | | 9999 | No communication check | | | |
| 549 to 551 | Refer to *Pr. 331 to Pr. 339, Pr. 341 to Pr. 343*. | | | | | | | |
| **Useful functions — Current average value monitor signal (Pr.555 to Pr.557)** | | | | | | | | |
| 555 | Current average time | 0.1s | 1s | 0.1 to 1.0s | Set the time taken to average the current during start pulse output (1s). | ○ | ○ | ○ |
| 556 | Data output mask time | 0.1s | 0s | 0.0 to 20.0s | Set the time for not obtaining (mask) transient state data. | ○ | ○ | ○ |
| 557 | Current average value monitor signal output reference current | 0.01/ 0.1A *1 | Rated inverter current *2 | 0 to 500/ 0 to 3600A *1 | Set the reference (100%) for outputting the signal of the current average value. | ○ | ○ | ○ |
| *1 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)<br>*2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | |
| 563, 564 | Refer to *Pr. 52, Pr. 54*. | | | | | | | |
| 569 | Refer to *Pr. 80, Pr. 81*. | | | | | | | |
| 571 | Refer to *Pr. 13*. | | | | | | | |
| 574 | Refer to *Pr. 95*. | | | | | | | |
| 575 to 577 | Refer to *Pr. 127 to Pr. 134.* | | | | | | | |
| 611 | Refer to *Pr. 57, Pr. 58*. | | | | | | | |
| 665 | Refer to *Pr. 882 to Pr. 886*. | | | | | | | |
| 684, 706, 707, 711, 712, 724, 725 | Refer to *Pr. 82 to Pr. 84*. | | | | | | | |
| **Adjusting the output torque (current) of the motor — Low-speed range torque characteristic selection (Pr.788)** PM | | | | | | | | |
| 788 | Low-speed range torque characteristics selection | 1 | 9999 | 0 | Disables the low-speed range torque characteristic (current synchronization operation). | ○ | ○ | ○ |
| | | | | 9999 | Enables the low-speed range torque characteristic (high frequency superposition control) | | | |
| 791, 792 | Refer to *Pr. 7, Pr. 8*. | | | | | | | |
| 800 | Refer to *Pr. 80, Pr. 81*. | | | | | | | |
| 802 | Refer to *Pr. 10 to Pr. 12*. | | | | | | | |
| 803 | Refer to *Pr. 22*. | | | | | | | |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| **Torque control — Torque command source selection (Pr.804 to Pr.806)** | | | | | | | | |
| 804 | Torque command source selection | 1 | 0 | 0 | Torque command by terminal 1 analog input | ○ | ○ | ○ |
| | | | | 1 | Torque command by parameter *Pr.805* or *Pr.806* setting (-400% to 400%) | | | |
| | | | | 2 | Torque command using pulse train input (FR-A7AL) | | | |
| | | | | 3 | Torque command by using CC-Link (FR-A7NC) | | | |
| | | | | 4 | Digital input from the option (FR-A7AX) | | | |
| | | | | 5 | Torque command by using CC-Link (FR-A7NC) | | | |
| | | | | 6 | | | | |
| 805 | Torque command value (RAM) | 1% | 1000% | 600 to 1400% | Digital setting of the torque command can be made by setting *Pr. 805* or *Pr. 806*. (Setting from communication option, etc. can be made.) In this case, set the speed limit value to an appropriate value to prevent overspeed. | × | ○ | ○ |
| 806 | Torque command value (RAM,EEPROM) | 1% | 1000% | 600 to 1400% | | ○ | ○ | ○ |
| **Torque control — Speed limit (Pr.807 to Pr.809)** | | | | | | | | |
| 807 | Speed limit selection | 1 | 0 | 0 | Use the speed command value during speed control as speed limit. | ○ | ○ | ○ |
| | | | | 1 | According to *Pr. 808* and *Pr. 809*, set the speed limit in forward and reverse rotation directions individually. | | | |
| | | | | 2 | The analog voltage of the terminal 1 input is used to make speed limit. For 0 to 10V input, set the forward rotation speed limit. (The reverse rotation speed limit is *Pr. 1 Maximum frequency*) For -10 to 0V input, set the reverse rotation speed limit. (The forward rotation speed limit is *Pr. 1 Maximum frequency*.) The maximum frequency of both the forward and reverse rotations is *Pr. 1 Maximum frequency*. | | | |
| 808 | Forward rotation speed limit | 0.01Hz | 60Hz | 0 to 120Hz | Set the speed limit level during forward rotation. (valid when *Pr. 807* = 1) | ○ | ○ | ○ |
| 809 | Reverse rotation speed limit | 0.01Hz | 9999 | 0 to 120Hz | Set the speed limit level during reverse rotation. (valid when *Pr. 807* = 1) | ○ | ○ | ○ |
| | | | | 9999 | As set in *Pr. 808*. | | | |
| 810 | Refer to *Pr. 22*. | | | | | | | |
| 811 | Refer to *Pr. 22* and *Pr. 37*. | | | | | | | |
| 812 to 817 | Refer to *Pr. 22*. | | | | | | | |
| **Gain adjustment — Easy gain tuning selection (Pr.818, Pr.819)** | | | | | | | | |
| 818 | Easy gain tuning response level setting | 1 | 2 | 1 to 15 | 1 : Slow response ↓ 15 : Fast response | ○ | ○ | ○ |
| 819 | Easy gain tuning selection | 1 | 0 | 0 | No tuning | ○ | × | ○ |
| | | | | 1 | With load estimation (only under vector control) — The optimum gain is automatically set from the torque command and speed during motor operation. | | | |
| | | | | 2 | Manual input of load (*Pr. 880*) — The optimum gain is automatically set from the torque command and speed during motor operation. | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Gain adjustment — Proportional gain setting for speed loops(Pr.820, Pr.830)** | | | | | | | | | |
| 820 | | Speed control P gain 1 | 1% | 60% * | 0 to 1000% | Set the proportional gain for speed control. (Increasing the value improves trackability in response to a speed command change and reduces speed variation with disturbance.) | ○ | ○ | ○ |
| | *830* | Speed control P gain 2 | 1% | 9999 | 0 to 1000% | Second function of *Pr. 820* (valid when RT signal is on) | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |
| **Gain adjustment — Speed control integral time setting (Pr.821, Pr.822)** | | | | | | | | | |
| 821 | | Speed control integral time 1 | 0.001s | 0.333s | 0 to 20s | Set the integral time during speed control. (Decrease the value to shorten the time taken for returning to the original speed if speed variation with disturbance occurs.) | ○ | ○ | ○ |
| | *831* | Speed control integral time 2 | 0.001s | 9999 | 0 to 20s | Second function of *Pr. 821* (valid when the RT terminal is on) | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| 822 | | Refer to *Pr. 74*. | | | | | | | |
| **Speed/torque detection filter — Speed detection filter function (Pr.823, Pr.833)** | | | | | | | | | |
| 823 | | Speed detection filter 1 | 0.001s | 0.001s | 0 to 0.1s | Set the primary delay filter for the speed feedback. | ○ | ○ | ○ |
| | *833* | Speed detection filter 2 | 0.001s | 9999 | 0 to 0.1s | Second function of *Pr. 823* (valid when RT signal is on) | ○ | ○ | ○ |
| | | | | | 9999 | No function | ○ | ○ | ○ |
| **Gain adjustment — Current loop proportional gain setting (Pr.824, Pr.834)** | | | | | | | | | |
| 824 | | Torque control P gain 1 (current loop proportional gain) | 1% | 100% | 0 to 200% | Set the proportional gain for the current control of the q and d axes. (Increasing the value improves trackability in response to a current command change and reduces current variation with disturbance.) | ○ | ○ | ○ |
| | *834* | Torque control P gain 2 | 1% | 9999 | 0 to 200% | Second function of *Pr. 824* (valid when the RT terminal is on) | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| **Gain adjustment — Current control integral time setting (Pr.825, Pr.835)** | | | | | | | | | |
| 825 | | Torque control integral time 1 (current loop integral time) | 0.1ms | 5ms * | 0 to 500ms | Set the integral time for the current control of the q and d axes. (Decreasing the value shortens the time taken to return to the original torque if current variation with disturbance occurs.) | ○ | ○ | ○ |
| | *835* | Torque control integral time 2 | 0.1ms | 9999 | 0 to 500ms | Second function of *Pr. 825* (valid when the RT signal is on) | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| * Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |
| 826 | | Refer to *Pr. 74*. | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| **Speed/torque detection filter — Torque detection filter function (Pr.827, Pr.837)** | | | | | | | Sensorless Vector P M | | |
| 827 | | Torque detection filter 1 | 0.001s | 0s | 0 to 0.1s | Set the time constant of the primary delay filter relative to the torque feedback signal. | ○ | ○ | ○ |
| | *837* | Torque detection filter 2 | 0.001s | 9999 | 0 to 0.1s | Second function of *Pr. 827* (valid when the RT signal is on) | ○ | ○ | ○ |
| | | | | | 9999 | No function | | | |
| **Speed control — Speed feed forward control, model adaptive speed control (Pr.828, Pr.877 to Pr.881)** | | | | | | | Sensorless Vector P M | | |
| 828 | | Model speed control gain | 1% | 60% | 0 to 1000% | Set the gain for model speed controller. | ○ | ○ | ○ |
| | *877* | Speed feed forward control/model adaptive speed control selection | 1 | 0 | 0 | Normal speed control is exercised | ○ | ○ | ○ |
| | | | | | 1 | Speed feed forward control is exercised. | | | |
| | | | | | 2 | Model adaptive speed control is enabled. | | | |
| | *878* | Speed feed forward filter | 0.01s | 0s | 0 to 1s | Set the primary delay filter for the speed feed forward result calculated using the speed command and load inertia ratio. | ○ | ○ | ○ |
| | *879* | Speed feed forward torque limit | 0.1% | 150% | 0 to 400% | Limits the maximum value of the speed feed forward torque. | ○ | ○ | ○ |
| | *880* | Load inertia ratio | 0.1 | 7 | 0 to 200 times | Set the load inertia ratio.<br>Inertia ratio found by easy gain turning. | ○ | × | ○ |
| | *881* | Speed feed forward gain | 1% | 0% | 0 to 1000% | Set the feed forward calculation result as a gain. | ○ | ○ | ○ |
| 830 | | Refer to *Pr. 820*. | | | | | | | |
| 831 | | Refer to *Pr. 821*. | | | | | | | |
| 832 | | Refer to *Pr. 74*. | | | | | | | |
| 833 | | Refer to *Pr. 823*. | | | | | | | |
| 834 | | Refer to *Pr. 824*. | | | | | | | |
| 835 | | Refer to *Pr. 825*. | | | | | | | |
| 836 | | Refer to *Pr. 74*. | | | | | | | |
| 837 | | Refer to *Pr. 827*. | | | | | | | |
| **Speed control — Torque bias function (Pr.840 to Pr.848)** | | | | | | | Vector | | |
| 840 | | Torque bias selection | 1 | 9999 | 0 | Set the contact signal (X42, X43) based-torque bias amount using *Pr.841* to *Pr.843*. | ○ | ○ | ○ |
| | | | | | 1 | Set the terminal 1-based torque bias amount as desired in *C16* to *C19*. (forward rotation) | | | |
| | | | | | 2 | Set the terminal 1-based torque bias amount as desired in *C16* to *C19*. (reverse rotation) | | | |
| | | | | | 3 | The terminal 1-based torque bias amount can be set automatically in *C16* to *C19*, *Pr.846* according to the load. | | | |
| | | | | | 9999 | Without torque bias, rated torque 100% | | | |
| 841 | | Torque bias 1 | 1% | 9999 | 600 to 999% | Negative torque bias amount (-400% to -1%) | ○ | ○ | ○ |
| 842 | | Torque bias 2 | | | 1000 to 1400% | Positive torque bias amount (0% to 400%) | | | |
| 843 | | Torque bias 3 | | | 9999 | Without torque bias setting | | | |
| 844 | | Torque bias filter | 0.001s | 9999 | 0 to 5s | Time until torque rises. | ○ | ○ | ○ |
| | | | | | 9999 | Same operation as when 0s is set. | | | |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| 845 | Torque bias operation time | 0.01s | 9999 | 0 to 5s | Time for maintaining torque equivalent to the torque bias amount. | ○ | ○ | ○ |
| | | | | 9999 | Same operation as when 0s is set. | | | |
| 846 | Torque bias balance compensation | 0.1V | 9999 | 0 to 10V | Set the voltage under balanced load. | ○ | ○ | ○ |
| | | | | 9999 | Same operation as when 0V is set. | | | |
| 847 | Fall-time torque bias terminal 1 bias | 1% | 9999 | 0 to 400% | Set the bias value of the torque command. | ○ | ○ | ○ |
| | | | | 9999 | Same as at a rise time (*C16*, *C17*). | | | |
| 848 | Fall-time torque bias terminal 1 gain | 1% | 9999 | 0 to 400% | Set the gain value of the torque command. | ○ | ○ | ○ |
| | | | | 9999 | Same as at a rise time (*C18*, *C19*). | | | |
| 849 | Refer to *Pr. 74*. | | | | | | | |
| 850 | Refer to *Pr. 10 to Pr. 12*. | | | | | | | |
| 853 | Refer to *Pr. 285*. | | | | | | | |
| **Position control — Excitation ratio (Pr.854)** | | | | | | | | |
| 854 | Excitation ratio | 1% | 100% | 0 to 100% | Set the excitation ratio under no load. | ○ | ○ | ○ |
| **Frequency and torque setting by analog input — Function assignment of analog input terminal (Pr.858, Pr.868)** | | | | | | | | |
| 858 | Terminal 4 function assignment | 1 | 0 | 0 | Frequency/speed command | ○ | × | ○ |
| | | | | 1 | Magnetic flux command | | | |
| | | | | 4 | Stall prevention/torque limit | | | |
| | | | | 9999 | No function | | | |
| *868* | Terminal 1 function assignment | 1 | 0 | 0 | Frequency setting auxiliary | ○ | × | ○ |
| | | | | 1 | Magnetic flux command | | | |
| | | | | 2 | Regenerative torque limit | | | |
| | | | | 3 | Torque command | | | |
| | | | | 4 | Stall prevention/torque limit/torque command | | | |
| | | | | 5 | Forward/reverse rotation speed limit | | | |
| | | | | 6 | Torque bias | | | |
| | | | | 9999 | No function | | | |
| 859 | Refer to *Pr. 82 to Pr. 84*. | | | | | | | |
| 860 | Refer to *Pr. 455 to Pr. 463*. | | | | | | | |
| **Speed control — Notch filter (Pr.862, Pr.863)** | | | | | | | | |
| 862 | Notch filter time constant | 1 | 0 | 0 to 60 | You can use the machine resonance speed to make this setting to reduce the response level of the machine resonance frequency band, avoiding machine resonance. | ○ | ○ | ○ |
| 863 | Notch filter depth | 1 | 0 | 0 | Deep (-40dB) | ○ | ○ | ○ |
| | | | | 1 | ↑ (-14dB) | | | |
| | | | | 2 | ↓ (-8dB) | | | |
| | | | | 3 | Shallow (-4dB) | | | |
| **Detection of output frequency, current, and torque — Torque detection (Pr.864)** | | | | | | | | |
| 864 | Torque detection | 0.1% | 150% | 0 to 400% | You can make setting to output a signal if the motor torque exceeds the predetermined value. | ○ | ○ | ○ |
| 865 | Refer to *Pr. 41 to Pr. 43*. | | | | | | | |
| 866 | Refer to *Pr. 55, Pr. 56*. | | | | | | | |
| 867 | Refer to *Pr. 52, Pr. 54*. | | | | | | | |

| Parameter | Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|---|
| 868 | | Refer to *Pr. 858*. | | | | | | | |
| 870 | | Refer to *Pr. 41 to Pr. 43*. | | | | | | | |
| 872 | | Refer to *Pr. 251*. | | | | | | | |
| **Speed control — Frequency limit (Pr.873)** | | | | | | | | | |
| 873 | | Speed limit | 0.01Hz | 20Hz | 0 to 120Hz | Frequency is limited at the set frequency + *Pr.873* during vector control. | ○ | ○ | ○ |
| 874 | | Refer to *Pr. 22*. | | | | | | | |
| **Operation setting at fault occurrence — Fault definition (Pr.875)** | | | | | | | | | |
| 875 | | Fault definition | 1 | 0 | 0 | At occurrence of any fault, output is shut off immediately. At this time, the fault output also turns on. | ○ | ○ | ○ |
| | | | | | 1 | At occurrence of external thermal operation (OHT), electronic thermal relay function (THM) or PTC thermistor function (PTC) fault, the motor is decelerated to a stop. At occurrence of a fault other than OHT, THM and PTC, inverter trips immediately. Same operation as when "0" is set is performed under position control. | | | |
| 877 to 881 | | Refer to *Pr. 828*. | | | | | | | |
| **Operation setting at fault occurrence — Regeneration avoidance function (Pr.882 to Pr.886, Pr.665)**<br>**Acceleration/deceleration time/pattern adjustment — Regeneration avoidance function (Pr.882 to Pr.886, Pr.665)** | | | | | | | | | |
| 882 | | Regeneration avoidance operation selection | 1 | 0 | 0 | Regeneration avoidance function invalid | ○ | ○ | ○ |
| | | | | | 1 | Regeneration avoidance function is always valid | | | |
| | | | | | 2 | Regeneration avoidance function is valid only at constant speed | | | |
| 883 | | Regeneration avoidance operation level | 0.1V | 380 / 760VDC *1 | 300 to 800V | Set the bus voltage level at which regeneration avoidance operates. When the bus voltage level is set to low, overvoltage error will be less apt to occur. However, the actual deceleration time increases. The set value must be higher than the power supply voltage × $\sqrt{2}$ | ○ | ○ | ○ |
| 884 | | Regeneration avoidance at deceleration detection sensitivity | 1 | 0 | 0 | Regeneration avoidance by bus voltage change ratio is invalid | ○ | ○ | ○ |
| | | | | | 1 to 5 | Set sensitivity to detect the bus voltage change. Setting: 1 → 5 Detection sensitivity: Low → High | | | |
| 885 | | Regeneration avoidance compensation frequency limit value | 0.01Hz | 6Hz *2 | 0 to 30Hz | Set the limit value of frequency which rises at activation of regeneration avoidance function. | ○ | ○ | ○ |
| | | | | | 9999 | Frequency limit invalid | | | |
| 886 | | Regeneration avoidance voltage gain | 0.1% | 100% | 0 to 200% | Adjust responsiveness at activation of regeneration avoidance. Setting a larger value in *Pr.886* will improve responsiveness to the bus voltage change. However, the output frequency could become unstable. When vibration is not suppressed by decreasing the *Pr.886* setting, set a smaller value in *Pr.665*. | ○ | ○ | ○ |
| | 665 | Regeneration avoidance frequency gain | 0.1% | 100% | 0 to 200% | | ○ | ○ | ○ |
| *1 The initial values differ according to the voltage level. (200V/400V)<br>*2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | | |
| **Useful functions — Free parameter (Pr.888, Pr.889)** | | | | | | | | | |
| 888 | | Free parameter 1 | 1 | 9999 | 0 to 9999 | Parameters you can use for your own purposes. Used for maintenance, management, etc. by setting a unique number to each inverter when multiple inverters are used. Data is held even if the inverter power is turned off. | ○ | × | × |
| 889 | | Free parameter 2 | 1 | 9999 | 0 to 9999 | | ○ | × | × |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| **Useful functions (Energy saving operation) — How much energy can be saved (energy saving monitor) (Pr.891 to Pr.899)** | | | | | | | | |
| 891 | Cumulative power monitor digit shifted times | 1 | 9999 | 0 to 4 | Set the number of times to shift the cumulative power monitor digit.<br>Clamps the monitor value at maximum. | ○ | ○ | ○ |
| | | | | 9999 | No shift<br>Clears the monitor value when it exceeds the maximum value. | | | |
| 892 | Load factor | 0.1% | 100% | 30 to 150% | Set the load factor for commercial power supply operation.<br>This value is used to calculate the power consumption estimated value during commercial power supply operation. | ○ | ○ | ○ |
| 893 | Energy saving monitor reference (motor capacity) | 0.01/ 0.1kW *1 | Inverter rated capacity *2 | 0.1 to 55/ 0 to 3600kW *1 | Set the motor capacity (pump capacity).<br>Set when calculating power saving rate, average power saving rate, commercial power supply operation power. | ○ | ○ | ○ |
| 894 | Control selection during commercial power-supply operation | 1 | 0 | 0 | Discharge damper control (fan) | ○ | ○ | ○ |
| | | | | 1 | Inlet damper control (fan) | | | |
| | | | | 2 | Valve control (pump) | | | |
| | | | | 3 | Commercial power-supply drive (fixed value) | | | |
| 895 | Power saving rate reference value | 1 | 9999 | 0 | Consider the value during commercial power-supply operation as 100% | ○ | ○ | ○ |
| | | | | 1 | Consider the *Pr. 893* setting as 100%. | | | |
| | | | | 9999 | No function | | | |
| 896 | Power unit cost | 0.01 | 9999 | 0 to 500 | Set the power unit cost. Displays the power saving rate on the energy saving monitor | ○ | ○ | ○ |
| | | | | 9999 | No function | | | |
| 897 | Power saving monitor average time | 1h | 9999 | 0 | Average for 30 minutes | ○ | ○ | ○ |
| | | | | 1 to 1000h | Average for the set time | | | |
| | | | | 9999 | No function | | | |
| 898 | Power saving cumulative monitor clear | 1 | 9999 | 0 | Cumulative monitor value clear | ○ | × | ○ |
| | | | | 1 | Cumulative monitor value hold | | | |
| | | | | 10 | Cumulative monitor continue (communication data upper limit 9999) | | | |
| | | | | 9999 | Cumulative monitor continue (communication data upper limit 65535) | | | |
| 899 | Operation time rate (estimated value) | 0.1% | 9999 | 0 to 100% | Use for calculation of annual power saving amount.<br>Set the annual operation ratio (consider 365 days × 24h as 100%). | ○ | ○ | ○ |
| | | | | 9999 | No function | | | |
| *1 The increments and setting range differ according to the inverter capacity. (55K or lower/75K or higher)<br>*2 Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | |
| **Monitor display and monitor output signal — Adjustment of terminal FM and AM (calibration) (C0(Pr.900), C1(Pr.901))** | | | | | | | | |
| C0 (900) | FM terminal calibration | – | – | – | Calibrate the scale of the meter connected to terminal FM. (Only when *Pr. 291* = 0, 1) | ○ | × | ○ |
| C1 (901) | AM terminal calibration | – | – | – | Calibrate the scale of the analog meter connected to terminal AM. | ○ | × | ○ |
| C2(902) to C7(905) | Refer to *Pr. 125 and Pr. 126*. | | | | | | | |
| The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07). | | | | | | | | |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| **Frequency and torque setting by analog input — Speed limit setting voltage bias and gain (C12(Pr.917) to C15(Pr.918))** | | | | | | | | |
| C12 (917) | Terminal 1 bias frequency (speed) | 0.01Hz | 0Hz | 0 to 400Hz | Set the frequency on the bias side of terminal 1 input. (valid when *Pr.868* = 5) | ○ | × | ○ |
| C13 (917) | Terminal 1 bias (speed) | 0.1% | 0% | 0 to 300% | Set the converted % of the bias side voltage of terminal 1 input. (valid when *Pr.868* = 5) | ○ | × | ○ |
| C14 (918) | Terminal 1 gain frequency (speed) | 0.01Hz | 60Hz * | 0 to 400Hz | Set the frequency of terminal 1 input gain (maximum). (valid when *Pr.868* = 5) | ○ | × | ○ |
| C15 (918) | Terminal 1 gain (speed) | 0.1% | 100% | 0 to 300% | Set the converted % of the gain side voltage of terminal 1 input. (valid when *Pr.868* = 5) | ○ | × | ○ |
| The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).<br>* Performing IPM parameter initialization changes the settings. (Refer to *page 74*) | | | | | | | | |
| **Frequency and torque setting by analog input — Torque (magnetic flux) setting voltage (current) bias and gain (C16(Pr.919) to C19(Pr.920), C38(Pr.932) to C41(Pr.933))** | | | | | | | | |
| C16 (919) | Terminal 1 bias command (torque/ magnetic flux) | 0.1% | 0% | 0 to 400% | Set the torque/magnetic flux command value on the bias side of terminal 1 input. (valid when *Pr. 868* ≠ 0, 5) | ○ | × | ○ |
| C17 (919) | Terminal 1 bias (torque/magnetic flux) | 0.1% | 0% | 0 to 300% | Set the converted % of the bias side voltage of terminal 1 input. (valid when *Pr. 868* ≠ 0, 5) | ○ | × | ○ |
| C18 (920) | Terminal 1 gain command (torque/ magnetic flux) | 0.1% | 150% | 0 to 400% | Set the torque/magnetic flux command value on the gain side of terminal 1 input. (valid when *Pr. 868* ≠ 0, 5) | ○ | × | ○ |
| C19 (920) | Terminal 1 gain (torque/magnetic flux) | 0.1% | 100% | 0 to 300% | Set the converted % of the gain side voltage of terminal 1 input. (valid when *Pr. 868* ≠ 0, 5) | ○ | × | ○ |
| C38 (932) | Terminal 4 bias command (torque/ magnetic flux) | 0.1% | 0% | 0 to 400% | Set the torque/magnetic flux command value on the bias side of terminal 4 input. (valid when *Pr. 858* = 1, 4) | ○ | × | ○ |
| C39 (932) | Terminal 4 bias (torque/magnetic flux) | 0.1% | 20% | 0 to 300% | Set the converted % of the bias side current (voltage) of terminal 4 input. (valid when *Pr. 858* = 1, 4) | ○ | × | ○ |
| C40 (933) | Terminal 4 gain command (torque/ magnetic flux) | 0.1% | 150% | 0 to 400% | Set the torque/magnetic flux command value on the bias side of terminal 4 input. (valid when *Pr. 858* = 1, 4) | ○ | × | ○ |
| C41 (933) | Terminal 4 gain (torque/magnetic flux) | 0.1% | 100% | 0 to 300% | Set the converted % of the gain side current (voltage) of terminal 4 input. (valid when *Pr. 858* = 1, 4) | ○ | × | ○ |
| The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07). | | | | | | | | |
| **Useful functions — Parameter copy alarm release (Pr.989)** | | | | | | | | |
| 989 | Parameter copy alarm release | 1 | 10/100 * | 10, 100 | Parameters for alarm release at parameter copy | ○ | × | ○ |
| * The initial value differs according to the inverter capacity. (55K or lower/75K or higher) | | | | | | | | |
| **Setting of the parameter unit and operation panel — Buzzer control of the operation panel (Pr.990)** | | | | | | | | |
| 990 | PU buzzer control | 1 | 1 | 0 | Without buzzer | ○ | ○ | ○ |
| | | | | 1 | With buzzer | | | |

| Parameter / Related parameters | Name | Increments | Initial Value | Range | Description | Parameter copy | Parameter clear | All parameter clear |
|---|---|---|---|---|---|---|---|---|
| **Setting of the parameter unit and operation panel — PU contrast adjustment (Pr.991)** | | | | | | | | |
| 991 | PU contrast adjustment | 1 | 58 | 0 to 63 | Contrast adjustment of the LCD of the parameter unit (FR-PU04/FR-PU07) can be performed.<br>0 (Light) → 63 (Dark) | ○ | × | ○ |
| 994, 995 | Refer to *Pr. 286 to Pr. 288*. | | | | | | | |
| **PM sensorless vector control — IPM parameter initialization (Pr.998)** | | | | | | | | |
| 998 ◎ | IPM parameter initialization | 1 | 0 | 0 | Parameter settings for a general-purpose motor (frequency) | × | × | × |
| | | | | 3003 | Parameter settings for an MM-CF IPM motor (rotations per minute) | | | |
| | | | | 3103 | Parameter settings for an MM-CF IPM motor (frequency) | | | |
| | | | | 8009 | Parameter (rotations per minute) settings for an IPM motor other than MM-CF (after tuning) | | | |
| | | | | 8109 | Parameter (frequency) settings for an IPM motor other than MM-CF (after tuning) | | | |
| **Useful functions — Automatic parameter setting (Pr.999)** | | | | | | | | |
| 999 ◎ | Automatic parameter setting | 1 | 9999 | 10 | GOT initial setting (PU connector) | × | × | × |
| | | | | 11 | GOT initial setting (RS-485 terminals) | | | |
| | | | | 20 | 50Hz rated frequency | | | |
| | | | | 21 | 60Hz rated frequency | | | |
| | | | | 30 | Acceleration/deceleration time (0.1s increment) | | | |
| | | | | 31 | Acceleration/deceleration time (0.01s increment) | | | |
| | | | | 9999 | No action | | | |
| **Useful functions — Parameter clear, parameter copy, and automatic parameter setting (Pr.CL, ALLC, Er.CL, PCPY, IPM, AUTO)** | | | | | | | | |
| Pr.CL | Parameter clear | 1 | 0 | 0, 1 | Setting "1" returns all parameters except calibration parameters to the initial values. | | | |
| ALLC | All parameter clear | 1 | 0 | 0, 1 | Setting "1" returns all parameters to the initial values. | | | |
| Er.CL | Faults history clear | 1 | 0 | 0, 1 | Setting "1" will clear eight past faults. | | | |
| PCPY | Parameter copy | 1 | 0 | 0 | Cancel | | | |
| | | | | 1 | Read the source parameters to the operation panel. | | | |
| | | | | 2 | Write the parameters copied to the operation panel to the destination inverter. | | | |
| | | | | 3 | Verify parameters in the inverter and operation panel. | | | |
| IPM | IPM parameter initialization | 1 | 0 | 0, 3003 | When "3003" is set, the parameters required to drive an IPM motor are automatically changed as a batch. | | | |
| AUTO | Automatic parameter setting | — | — | — | Parameter settings are changed as a batch. Those include communication parameter settings for a GOT connection, rated frequency settings of 50Hz/60Hz, and acceleration/deceleration time increment settings. | | | |

# 4 TROUBLESHOOTING

When a fault occurs in the inverter, the inverter trips and the PU display automatically changes to one of the following fault or alarm indications.
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 fault output signal ..... When the magnetic contactor (MC) provided on the input side of the inverter is opened when a fault occurs, the inverter's control power will be lost and the fault output will not be held.
- Fault or alarm indication ..... When a fault or alarm occurs, the operation panel display automatically switches to the fault or alarm indication
- Resetting method ..... When a fault occurs, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart. *(Refer to page 149.)*
- When any fault occurs, take the appropriate corrective action, then reset the inverter, and resume operation. Not doing so may lead to the inverter fault and damage.

Inverter fault or alarm indications are roughly categorized as below.

(1) Error message
A message regarding operational fault and setting fault by the operation panel (FR-DU07) and parameter unit (FR-PU04 /FR-PU07) is displayed. The inverter does not trip.

(2) Warning
The inverter does not trip even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.

(3) Alarm
The inverter does not trip. You can also output an alarm signal by making parameter setting.

(4) Fault
When a fault occurs, the inverter trips and a fault signal is output.

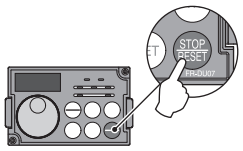
**REMARKS**

· Past eight faults can be displayed using the setting dial. (*Refer to page 167* for the operation.)

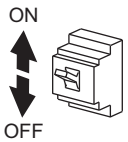
## 4.1 Reset method of protective function

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

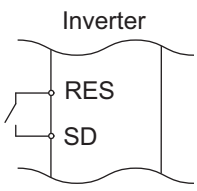
Operation 1: ..... Using the operation panel, press STOP RESET to reset the inverter.
(This may only be performed when a fault occurs. (Refer to *page 155* for fault.))




Operation 2:..... Switch power OFF once, then switch it ON again.




Operation 3: ..... Turn ON the reset signal (RES) for more than 0.1s. (If the RES signal is kept ON, "Err." appears (flickers) to indicate that the inverter is in a reset status.)




**CAUTION**

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

# 4.2 List of fault or alarm display

| Operation Panel Indication | | | Name | Refer to |
|---|---|---|---|---|
| Error message | E - - - | E - - - | Faults history | 167 |
| | HOLd | HOLD | Operation panel lock | 151 |
| | LOCd | LOCD | Password locked | 151 |
| | Er1 to Er4 | Er1 to 4 | Parameter write error | 151 |
| | rE1 to rE4 | rE1 to 4 | Copy operation error | 152 |
| | Err. | Err. | Error | 152 |
| Warning | OL | OL | Stall prevention (overcurrent) | 153 |
| | oL | oL | Stall prevention (overvoltage) | 153 |
| | rb | RB | Regenerative brake pre-alarm | 154 |
| | TH | TH | Electronic thermal relay function pre-alarm | 154 |
| | PS | PS | PU stop | 153 |
| | MT | MT | Maintenance signal output | 154 |
| | CP | CP | Parameter copy | 154 |
| | SL | SL | Speed limit indication (Output during speed limit) | 154 |
| Alarm | FN | FN | Fan alarm | 155 |
| Fault | E.OC1 | E.OC1 | Overcurrent trip during acceleration | 155 |
| | E.OC2 | E.OC2 | Overcurrent trip during constant speed | 156 |
| | E.OC3 | E.OC3 | Overcurrent trip during deceleration or stop | 156 |
| | E.OV1 | E.OV1 | Regenerative overvoltage trip during acceleration | 156 |
| | E.OV2 | E.OV2 | Regenerative overvoltage trip during constant speed | 157 |
| | E.OV3 | E.OV3 | Regenerative overvoltage trip during deceleration or stop | 157 |
| | E.THT | E.THT | Inverter overload trip (electronic thermal relay function) | 157 |
| | E.THM | E.THM | Motor overload trip (electronic thermal relay function) | 158 |
| | E.FIN | E.FIN | Heatsink overheat | 158 |
| | E.IPF | E.IPF | Instantaneous power failure | 158 |
| | E.UVT | E.UVT | Undervoltage | 159 |
| | E.ILF | E.ILF * | Input phase loss | 159 |
| | E.OLT | E.OLT | Stall prevention stop | 159 |
| | E.SOT | E.SOT * | Loss of synchronism detection | 160 |
| | E. GF | E.GF | Output side earth (ground) fault overcurrent | 160 |
| | E. LF | E.LF | Output phase loss | 160 |

| Operation Panel Indication | | | Name | Refer to |
|---|---|---|---|---|
| Fault | E.OHT | E.OHT | External thermal relay operation | 160 |
| | E.PTC | E.PTC * | PTC thermistor operation | 160 |
| | E.OPT | E.OPT | Option fault | 161 |
| | E.OP3 | E.OP3 | Communication option fault | 161 |
| | E. 1 to E. 3 | E. 1 to E. 3 | Option fault | 161 |
| | E. PE | E.PE | Parameter storage device fault | 161 |
| | E.PUE | E.PUE | PU disconnection | 162 |
| | E.rET | E.RET | Retry count excess | 162 |
| | E.PE2 | E.PE2 * | Parameter storage device fault | 162 |
| | E. 5 to E. 7 E.CPU | E. 5 to E. 7 E.CPU | CPU fault | 162 |
| | E.CTE | E.CTE | RS-485 terminal power supply short circuit | 162 |
| | E.P24 | E.P24 | 24VDC power output short circuit | 164 |
| | E.CDO | E.CDO * | Output current detection value exceeded | 164 |
| | E.IOH | E.IOH * | Inrush current limit circuit fault | 164 |
| | E.SER | E.SER * | Communication fault (inverter) | 165 |
| | E.AIE | E.AIE * | Analog input fault | 165 |
| | E. OS | E.OS | Overspeed occurrence | 163 |
| | E.OSD | E.OSD | Speed deviation excess detection | 163 |
| | E.ECT | E.ECT | Signal loss detection | 163 |
| | E. Od | E.OD | Excessive position fault | 164 |
| | E.MB1 to E.MB7 | E.MB1 to E.MB7 | Brake sequence fault | 163 |
| | E.EP | E.EP | Encoder phase fault | 164 |
| | E. bE | E.BE | Brake transistor alarm detection | 158 |
| | E.USB | E.USB * | USB communication fault | 165 |
| | E. 11 | E.11 | Opposite rotation deceleration fault | 165 |
| | E. 13 | E.13 | Internal circuit fault | 165 |

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

* If a fault occurs when using the FR-PU04, "Fault 14" is displayed on the FR-PU04.

## 4.3 Causes and corrective actions

(1) Error message

A message regarding operational troubles is displayed. Output is not shut off.

| Operation Panel Indication | HOLD | HOLd |
|---|---|---|
| Name | Operation panel lock | |
| Description | Operation lock mode is set. Operation other than STOP RESET is invalid. *(Refer to page 52.)* | |
| Check point | — | |
| Corrective action | Press MODE for 2s to release lock. | |

| Operation Panel Indication | LOCD | LOCd |
|---|---|---|
| Name | Password locked | |
| Description | Password function is active. Display and setting of parameter is restricted. | |
| Check point | — | |
| Corrective action | Enter the password in *Pr. 297 Password lock/unlock* to unlock the password function before operating. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | |

| Operation Panel Indication | Er1 | Er 1 |
|---|---|---|
| Name | Write disable error | |
| Description | · You attempted to make parameter setting when *Pr. 77 Parameter write selection* has been set to disable parameter write.<br>· Frequency jump setting range overlapped.<br>· Adjustable 5 points V/F settings overlapped<br>· The PU and inverter cannot make normal communication<br>· Appears if IPM parameter initialization is attempted in the parameter setting mode while *Pr. 72* = "25". | |
| Check point | · Check the setting of *Pr. 77 Parameter write selection (Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check the settings of *Pr. 31 to 36 (frequency jump). (Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check the settings of *Pr. 100 to Pr. 109 (adjustable 5 points V/F). (Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check the connection of the PU and inverter.<br>· Check the *Pr. 72 PWM frequency selection* setting. A sine wave filter cannot be used under PM sensorless vector control. | |

| Operation Panel Indication | Er2 | Er2 |
|---|---|---|
| Name | Write error during operation | |
| Description | When parameter write was performed during operation with a value other than "2" (writing is enabled independently of operating status in any operation mode) is set in *Pr. 77* and the STF (STR) is ON. | |
| Check point | · Check the *Pr. 77* setting. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check that the inverter is not operating. | |
| Corrective action | · Set "2" in *Pr. 77*.<br>· After stopping operation, make parameter setting. | |

| Operation Panel Indication | Er3 | Er3 |
|---|---|---|
| Name | Calibration error | |
| Description | Analog input bias and gain calibration values are too close. | |
| Check point | Check the settings of C3, C4, C6 and C7 (calibration functions). *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | |

| Operation Panel Indication | Er4 | Er4 |
|---|---|---|
| Name | Mode designation error | |
| Description | · Appears if a parameter setting is attempted in the External or NET operation mode with *Pr. 77* ≠ "2".<br>· Appears if a parameter setting is attempted when the command source is not at the operation panel. (FR-DU07). | |
| Check point | · Check that operation mode is "PU operation mode".<br>· Check the *Pr. 77* setting. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check the *Pr. 551* setting. | |
| Corrective action | · After setting the operation mode to the "PU operation mode", make parameter setting. *(Refer to page 63.)*<br>· After setting *Pr. 77* = "2", make parameter setting.<br>· Set *Pr.551* = "2 (initial value)". *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | |

| Operation Panel Indication | rE1 | rE1 |
|---|---|---|
| Name | Parameter read error | |
| Description | An error occurred in the EEPROM on the operation panel side during parameter copy reading. | |
| Check point | — | |
| Corrective action | · Make parameter copy again. *(Refer to page 56.)*<br>· Check for an operation panel (FR-DU07) failure. Please contact your sales representative. | |

| Operation Panel Indication | rE2 | rE2 |
|---|---|---|
| Name | Parameter write error | |
| Description | · You attempted to perform parameter copy write during operation.<br>· An error occurred in the EEPROM on the operation panel side during parameter copy writing. | |
| Check point | Is the FWD or REV LED of the operation panel (FR-DU07) lit or flickering? | |
| Corrective action | · After stopping operation, make parameter copy again. *(Refer to page 56.)*<br>· Check for an operation panel (FR-DU07) failure. Please contact your sales representative. | |

| Operation Panel Indication | rE3 | rE3 |
|---|---|---|
| Name | Parameter verification error | |
| Description | · Data on the operation panel side and inverter side are different.<br>· An error occurred in the EEPROM on the operation panel side during parameter verification. | |
| Check point | Check for the parameter setting of the source inverter and inverter to be verified. | |
| Corrective action | · Press (SET) to continue verification.<br>Make parameter verification again. *(Refer to page 57.)*<br>· Check for an operation panel (FR-DU07) failure. Please contact your sales representative. | |

| Operation Panel Indication | rE4 | rE4 |
|---|---|---|
| Name | Model error | |
| Description | · A different model was used for parameter write and verification during parameter copy.<br>· When parameter copy write is stopped after parameter copy read is stopped | |
| Check point | · Check that the verified inverter is the same model.<br>· Check that the power is not turned OFF or an operation panel is not disconnected, etc. during parameter copy read. | |
| Corrective action | · Use the same model (FR-A700 series) for parameter copy and verification.<br>· Perform parameter copy read again. | |

| Operation Panel Indication | Err. | Err. |
|---|---|---|
| Description | · The RES signal is on<br>· The PU and inverter cannot make normal communication (contact fault of the connector)<br>· When the voltage drops in the inverter's input side.<br>· When the control circuit power (R1/L11, S1/L21) and the main circuit power (R/L1, S/L2, T/L3) are connected to a separate power, it may appear at turning ON of the main circuit. It is not a fault. | |
| Corrective action | · Turn OFF the RES signal.<br>· Check the connection of the PU and inverter.<br>· Check the voltage on the inverter's input side. | |

(2) Warning

When the protective function is activated, the output is not shut off.

| Operation Panel Indication | OL |  | FR-PU04 FR-PU07 | OL |
|---|---|---|---|---|
| **Name** | Stall prevention (overcurrent) | | | |
| **Description** | During acceleration | When the output current (output torque during Real sensorless vector control or vector control) of the inverter exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function stops the increase in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has decreased below stall prevention operation level, this function increases the frequency again. | | |
| | During constant speed operation | When the output current (output torque during Real sensorless vector control or vector control) of the inverter exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function reduces frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has decreased below stall prevention operation level, this function increases the frequency up to the set value. | | |
| | During deceleration | When the output current (output torque during Real sensorless vector control or vector control) of the inverter exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function stops the decrease in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has decreased below stall prevention operation level, this function decreases the frequency again. | | |
| **Check point** | · Check that the *Pr. 0 Torque boost* setting is not too large.<br>· Check that the *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time* settings are not too small.<br>· Check that the load is not too heavy.<br>· Are there any failure in peripheral devices?<br>· Check that the *Pr. 13 Starting frequency* is not too large.<br>· Check the motor for use under overload.<br>· Check that *Pr. 22 Stall prevention operation level* is appropriate. | | | |
| **Corrective action** | · Increase or decrease the *Pr. 0 Torque boost* value 1% by 1% and check the motor status. *(Refer to page 60.)*<br>· Set a larger value in *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time*. *(Refer to page 61.)*<br>· Reduce the load weight.<br>· Try Advanced magnetic flux vector control, Real sensorless vector control or vector control.<br>· Change the *Pr. 14 Load pattern selection* setting.<br>· Set stall prevention operation current in *Pr. 22 Stall prevention operation level*. (The initial value is 150%.) The acceleration/deceleration time may change. Increase the stall prevention operation level with *Pr. 22 Stall prevention operation level*, or disable stall prevention with *Pr. 156 Stall prevention operation selection*. (Use *Pr. 156* to set either operation continued or not at OL operation.) | | | |

| Operation Panel Indication | oL |  | FR-PU04 FR-PU07 | oL |
|---|---|---|---|---|
| **Name** | Stall prevention (overvoltage) | | | |
| **Description** | During deceleration | · If the regenerative energy of the motor becomes excessive and exceeds the regenerative energy consumption capability, this function stops the decrease in frequency to prevent overvoltage trip. As soon as the regenerative energy has decreased, deceleration resumes.<br>· If the regenerative energy of the motor becomes excessive when regeneration avoidance function is selected (*Pr. 882* = 1), this function increases the speed to prevent overvoltage trip. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | |
| **Check point** | · Check for sudden speed reduction.<br>· Regeneration avoidance function *(Pr. 882 to Pr. 886)* is being used? *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |
| **Corrective action** | The deceleration time may change. Increase the deceleration time using *Pr. 8 Deceleration time*. | | | |

| Operation Panel Indication | PS |  | FR-PU04 FR-PU07 | PS |
|---|---|---|---|---|
| **Name** | PU stop | | | |
| **Description** | Stop with STOP RESET of the PU is set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*. (For *Pr. 75*, refer to *Chapter 4 of the Instruction Manual (Applied)*.) | | | |
| **Check point** | Check for a stop made by pressing STOP RESET of the operation panel. | | | |
| **Corrective action** | Turn the start signal OFF and release with PU EXT. | | | |

| Operation Panel Indication | RB | rb | FR-PU04 FR-PU07 | RB |
|---|---|---|---|---|
| **Name** | Regenerative brake pre-alarm | | | |
| **Description** | Appears if the regenerative brake duty reaches or exceeds 85% of the *Pr. 70 Special regenerative brake duty* value. For the 11K or higher, when the *Pr. 70* setting is the initial value (*Pr. 70* = "0"), this protective function is not available. If the regenerative brake duty reaches 100%, a regenerative overvoltage (E. OV_) occurs.<br>The RBP signal can be simultaneously output with the [RB] display. For the terminal used for the RBP signal output, assign the function by setting "7" (positive logic) or "107" (negative logic) in any of *Pr. 190 to Pr. 196 (output terminal function selection). (Refer to Chapter 4 of the Instruction Manual (Applied))* | | | |
| **Check point** | · Check that the brake resistor duty is not high.<br>· Check that the *Pr. 30 Regenerative function selection* and *Pr. 70 Special regenerative brake duty* values are correct. | | | |
| **Corrective action** | · Increase the deceleration time.<br>· Check the *Pr. 30 Regenerative function selection* and *Pr. 70 Special regenerative brake duty* values. | | | |

| Operation Panel Indication | TH | TH | FR-PU04 FR-PU07 | TH |
|---|---|---|---|---|
| **Name** | Electronic thermal relay function pre-alarm | | | |
| **Description** | Appears if the cumulative value of the *Pr. 9 Electronic thermal O/L relay* reaches or exceeds 85% of the preset level. If it reaches 100% of the *Pr. 9 Electronic thermal O/L relay* setting, a motor overload trip (E. THM) occurs.<br>The THP signal can be simultaneously output with the [TH] display. For the terminal used for the THP signal output, assign the function by setting "8" (positive logic) or "108" (negative logic) in any of *Pr. 190 to Pr. 196 (output terminal function selection). (Refer to Chapter 4 of the Instruction Manual (Applied))* | | | |
| **Check point** | · Check for large load or sudden acceleration.<br>· Is the *Pr. 9 Electronic thermal O/L relay* setting is appropriate? *(Refer to page 59.)* | | | |
| **Corrective action** | · Reduce the load weight or the number of operation times.<br>· Set an appropriate value in *Pr. 9 Electronic thermal O/L relay*. *(Refer to page 59.)* | | | |

| Operation Panel Indication | MT | MT | FR-PU04 | ——— |
|---|---|---|---|---|
| | | | FR-PU07 | MT |
| **Name** | Maintenance signal output | | | |
| **Description** | Indicates that the cumulative energization time of the inverter has reached a given time.<br>When the setting of *Pr. 504 Maintenance timer alarm output set time* is the initial value (*Pr. 504* = "9999"), this warning does not occur. | | | |
| **Check point** | The *Pr. 503 Maintenance timer* setting is larger than the *Pr. 504 Maintenance timer alarm output set time* setting. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |
| **Corrective action** | Setting "0" in *Pr. 503 Maintenance timer* erases the signal. | | | |

| Operation Panel Indication | CP | CP | FR-PU04 | ——— |
|---|---|---|---|---|
| | | | FR-PU07 | CP |
| **Name** | Parameter copy | | | |
| **Description** | Appears when parameters are copied between models with capacities of 55K or lower and 75K or higher. | | | |
| **Check point** | Resetting of *Pr. 9, Pr. 30, Pr. 51, Pr. 52, Pr. 54, Pr. 56, Pr. 57, Pr. 61, Pr. 70, Pr. 72, Pr. 80, Pr. 82, Pr. 90 to Pr. 94, Pr. 158, Pr. 455, Pr. 458 to Pr. 462, Pr. 557, Pr. 859, Pr. 860* and *Pr. 893* is necessary. | | | |
| **Corrective action** | Set the initial value in *Pr. 989 Parameter copy alarm release*. | | | |

| Operation Panel Indication | SL | SL | FR-PU04 | ——— |
|---|---|---|---|---|
| | | | FR-PU07 | SL |
| **Name** | Speed limit indication (output during speed limit) | | | |
| **Description** | Output if the speed limit level is exceeded during torque control. | | | |
| **Check point** | · Check that the torque command is not larger than required.<br>· Check that the speed limit level is not low. | | | |
| **Corrective action** | · Decrease the torque command.<br>· Increase the speed limit level. | | | |

(3) Alarm

When an alarm occurs, the output is not shut off. You can also output an alarm signal by making parameter setting. (Set "98" in any of *Pr. 190 to Pr. 196 (output terminal function selection)*. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*)

| Operation Panel Indication | FN | Fn | FR-PU04 FR-PU07 | FN |
|---|---|---|---|---|
| **Name** | Fan alarm | | | |
| **Description** | For the inverter that contains a cooling fan, Fn appears on the operation panel when the cooling fan stops due to a fault or different operation from the setting of *Pr. 244 Cooling fan operation selection*. | | | |
| **Check point** | Check the cooling fan for a fault. | | | |
| **Corrective action** | Check for fan fault. Please contact your sales representative. | | | |

(4) Fault

When a fault occurs, the inverter trips and a fault signal is output.

| Operation Panel Indication | E.OC1 | E.OC 1 | FR-PU04 FR-PU07 | OC During Acc |
|---|---|---|---|---|
| **Name** | Overcurrent trip during acceleration | | | |
| **Description** | When the inverter output current reaches or exceeds approximately 220% of the rated current during acceleration, the protective circuit is activated to stop the inverter output. | | | |
| **Check point** | · Check for sudden acceleration.<br>· Check that the downward acceleration time is not long in vertical lift application.<br>· Check for output short circuit.<br>· Check that the *Pr. 3 Base frequency* setting is not 60Hz when the rated motor frequency is 50Hz.<br>· Check if the stall prevention operation level is set too high.<br>Check if the fast-response current limit operation is disabled.<br>· Check that the regeneration is not performed frequently. (Check that the output voltage becomes larger than the V/F reference voltage at regeneration and overcurrent occurs due to the high voltage.)<br>· Check that the power supply for RS-485 terminal is not shorted. (under vector control)<br>· Check that the encoder wiring and the specifications (encoder power supply, resolution, differential/ complementary) are correct. Check also that the motor wiring (U, V, W) is correct. (under vector control)<br>· Check that the rotation direction is not switched from forward to reverse rotation (or from reverse to forward) during torque control under Real sensorless vector control.<br>· Check that the inverter capacity matches with the motor capacity. (PM sensorless vector control)<br>· Check if a start command is given to the inverter while the motor is coasting. (PM sensorless vector control) | | | |
| **Corrective action** | · Increase the acceleration time.<br>(Shorten the downward acceleration time in vertical lift application.)<br>· When "E.OC1" is always lit at starting, disconnect the motor once and start the inverter.<br>If "E.OC1" is still lit, contact your sales representative.<br>· Check the wiring to make sure that output short circuit does not occur.<br>· Set the *Pr. 3 Base frequency* to 50Hz. *(Refer to page 59.)*<br>· Lower the setting of stall prevention operation level.<br>Activate the fast-response current limit operation. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Set base voltage (rated voltage of the motor, etc.) in *Pr. 19 Base frequency voltage*. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check RS-485 terminal connection. (under vector control)<br>· Find the correct wiring and specifications for the encoder and the motor, and perform the setting accordingly. (under vector control) *(Refer to page 28.)*<br>· Prevent the motor from switching the rotation direction from forward to reverse (or from reverse to forward) during torque control under Real sensorless vector control.<br>· Choose inverter and motor capacities that match. (PM sensorless vector control)<br>· Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* (PM sensorless vector control) | | | |

| Operation Panel Indication | E.OC2 | E.OC2 | FR-PU04 FR-PU07 | Stedy Spd OC |
|---|---|---|---|---|
| **Name** | Overcurrent trip during constant speed | | | |
| **Description** | When the inverter output current reaches or exceeds approximately 220% of the rated current during constant speed operation, the protective circuit is activated to stop the inverter output. | | | |
| **Check point** | · Check for sudden load change.<br>· Check for output short circuit.<br>· Check if the stall prevention operation level is set too high.<br>Check if the fast-response current limit operation is disabled.<br>· Check that the power supply for RS-485 terminal is not shorted. (under vector control)<br>· Check that the rotation direction is not switched from forward to reverse rotation (or from reverse to forward) during torque control under Real sensorless vector control.<br>· Check that the inverter capacity matches with the motor capacity. (PM sensorless vector control)<br>· Check if a start command is given to the inverter while the motor is coasting. (PM sensorless vector control) | | | |
| **Corrective action** | · Keep load stable.<br>· Check the wiring to make sure that output short circuit does not occur.<br>· Lower the setting of stall prevention operation level. Activate the fast-response current limit operation. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)*<br>· Check RS-485 terminal connection. (under vector control)<br>· Prevent the motor from switching the rotation direction from forward to reverse (or from reverse to forward) during torque control under Real sensorless vector control.<br>· Choose inverter and motor capacities that match. (PM sensorless vector control)<br>· Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)* (PM sensorless vector control) | | | |

| Operation Panel Indication | E.OC3 | E.OC3 | FR-PU04 FR-PU07 | OC During Dec |
|---|---|---|---|---|
| **Name** | Overcurrent trip during deceleration or stop | | | |
| **Description** | When the inverter output current reaches or exceeds approximately 220% of the rated inverter current during deceleration (other than acceleration or constant speed), the protective circuit is activated to stop the inverter output. | | | |
| **Check point** | · Check for sudden speed reduction.<br>· Check for output short circuit.<br>· Check for too fast operation of the motor's mechanical brake.<br>· Check if the stall prevention operation level is set too high.<br>Check if the fast-response current limit operation is disabled.<br>· Check that the power supply for RS-485 terminal is not shorted. (under vector control)<br>· Check that the rotation direction is not switched from forward to reverse rotation (or from reverse to forward) during torque control under Real sensorless vector control.<br>· Check that the inverter capacity matches with the motor capacity. (PM sensorless vector control)<br>· Check if a start command is given to the inverter while the motor is coasting. (PM sensorless vector control) | | | |
| **Corrective action** | · Increase the deceleration time.<br>· Check the wiring to make sure that output short circuit does not occur.<br>· Check the mechanical brake operation.<br>· Lower the setting of stall prevention operation level. Activate the fast-response current limit operation. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)*<br>· Check RS-485 terminal connection. (under vector control)<br>· Prevent the motor from switching the rotation direction from forward to reverse (or from reverse to forward) during torque control under Real sensorless vector control.<br>· Choose inverter and motor capacities that match. (PM sensorless vector control)<br>· Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)* (PM sensorless vector control) | | | |

| Operation Panel Indication | E.OV1 | E.OV1 | FR-PU04 FR-PU07 | OV During Acc |
|---|---|---|---|---|
| **Name** | Regenerative overvoltage trip during acceleration | | | |
| **Description** | If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system. | | | |
| **Check point** | · Check for too slow acceleration. (e.g. during descending acceleration in vertical lift load)<br>· Check that the *Pr. 22 Stall prevention operation level* is not lower than the no load current.<br>· Check if the stall prevention operation is frequently activated in an application with a large load inertia. | | | |
| **Corrective action** | · Decrease the acceleration time.<br>· Use regeneration avoidance function *(Pr. 882 to Pr. 886)*. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)*<br>· Set a value larger than the no load current in *Pr. 22 Stall prevention operation level*.<br>· Set *Pr.154 Voltage reduction selection during stall prevention operation* = "10 or 11". *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)* | | | |

| Operation Panel Indication | E.OV2 | E.Ov2 | FR-PU04 FR-PU07 | Stedy Spd OV |
|---|---|---|---|---|
| **Name** | Regenerative overvoltage trip during constant speed | | | |
| **Description** | If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system. | | | |
| **Check point** | · Check for sudden load change.<br>· Check that the *Pr. 22 Stall prevention operation level* is not lower than the no load current.<br>· Check if the stall prevention operation is frequently activated in an application with a large load inertia. | | | |
| **Corrective action** | · Keep load stable.<br>· Use regeneration avoidance function *(Pr. 882 to Pr. 886). (Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Use the brake unit or power regeneration common converter (FR-CV) as required.<br>· Set a value larger than the no load current in *Pr. 22 Stall prevention operation level*.<br>· Set *Pr.154 Voltage reduction selection during stall prevention operation* = "10 or 11". *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |

| Operation Panel Indication | E.OV3 | E.Ov3 | FR-PU04 FR-PU07 | OV During Dec |
|---|---|---|---|---|
| **Name** | Regenerative overvoltage trip during deceleration or stop | | | |
| **Description** | If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system. | | | |
| **Check point** | · Check for sudden speed reduction.<br>· Check if the stall prevention operation is frequently activated in an application with a large load inertia. | | | |
| **Corrective action** | · Increase the deceleration time. (Set the deceleration time which matches the moment of inertia of the load)<br>· Longer the brake cycle.<br>· Use regeneration avoidance function *(Pr. 882 to Pr. 886). (Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Use the brake unit or power regeneration common converter (FR-CV) as required.<br>· Set *Pr.154 Voltage reduction selection during stall prevention operation* = "10 or 11". *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |

| Operation Panel Indication | E.THT | E.THT | FR-PU04 FR-PU07 | Inv. Ovrload |
|---|---|---|---|---|
| **Name** | Inverter overload trip (electronic thermal relay function) * | | | |
| **Description** | If a current not less than 150% of the rated output current flows and overcurrent trip does not occur (220% or less), the electronic thermal relay activates to stop the inverter output in order to protect the output transistors. (Overload capacity 150% 60s, inverse-time characteristic) | | | |
| **Check point** | · Check that acceleration/deceleration time is not too short.<br>· Check that torque boost setting is not too large (small).<br>· Check that load pattern selection setting is appropriate for the load pattern of the using machine.<br>· Check the motor for use under overload.<br>· Check that the encoder wiring and the specifications (encoder power supply, resolution, differential/ complementary) are correct. Check also that the motor wiring (U, V, W) is correct. (under vector control) | | | |
| **Corrective action** | · Increase acceleration/deceleration time.<br>· Adjust the torque boost setting.<br>· Set the load pattern selection setting according to the load pattern of the using machine.<br>· Reduce the load weight.<br>· Find the correct wiring and specifications for the encoder and the motor, and perform the setting accordingly. (under vector control) *(Refer to page 28.)* | | | |

* Resetting the inverter initializes the internal heat accumulated value of the electronic thermal relay function.

| Operation Panel Indication | E.THM | E.THM | FR-PU04 FR-PU07 | Motor Ovrload |
|---|---|---|---|---|
| **Name** | Motor overload trip (electronic thermal relay function) * | | | |
| **Description** | The electronic thermal relay function in the inverter detects motor overheat due to overload or reduced cooling capability during low-speed operation and pre-alarm (TH display) is output when the integrated value reaches 85% of the *Pr. 9 Electronic thermal O/L relay* setting and the protection circuit is activated to stop the inverter output when the integrated value reaches the specified value. When running a special motor such as a multi-pole motor or multiple motors, provide a thermal relay on the inverter output side since such motor(s) cannot be protected by the electronic thermal relay function. | | | |
| **Check point** | · Check the motor for use under overload.<br>· Check that the setting of *Pr. 71 Applied motor* for motor selection is correct. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check that stall prevention operation setting is correct. | | | |
| **Corrective action** | · Reduce the load weight.<br>· For a constant-torque motor, set the constant-torque motor in *Pr. 71 Applied motor*.<br>· Check that stall prevention operation setting is correct. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |

* Resetting the inverter initializes the internal heat accumulated value of the electronic thermal relay function.

| Operation Panel Indication | E.FIN | E.FIN | FR-PU04 FR-PU07 | H/Sink O/Temp |
|---|---|---|---|---|
| **Name** | Heatsink overheat | | | |
| **Description** | If the heatsink overheats, the temperature sensor is actuated to stop the inverter output.<br>The FIN signal can be output when the temperature becomes approximately 85% of the heatsink overheat protection operation temperature.<br>For the terminal used for the FIN signal output, assign the function by setting "26" (positive logic) or "126" (negative logic) in any of *Pr. 190 to Pr. 196 (output terminal function selection)*. *(Refer to Chapter 4 of the Instruction Manual (Applied))* | | | |
| **Check point** | · Check for too high surrounding air temperature.<br>· Check for heatsink clogging.<br>· Check that the cooling fan is stopped. (Check that FN is displayed on the operation panel.) | | | |
| **Corrective action** | · Set the surrounding air temperature to within the specifications.<br>· Clean the heatsink.<br>· Replace the cooling fan. | | | |

| Operation Panel Indication | E.IPF | E.IPF | FR-PU04 FR-PU07 | Inst. Pwr. Loss |
|---|---|---|---|---|
| **Name** | Instantaneous power failure | | | |
| **Description** | If a power failure occurs for longer than 15ms (this also applies to inverter input shut-off), the instantaneous power failure protective function is activated to trip the inverter in order to prevent the control circuit from malfunctioning. If a power failure persists for longer than 100ms, the fault output is not provided, and the inverter restarts if the start signal is ON upon power restoration. (The inverter continues operating if an instantaneous power failure is within 15ms.) In some operating status (load magnitude, acceleration/deceleration time setting, etc.), overcurrent or other protection may be activated upon power restoration.<br>When instantaneous power failure protection is activated, the IPF signal is output. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |
| **Check point** | Find the cause of instantaneous power failure occurrence. | | | |
| **Corrective action** | · Remedy the instantaneous power failure.<br>· Prepare a backup power supply for instantaneous power failure.<br>· Set the function of automatic restart after instantaneous power failure (*Pr. 57*). *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |

| Operation Panel Indication | E.BE | E.BE | FR-PU04 FR-PU07 | Br. Cct. Fault |
|---|---|---|---|---|
| **Name** | Brake transistor alarm detection | | | |
| **Description** | This function stops the inverter output if an alarm occurs in the brake circuit, e.g. damaged brake transistors. In this case, the inverter must be powered OFF immediately. | | | |
| **Check point** | · Reduce the load inertia.<br>· Check that the frequency of using the brake is proper. | | | |
| **Corrective action** | Replace the inverter. | | | |

| Operation Panel Indication | E.UVT | E.UvT | FR-PU04 FR-PU07 | Under Voltage |
|---|---|---|---|---|
| **Name** | Undervoltage | | | |
| **Description** | If the power supply voltage of the inverter decreases, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage decreases below about 150VAC (300VAC for the 400V class), this function stops the inverter output.<br>When a jumper is not connected across P/+ and P1, the undervoltage protective function is activated.<br>When undervoltage protection is activated, the IPF signal is output. *(Refer to Chapter 4 of the Instruction Manual (Applied))* | | | |
| **Check point** | · Check for start of large-capacity motor.<br>· Check that a jumper or DC reactor is connected across terminals P/+ and P1. | | | |
| **Corrective action** | · Check the power supply system equipment such as the power supply.<br>· Connect a jumper or DC reactor across terminals P/+ and P1.<br>If the problem still persists after taking the above measure, please contact your sales representative. | | | |

| Operation Panel Indication | E.ILF | E.I LF | FR-PU04 | Fault 14 |
|---|---|---|---|---|
| | | | FR-PU07 | Input phase loss |
| **Name** | Input phase loss | | | |
| **Description** | This fault is output when function valid setting (= 1) is set in *Pr. 872 Input phase loss protection selection* and one phase of the three phase power input is lost. When the setting of *Pr. 872 Input phase loss protection selection* is the initial value (*Pr. 872* = "0"), this fault does not occur. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |
| **Check point** | Check for a break in the cable for the three-phase power supply input. | | | |
| **Corrective action** | · Wire the cables properly.<br>· Repair a break portion in the cable.<br>· Check the *Pr. 872 Input phase loss protection selection* setting. | | | |

| Operation Panel Indication | E.OLT | E.OLT | FR-PU04 FR-PU07 | Stll Prev STP |
|---|---|---|---|---|
| **Name** | Stall prevention stop | | | |
| **Description** | If the frequency has fallen to 0.5Hz by stall prevention operation and remains for 3s, a fault (E.OLT) appears and trips the inverter. OL appears while stall prevention is being activated.<br>When speed control is performed by Real sensorless vector control, vector control, or PM sensorless vector control, a fault (E.OLT) is displayed and the inverter output is stopped if frequency drops to the *Pr. 865 Low speed detection* (initial value is 1.5Hz) setting by torque limit operation and the output torque exceeds *Pr. 874 OLT level setting* (initial value is 150%) setting and remains for more than 3s. | | | |
| **Check point** | · Check the motor for use under overload. *(Refer to Chapter 4 of the Instruction Manual (Applied).)*<br>· Check that the *Pr. 865 Low speed detection* and *Pr. 874 OLT level setting* values are correct. (Check the *Pr. 22 Stall prevention operation level* setting if V/F control is exercised.) | | | |
| **Corrective action** | · Reduce the load weight.<br>· Change the *Pr. 22 Stall prevention operation level*, *Pr. 865 Low speed detection* and *Pr. 874 OLT level setting* values. (Check the *Pr. 22 Stall prevention operation level* setting if V/F control is exercised.)<br>· Check the connection of the IPM motor. (PM sensorless vector control)<br>· For a test operation, set the IPM motor test operation. (Refer to *Chapter 4 of the Instruction Manual (Applied)*.) | | | |

| Operation Panel Indication | E.SOT | E.SOT | FR-PU04 | Fault 14 |
|---|---|---|---|---|
| | | | FR-PU07 | Motor step out |
| Name | Loss of synchronism detection | | | |
| Description | Stops the output when the operation is not synchronized. (This function is only available under PM sensorless vector control.) | | | |
| Check point | · Check that the IPM motor is not driven overloaded.<br>· Check if a start command is given to the inverter while the IPM motor is coasting.<br>· Check if a motor is connected under PM sensorless vector control.<br>· Check if a motor other than the IPM motor (MM-CF series) is driven. | | | |
| Corrective action | · Set the acceleration time longer.<br>· Reduce the load.<br>· If the inverter restarts during coasting, set *Pr.57 Restart coasting time* ≠ "9999," and select the automatic restart after instantaneous power failure.<br>· Check the connection of the IPM motor.<br>· Drive the IPM motor (MM-CF series).<br>· To perform PM sensorless vector control on an IPM motor other than MM-CF, contact your sales representative. | | | |

| Operation Panel Indication | E.GF | E. GF | FR-PU04 FR-PU07 | Ground Fault |
|---|---|---|---|---|
| Name | Output side earth (ground) fault overcurrent | | | |
| Description | This function stops the inverter output if an earth (ground) fault overcurrent flows due to an earth (ground) fault that occurred on the inverter's output (load) side. | | | |
| Check point | Check for an earth (ground) fault in the motor and connection cable. | | | |
| Corrective action | Remedy the earth (ground) fault portion. | | | |

| Operation Panel Indication | E.LF | E. LF | FR-PU04 FR-PU07 | E.LF |
|---|---|---|---|---|
| Name | Output phase loss | | | |
| Description | This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) is lost. | | | |
| Check point | · Check the wiring (Check that the motor is normal.)<br>· Check that the capacity of the motor used is not smaller than that of the inverter.<br>· Check if a start command is given to the inverter while the motor is coasting. (PM sensorless vector control) | | | |
| Corrective action | · Wire the cables properly.<br>· Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. *(Refer to Chapter 4 of the Instruction Manual (Applied).)* (PM sensorless vector control) | | | |

| Operation Panel Indication | E.OHT | E.OHT | FR-PU04 FR-PU07 | OH Fault |
|---|---|---|---|---|
| Name | External thermal relay operation | | | |
| Description | If the external thermal relay provided for motor overheat protection, or the internally mounted temperature relay in the motor, etc. switches ON (contacts open), the inverter output is stopped.<br>This function is available when "7" (OH signal) is set in any of *Pr. 178 to Pr. 189 (input terminal function selection)*.<br>When the initial value (without OH signal assigned) is set, this protective function is not available. | | | |
| Check point | · Check for motor overheating.<br>· Check that the value of 7 (OH signal) is set correctly in any of *Pr. 178 to Pr. 189 (input terminal function selection)*. | | | |
| Corrective action | · Reduce the load and operating duty.<br>· Even if the relay contacts are reset automatically, the inverter will not restart unless it is reset. | | | |

| Operation Panel Indication | E.PTC | E.PTC | FR-PU04 | Fault 14 |
|---|---|---|---|---|
| | | | FR-PU07 | PTC activated |
| Name | PTC thermistor operation | | | |
| Description | Stops the inverter output when the motor overheat status is detected for 10s or more by the external PTC thermistor input connected to the terminal AU.<br>This fault is available when "63" is set in *Pr. 184 AU terminal function selection* and AU/PTC switch is set in PTC side. When the initial value (*Pr. 184* = "4") is set, this protective function is not available. | | | |
| Check point | · Check the connection between the PTC thermistor switch and thermal protector.<br>· Check the motor for operation under overload.<br>· Is valid setting ( = 63) selected in *Pr. 184 AU terminal function selection* ? *(Refer to Chapter 4 of the Instruction Manual (Applied).)* | | | |
| Corrective action | Reduce the load weight. | | | |

| Operation Panel Indication | E.OPT | E.OPT | FR-PU04 FR-PU07 | Option Fault |
|---|---|---|---|---|
| **Name** | Option fault | | | |
| **Description** | · Appears when the AC power supply is connected to the terminal R/L1, S/L2, T/L3 accidentally when a high power factor converter is connected.<br>· Appears when the plug-in option is set to be the torque command source by *Pr. 804 Torque command source selection* setting, but the plug-in option in not connected under torque control.<br>· Appears when the switch for the manufacturer setting of the plug-in option is changed.<br>· Appears when a communication option is connected while *Pr. 296* = "0 or 100". | | | |
| **Check point** | · Check that the AC power supply is not connected to the terminal R/L1, S/L2, T/L3 when a high power factor converter (FR-HC2) or power regeneration common converter (FR-CV) is connected.<br>· Check that the plug-in option for torque command setting is connected.<br>· Check for the password lock with a setting of *Pr. 296* = "0, 100" | | | |
| **Corrective action** | · Check the parameter (*Pr. 30*) setting and wiring.<br>· The inverter may be damaged if the AC power supply is connected to the terminal R/L1, S/L2, T/L3 when a high power factor converter is connected. Please contact your sales representative.<br>· Check for connection of the plug-in option. Check the *Pr. 804 Torque command source selection* setting.<br>· Return the switch for the manufacturer setting of the plug-in option to the initial status. *(Refer to 📖 instruction manual of each option)*<br>· To apply the password lock when installing a communication option, set *Pr.296* ≠ "0, 100". *(Refer to Chapter 4 of 📖 the Instruction Manual (Applied).)* | | | |

| Operation Panel Indication | E.OP3 | E.OP3 | FR-PU04 FR-PU07 | Option3 Fault |
|---|---|---|---|---|
| **Name** | Communication option fault | | | |
| **Description** | Stops the inverter output when a communication line error occurs in the communication option. | | | |
| **Check point** | · Check for a wrong option function setting and operation.<br>· Check that the plug-in option is plugged into the connector securely.<br>· Check for a break in the communication cable.<br>· Check that the terminating resistor is fitted properly. | | | |
| **Corrective action** | · Check the option function setting, etc.<br>· Connect the plug-in option securely.<br>· Check the connection of communication cable. | | | |

| Operation Panel Indication | E. 1 to E. 3 | E. 1 to E. 3 | FR-PU04 FR-PU07 | Fault 1 to Fault 3 |
|---|---|---|---|---|
| **Name** | Option fault | | | |
| **Description** | Stops the inverter output if a contact fault, etc. of the connector between the inverter and plug-in option occurs or if a communication option is fitted to the connector 1 or 2.<br>Appears when the switch for the manufacturer setting of the plug-in option is changed. | | | |
| **Check point** | · Check that the plug-in option is plugged into the connector securely.<br>(1 to 3 indicate the option connector numbers.)<br>· Check for excess electrical noises around the inverter.<br>· Check that the communication option is not fitted to the connector 1 or 2. | | | |
| **Corrective action** | · Connect the plug-in option securely.<br>· Take measures against noises if there are devices producing excess electrical noises around the inverter.<br>If the problem still persists after taking the above measure, please contact your sales representative or distributor.<br>· Fit the communication option to the connector 3.<br>· Return the switch position for the manufacturer setting of the plug-in option to the initial status. *(Refer to 📖 instruction manual of each option)* | | | |

| Operation Panel Indication | E.PE | E.PE | FR-PU04 FR-PU07 | Corrupt Memry |
|---|---|---|---|---|
| **Name** | Parameter storage device fault (control circuit board) | | | |
| **Description** | Stops the inverter output if fault occurred in the parameter stored. (EEPROM failure) | | | |
| **Check point** | Check for too many number of parameter write times. | | | |
| **Corrective action** | Please contact your sales representative.<br>When performing parameter write frequently for communication purposes, set "1" in *Pr. 342* to enable RAM write. Note that powering OFF returns the inverter to the status before RAM write. | | | |

| Operation Panel Indication | E.PE2 | E.PE2 | FR-PU04 | Fault 14 |
|---|---|---|---|---|
| | | | FR-PU07 | PR storage alarm |
| Name | Parameter storage device fault (main circuit board) | | | |
| Description | Stops the inverter output if fault occurred in the parameter stored. (EEPROM failure) | | | |
| Check point | ———————— | | | |
| Corrective action | Please contact your sales representative. | | | |

| Operation Panel Indication | E.PUE | E.PUE | FR-PU04 FR-PU07 | PU Leave Out |
|---|---|---|---|---|
| Name | PU disconnection | | | |
| Description | · This function stops the inverter output if communication between the inverter and PU is suspended, e.g. the operation panel and parameter unit is disconnected, when "2, 3, 16 or 17" was set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*.<br>· This function stops the inverter output when communication errors occurred consecutively for more than permissible number of retries when a value other than "9999" is set in *Pr. 121 Number of PU communication retries* during the RS-485 communication with the PU connector.<br>· This function stops the inverter output if communication is broken within the period of time set in *Pr. 122 PU communication check time interval* during the RS-485 communication with the PU connector. | | | |
| Check point | · Check that the FR-DU07 or parameter unit (FR-PU04/FR-PU07) is connected properly.<br>· Check the *Pr. 75* setting. | | | |
| Corrective action | Fit the FR-DU07 or parameter unit (FR-PU04/FR-PU07) securely. | | | |

| Operation Panel Indication | E.RET | E.rET | FR-PU04 FR-PU07 | Retry No Over |
|---|---|---|---|---|
| Name | Retry count excess | | | |
| Description | If operation cannot be resumed properly within the number of retries set, this function trips the inverter. This function is available only when *Pr. 67 Number of retries at fault occurrence* is set. When the initial value (*Pr. 67* = "0") is set, this fault does not occur. | | | |
| Check point | Find the cause of alarm occurrence. | | | |
| Corrective action | Eliminate the cause of the error preceding this error indication. | | | |

| Operation Panel Indication | E. 5 | E. 5 | FR-PU04 FR-PU07 | Fault 5 |
|---|---|---|---|---|
| | E. 6 | E. 6 | | Fault 6 |
| | E. 7 | E. 7 | | Fault 7 |
| | E.CPU | E.CPU | | CPU Fault |
| Name | CPU fault | | | |
| Description | Stops the inverter output if the communication error of the built-in CPU occurs. | | | |
| Check point | Check for devices producing excess electrical noises around the inverter. | | | |
| Corrective action | · Take measures against noises if there are devices producing excess electrical noises around the inverter.<br>· Please contact your sales representative. | | | |

| Operation Panel Indication | E.CTE | E.CTE | FR-PU04 | —— |
|---|---|---|---|---|
| | | | FR-PU07 | E.CTE |
| Name | RS-485 terminal power supply short circuit | | | |
| Description | When the internal power supply for RS-485 terminals are shorted, this function shuts off the power output.<br>At this time, communication from the RS-485 terminals cannot be made.<br>To reset, enter the RES signal or switch power OFF, then ON again. | | | |
| Check point | Check that the RS-485 terminals are connected correctly. | | | |
| Corrective action | Check the connection of the RS-485 terminals | | | |

| Operation Panel Indication | E.MB1 to 7 | E.MB 1 to E.MB7 | FR-PU04 | —— |
|---|---|---|---|---|
| | | | FR-PU07 | E.MB1 Fault to E.MB7 Fault |
| Name | Brake sequence fault | | | |
| Description | The inverter output is stopped when a sequence error occurs during use of the brake sequence function (*Pr. 278* to *Pr. 285*). This fault is not available in the initial status (brake sequence function is invalid). *(Refer to Chapter 4 of the Instruction Manual (Applied))* | | | |
| Check point | Find the cause of alarm occurrence. | | | |
| Corrective action | Check the set parameters and perform wiring properly. | | | |

| Operation Panel Indication | E.OS | E. 05 | FR-PU04 FR-PU07 | E.OS |
|---|---|---|---|---|
| Name | Overspeed occurrence | | | |
| Description | Trips the inverter when the motor speed exceeds the *Pr. 374 Overspeed detection level* during encoder feedback control, Real sensorless vector control, vector control, and PM sensorless vector control. This fault is not available in the initial status. | | | |
| Check point | · Check that the *Pr. 374 Overspeed detection level* value is correct.<br>· Check that the number of encoder pulses does not differ from the actual number of encoder pulses. (Encoder feedback control, vector control) | | | |
| Corrective action | · Set the *Pr. 374 Overspeed detection level* value correctly.<br>· Set the correct number of encoder pulses in *Pr. 369 Number of encoder pulses*. (Encoder feedback control, vector control) | | | |

| Operation Panel Indication | E.OSD | E.05d | FR-PU04 FR-PU07 | E.OSd |
|---|---|---|---|---|
| Name | Speed deviation excess detection | | | |
| Description | Trips the inverter if the motor speed is increased or decreased under the influence of the load etc. during vector control with *Pr. 285 Overspeed detection frequency* set and cannot be controlled in accordance with the speed command value.<br>While deceleration stop is attempted when the motor is accelerated against the stop command, if the actual motor speed does not decrease for one second, this function stops the inverter output. | | | |
| Check point | · Check that the values of *Pr. 285 Overspeed detection frequency* and *Pr. 853 Speed deviation time* are correct.<br>· Check for sudden load change.<br>· Check that the *Pr. 369 Number of encoder pulses* does not differ from the actual number of encoder pulses. | | | |
| Corrective action | · Set *Pr. 285 Overspeed detection frequency* and *Pr. 853 Speed deviation time* correctly.<br>· Keep load stable.<br>· Set the correct number of encoder pulses in *Pr. 369 Number of encoder pulses*. | | | |

| Operation Panel Indication | E.ECT | E.ECT | FR-PU04 FR-PU07 | E.ECT |
|---|---|---|---|---|
| Name | Signal loss detection | | | |
| Description | Trips the inverter when the encoder signal is shut off under orientation control, encoder feedback control or vector control.<br>This fault is not available in the initial status. | | | |
| Check point | · Check for the encoder signal loss.<br>· Check that the encoder specifications are correct.<br>· Check for a loose connector.<br>· Check that the switch setting of FR-A7AP/FR-A7AL (option) is correct.<br>· Check that the power is supplied to the encoder. Or, check that the power is not supplied to the encoder later than the inverter.<br>· Check that the voltage of the power supplied to the encoder is same as the encoder output voltage. | | | |
| Corrective action | · Remedy the signal loss.<br>· Use an encoder that meets the specifications.<br>· Make connection securely.<br>· Make a switch setting of FR-A7AP/FR-A7AL (option) correctly. *(Refer to page 29)*<br>· Supply the power to the encoder. Or supply the power to the encoder at the same time when the power is supplied to the inverter.<br>If the power is supplied to the encoder after the inverter, check that the encoder signal is securely sent and set "0" in *Pr. 376*.<br>· Make the voltage of the power supplied to the encoder the same as the encoder output voltage. | | | |

| Operation Panel Indication | E.OD | E. Od | FR-PU04 / FR-PU07 | Fault 14 / E.Od |
|---|---|---|---|---|
| **Name** | Excessive position fault | | | |
| **Description** | Trips the inverter when the difference between the position command and position feedback exceeds *Pr. 427 Excessive level error* under position control.<br>This fault is not available in the initial status. | | | |
| **Check point** | · Check that the position detecting encoder mounting orientation matches the parameter.<br>· Check that the load is not large.<br>· Check that the *Pr. 427 Excessive level error* and *Pr. 369 Number of encoder pulses* are correct. | | | |
| **Corrective action** | · Check the parameters.<br>· Reduce the load weight.<br>· Set the *Pr. 427 Excessive level error* and *Pr. 369 Number of encoder pulses* correctly. | | | |

| Operation Panel Indication | E.EP | E.EP | FR-PU04 / FR-PU07 | Fault 14 / E.EP |
|---|---|---|---|---|
| **Name** | Encoder phase fault | | | |
| **Description** | Trips the inverter when the rotation command of the inverter differs from the actual motor rotation direction detected from the encoder.<br>This fault is not available in the initial status. | | | |
| **Check point** | · Check for mis-wiring of the encoder cable.<br>· Check for wrong setting of *Pr. 359 Encoder rotation direction*. | | | |
| **Corrective action** | · Perform connection and wiring securely.<br>· Change the *Pr. 359 Encoder rotation direction* value. | | | |

| Operation Panel Indication | E.P24 | E.P24 | FR-PU04 / FR-PU07 | E.P24 |
|---|---|---|---|---|
| **Name** | 24VDC power output short circuit | | | |
| **Description** | When the 24VDC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch OFF. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel or switch power OFF, then ON again. | | | |
| **Check point** | · Check for a short circuit in the PC terminal output. | | | |
| **Corrective action** | · Remedy the earth (ground) fault portion. | | | |

| Operation Panel Indication | E.CDO | E.CdO | FR-PU04 / FR-PU07 | Fault 14 / OC detect level |
|---|---|---|---|---|
| **Name** | Output current detection value exceeded | | | |
| **Description** | Trips the inverter when the output current exceeds the setting of *Pr. 150 Output current detection level*. This function is available when *Pr. 167 Output current detection operation selection* is set to "1". When the initial value (*Pr. 167* = "0") is set, this protective function is not available. | | | |
| **Check point** | Check the settings of *Pr. 150 Output current detection level*, *Pr. 151 Output current detection signal delay time*, *Pr. 166 Output current detection signal retention time*, *Pr. 167 Output current detection operation selection*. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)* | | | |

| Operation Panel Indication | E.IOH | E.IOH | FR-PU04 / FR-PU07 | Fault 14 / Inrush overheat |
|---|---|---|---|---|
| **Name** | Inrush current limit circuit fault | | | |
| **Description** | Stops the inverter output when the resistor of inrush current limit circuit overheated. The inrush current limit circuit failure | | | |
| **Check point** | · Check that frequent power ON/OFF is not repeated.<br>· Check that the primary side fuse (5A) in the power supply circuit of the inrush current limit circuit contactor (FR-A740-110K or higher) is not fused.<br>· Check that the power supply circuit of inrush current limit circuit contactor is not damaged. | | | |
| **Corrective action** | Configure a circuit where frequent power ON/OFF is not repeated.<br>If the problem still persists after taking the above measure, please contact your sales representative. | | | |

| Operation Panel Indication | E.SER | E.SEr | FR-PU04 | Fault 14 |
|---|---|---|---|---|
| | | | FR-PU07 | VFD Comm error |
| **Name** | Communication fault (inverter) | | | |
| **Description** | This function stops the inverter output when communication error occurs consecutively for more than permissible retry count when a value other than "9999" is set in *Pr. 335 RS-485 communication retry count* during RS-485 communication from the RS-485 terminals. This function also stops the inverter output if communication is broken for the period of time set in *Pr. 336 RS-485 communication check time interval*. | | | |
| **Check point** | Check the RS-485 terminal wiring. | | | |
| **Corrective action** | Perform wiring of the RS-485 terminals properly. | | | |

| Operation Panel Indication | E.AIE | E.AI E | FR-PU04 | Fault 14 |
|---|---|---|---|---|
| | | | FR-PU07 | Analog in error |
| **Name** | Analog input fault | | | |
| **Description** | Stops the inverter output when a 30mA or higher current or a 7.5V or higher voltage is input to terminal 2 while the current input is selected by *Pr. 73 Analog input selection*, or to terminal 4 while the current input is selected by *Pr. 267 Terminal 4 input selection*. | | | |
| **Check point** | Check the setting of *Pr. 73 Analog input selection*, *Pr. 267 Terminal 4 input selection* and voltage/current input switch. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied).)* | | | |
| **Corrective action** | Either give a frequency command by current input or set *Pr. 73 Analog input selection*, *Pr. 267 Terminal 4 input selection*, and voltage/current input switch to voltage input. | | | |

| Operation Panel Indication | E.USB | E.USb | FR-PU04 | Fault 14 |
|---|---|---|---|---|
| | | | FR-PU07 | USB comm error |
| **Name** | USB communication fault | | | |
| **Description** | When the time set in *Pr. 548 USB communication check time interval* has broken, this function stops the inverter output. | | | |
| **Check point** | Check the USB communication cable. | | | |
| **Corrective action** | · Check the *Pr. 548 USB communication check time interval* setting.<br>· Check the USB communication cable.<br>· Increase the *Pr. 548 USB communication check time interval* setting. Or, change the setting to 9999. *(Refer to Chapter 4 of 🕮 the Instruction Manual (Applied))* | | | |

| Operation Panel Indication | E.11 | E. 11 | FR-PU04<br>FR-PU07 | Fault 11 |
|---|---|---|---|---|
| **Name** | Opposite rotation deceleration fault | | | |
| **Description** | The speed may not decelerate during low speed operation if the rotation direction of the speed command and the estimated speed differ when the rotation is changing from forward to reverse or from reverse to forward during torque control under Real sensorless vector control. At this time, the inverter output is stopped if the rotation direction will not change, causing overload. This fault is not available in the initial status (V/F control). (It is available only during Real sensorless vector control.) | | | |
| **Check point** | Check that the rotation direction is not switched from forward to reverse rotation (or from reverse to forward) during torque control under Real sensorless vector control. | | | |
| **Corrective action** | · Prevent the motor from switching the rotation direction from forward to reverse (or from reverse to forward) during torque control under Real sensorless vector control.<br>· Please contact your sales representative. | | | |

| Operation Panel Indication | E.13 | E. 13 | FR-PU04<br>FR-PU07 | Fault 13 |
|---|---|---|---|---|
| **Name** | Internal circuit fault | | | |
| **Description** | Stop the inverter output when an internal circuit fault occurred. | | | |
| **Corrective action** | Please contact your sales representative. | | | |

**CAUTION**

- If protective functions of E.ILF, E.SOT, E.PTC, E.PE2, E.EP, E.OD, E.CDO, E.IOH, E.SER, E.AIE, E.USB are activated when using the FR-PU04, "Fault 14" appears.
  Also when the faults history is checked on the FR-PU04, the display is "E.14".
- If faults other than the above appear, contact your sales representative.

# 4.4 Correspondences between digital and actual characters

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

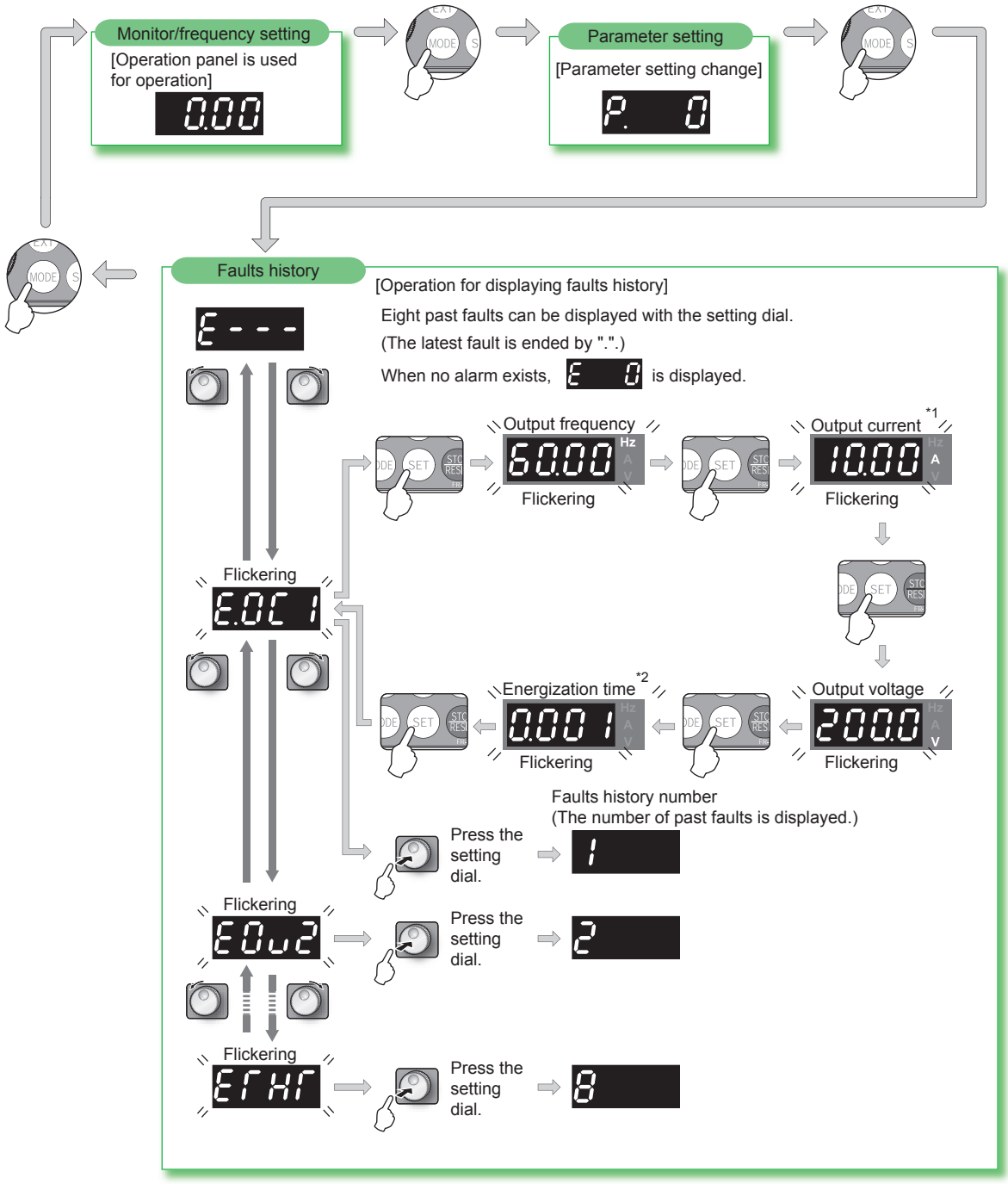
| Actual | Digital |
|---|---|
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

| Actual | Digital |
|---|---|
| A |  |
| B |  |
| C |  |
| D |  |
| E |  |
| F |  |
| G |  |
| H |  |
| I |  |
| J |  |
| L |  |

| Actual | Digital |
|---|---|
| M |  |
| N |  |
| O |  |
| o |  |
| P |  |
| S |  |
| T |  |
| U |  |
| V |  |
| r |  |
| - |  |

# 4.5 Check and clear of the faults history

## (1) Check for the faults history




*1 When an overcurrent trip occurs by an instant overcurrent, the monitored current value saved in the faults history may be lower than the actual current that has flowed.

*2 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel (FR-DU07) is used, the time is displayed up to 65.53 (65530h) in the indication of 1h = 0.001, and thereafter, it is added up from 0.

## (2) Clearing procedure

**POINT**

· The faults history can be cleared by setting "1" in *Er.CL Faults history clear*.

**Operation**

**1.** Screen at power-ON

The monitor display appears.

**2.** Parameter setting mode

Press (MODE) to choose the parameter setting mode.

(The parameter number previously read appears.)

**3.** Selecting the parameter number

Turn  until "Er.CL" (faults history clear) appears.

Press (SET) to read the present set value. "0" (initial value) appears.

**4.** Faults history clear

Turn  to change it to the set value "1". Press (SET) to set.

"1" and "Er.CL" flicker alternately after the faults history is cleared.

·By turning  , you can read another parameter.

·Press (SET) to show the setting again.

·Press (SET) twice to show the next parameter.

# 4.6 Check first when you have a trouble

Refer to troubleshooting on *page 88* (speed control) in addition to the following check points.

**POINT**

- If the cause is still unknown after every check, it is recommended to initialize the parameters (initial value) then reset the required parameter values and check again.
- Refer to the *Instruction Manual (Applied)* for 🕮 in "Refer to page" column.

## *4.6.1 Motor does not start*

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Main circuit | Appropriate power supply voltage is not applied. (Operation panel display is not provided.) | Power ON a moulded case circuit breaker (MCCB), an earth leakage circuit breaker (ELB), or a magnetic contactor (MC). | — |
| | | Check for the decreased input voltage, input phase loss, and wiring. | |
| | | If only the control power is ON when using a separate power source for the control circuit, turn ON the main circuit power. | *17* |
| | Motor is not connected properly. | Check the wiring between the inverter and the motor. If the electronic bypass function is active, check the wiring of the magnetic contactor connected between the inverter and the motor. | *11* |
| | The jumper across P/+ and P1 is disconnected. (55K or lower) | Securely fit a jumper across P/+ and P1. When using a DC reactor (FR-HEL), remove the jumper across P/+ and P1, and then connect the DC reactor. | *11* |
| Input signal | Start signal is not input. | Check the start command source, and input a start signal. PU operation mode: FWD / REV External operation mode : STF/STR signal | *2* |
| | Both the forward and reverse rotation start signals (STF, STR) are input simultaneously. | Turn ON only one of the forward and reverse rotation start signals (STF or STR). If STF and STR signals are turned ON simultaneously in the initial setting, a stop command is given. | *19* |
| | Frequency command is zero. (FWD or REV LED on the operation panel is flickering.) | Check the frequency command source and enter a frequency command. | *2* |
| | AU signal is not ON when terminal 4 is used for frequency setting. (FWD or REV LED on the operation panel is flickering.) | Turn ON the AU signal. Turning ON the AU signal activates terminal 4 input. | *19* |
| | Output stop signal (MRS) or reset signal (RES) is ON. (FWD or REV LED on the operation panel is flickering.) | Turn MRS or RES signal OFF. Inverter starts the operation with a given start command and a frequency command after turning OFF MRS or RES signal. Before turning OFF, ensure the safety. | *19* |
| | CS signal is OFF when automatic restart after instantaneous power failure function is selected (*Pr. 57* ≠ "9999"). (FWD or REV LED on the operation panel is flickering. ) | Turn ON the CS signal. Restart operation is enabled when restart after instantaneous power signal (CS) is ON. | 🕮 |
| | Jumper connector of sink - source is wrongly selected. (FWD or REV LED on the operation panel is flickering.) | Check that the control logic switchover jumper connector is correctly installed. If it is not installed correctly, input signal is not recognized. | *22* |
| | Wiring of encoder is incorrect. (Under encoder feedback control or vector control) | Check the wiring of encoder. | *31* |
| | Voltage/current input switch is not correctly set for analog input signal (0 to 5V/0 to 10V, 4 to 20mA). (FWD or REV LED on the operation panel is flickering.) | Set *Pr. 73, Pr. 267*, and a voltage/current input switch correctly, then input an analog signal in accordance with the setting. | *19* |

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Input signal | STOP RESET was pressed.<br>(Operation panel indication is PS (PS).) | During the External operation mode, check the method of restarting from a STOP RESET input stop from PU. | 153 |
| | Two-wire or three-wire type connection is wrong. | Check the connection.<br>Connect STOP signal when three-wire type is used. | 127 |
| Parameter setting | *Pr. 0 Torque boost* setting is improper when V/F control is used. | Increase *Pr. 0* setting by 0.5% increments while observing the rotation of a motor.<br>If that makes no difference, decrease the setting. | 60 |
| | *Pr. 78 Reverse rotation prevention selection* is set. | Check the *Pr. 78* setting.<br>Set *Pr. 78* when you want to limit the motor rotation to only one direction. | 115 |
| | *Pr. 79 Operation mode selection* setting is wrong. | Select the operation mode which corresponds with input methods of start command and frequency command. | 2 |
| | Bias and gain *(calibration parameter C2 to C7)* settings are improper. | Check the bias and gain *(calibration parameter C2 to C7)* settings. | 121 |
| | *Pr. 13 Starting frequency* setting is greater than the running frequency. | Set running frequency higher than *Pr. 13*.<br>The inverter does not start if the frequency setting signal is less than the value set in *Pr. 13*. | 101 |
| | Frequency settings of various running frequency (such as multi-speed operation) are zero.<br>Especially, *Pr. 1 Maximum frequency* is zero. | Set the frequency command according to the application.<br>Set *Pr. 1* higher than the actual frequency used. | 60 |
| | *Pr. 15 Jog frequency* setting is lower than *Pr. 13 Starting frequency*. | Set *Pr. 15 Jog frequency* higher than *Pr. 13 Starting frequency.* | 104 |
| | The *Pr.359 Encoder rotation direction* setting is incorrect under encoder feedback control or under vector control. | If the "REV" on the operation panel is lit even though the forward-rotation command is given, set *Pr. 359* ="1." | 33 |
| | Operation mode and a writing device do not match. | Check *Pr. 79, Pr. 338, Pr. 339, Pr. 550, Pr. 551,* and select an operation mode suitable for the purpose. | 63, 132 |
| | Start signal operation selection is set by the *Pr. 250 Stop selection* | Check *Pr. 250* setting and connection of STF and STR signals. | 127 |
| | The motor is decelerated to a stop when power failure deceleration stop function is selected. | When power is restored, ensure the safety, and turn OFF the start signal once, then turn ON again to restart.<br>The motor restarts when *Pr. 261*="2, 12". | 128 |
| | Auto tuning is being performed. | In the PU operation, press STOP RESET on the operation panel after the offline auto tuning completes.<br>In the External operation, turn OFF the start signal (STF, STR).<br>By this operation, offline auto tuning is cancelled, and the monitor display on the PU goes back to normal.<br>(If this operation is not performed, you cannot proceed to the next operation.) | 80 |
| | Automatic restart after instantaneous power failure function or power failure stop function is activated.<br>(Performing overload operation during input phase loss may cause voltage insufficiency, and that may result in detection of power failure.) | • Set *Pr. 872 Input phase loss protection selection* = "1" (input phase failure protection active).<br>• Disable the automatic restart after instantaneous power failure function and power failure stop function.<br>• Reduce the load.<br>• Increase the acceleration time if the automatic restart after instantaneous power failure function or power failure stop function occurred during acceleration. | 110, 128 |
| | The test operation is selected under vector control and PM sensorless vector control. | Check the *Pr. 800 Control method selection* setting. | 64 |
| Load | Load is too heavy. | Reduce the load. | — |
| | Shaft is locked. | Inspect the machine (motor). | — |

### 4.6.2 Motor or machine is making abnormal acoustic noise

Even if the carrier frequency (*Pr. 72*) is set to a value higher than 3kHz for a 55K or lower capacity inverter, the carrier frequency is automatically lowered to as low as 2kHz in an overloaded operation at a low speed (output frequency lower than 3Hz). The lower limit is 6kHz when using an MM-CF IPM motor with the low-speed high-torque characteristic (*Pr. 788*="9999 (initial value)"). Acoustic noise from the motor increases, but it is not a fault. (*Refer to page 114* for *Pr. 72*)

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| **Input signal** | Disturbance due to EMI when frequency command is given from analog input (terminal 1, 2, 4). | Take countermeasures against EMI. | 📖 |
| **Parameter setting** | | Increase the *Pr. 74 Input filter time constant* if steady operation cannot be performed due to EMI. | *115* |
| **Parameter setting** | No carrier frequency noises (metallic noises) are generated. | In the initial setting, *Pr. 240 Soft-PWM operation selection* is enabled to change motor noise to an unoffending complex tone. Therefore, no carrier frequency noises (metallic noises) are generated.<br>Set *Pr. 240* = "0" to disable this function. | *114* |
| | Resonance occurs. (output frequency) | Set *Pr. 31 to Pr. 36 (Frequency jump)*.<br>When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped. | *107* |
| | Resonance occurs. (carrier frequency) | Change *Pr. 72 PWM frequency selection* setting.<br>Changing the PWM carrier frequency produces an effect on avoiding the resonance frequency of a mechanical system or a motor. | *114* |
| | | Set a notch filter. | 📖 |
| | Auto tuning is not performed under Advanced magnetic flux vector control, Real sensorless vector control, or vector control. | Perform offline auto tuning. | *80* |
| | Gain adjustment during PID control is insufficient. | To stabilize the measured value, change the proportional band (*Pr. 129*) to a larger value, the integral time (*Pr. 130*) to a slightly longer time, and the differential time (*Pr. 134*) to a slightly shorter time.<br>Check the calibration of set point and measured value. | *121* |
| | The gain is too high under Real sensorless vector control, vector control or PM sensorless vector control. | During speed control, check the setting of *Pr. 820* (*Pr. 830*) *speed control P gain*. | *142* |
| | | During torque control, check the setting of *Pr. 824* (*Pr. 834*) *torque control P gain*. | *142* |
| **Others** | Mechanical looseness | Adjust machine/equipment so that there is no mechanical looseness. | — |
| | Contact the motor manufacturer. | | |
| **Motor** | Operating with output phase loss | Check the motor wiring. | — |

### 4.6.3 Inverter generates abnormal noise

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| **Fan** | Fan cover was not correctly installed when a cooling fan was replaced. | Install the fan cover correctly. | *181* |

### 4.6.4 Motor generates heat abnormally

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| **Motor** | Motor fan is not working<br>(Dust is accumulated.) | Clean the motor fan.<br>Improve the environment. | — |
| | Phase to phase insulation of the motor is insufficient. | Check the insulation of the motor. | — |
| **Main circuit** | The inverter output voltage (U, V, W) are unbalanced. | Check the output voltage of the inverter.<br>Check the insulation of the motor. | *178* |
| **Parameter setting** | The *Pr. 71 Applied motor* setting is wrong. | Check the *Pr. 71 Applied motor* setting. | *113* |
| **—** | Motor current is large. | Refer to "4.6.11 Motor current is too large" | *174* |

### 4.6.5 Motor rotates in the opposite direction

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Main circuit | Phase sequence of output terminals U, V and W is incorrect. | Connect phase sequence of the output cables (terminal U, V, W) to the motor correctly. | *11* |
| Input signal | The start signals (forward rotation, reverse rotation) are connected improperly. | Check the wiring. (STF: forward rotation , STR: reverse rotation) | *19* |
| | The polarity of the frequency command is negative during the polarity reversible operation set by *Pr. 73 Analog input selection*. | Check the polarity of the frequency command. | 🕮 |
| Input signal Parameter setting | Torque command is negative during torque control under vector control. | Check the torque command value. | 🕮 |

### 4.6.6 Speed greatly differs from the setting

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Input signal | Frequency setting signal is incorrectly input. | Measure the input signal level. | — |
| | The input signal lines are affected by external EMI. | Take countermeasures against EMI such as using shielded wires for input signal lines. | 🕮 |
| Parameter setting | *Pr. 1, Pr. 2, Pr. 18, calibration parameter C2 to C7* settings are improper. | Check the settings of *Pr. 1 Maximum frequency, Pr. 2 Minimum frequency, Pr. 18 High speed maximum frequency.* | *101* |
| | | Check the *calibration parameter C2 to C7* settings. | *121* |
| | *Pr. 31 to Pr. 36 (frequency jump)* settings are improper. | Narrow down the range of frequency jump. | *107* |
| Load | Stall prevention (torque limit) function is activated due to a heavy load. | Reduce the load weight. | — |
| Parameter setting | | Set *Pr. 22 Stall prevention operation level (Torque limit level)* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC☐).) | *104* (*105*) |
| Motor | | Check the capacities of the inverter and the motor. | — |

### 4.6.7 Acceleration/deceleration is not smooth

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Parameter setting | Acceleration/deceleration time is too short. | Increase acceleration/deceleration time. | *61* |
| | Torque boost (*Pr. 0, Pr. 46*, *Pr. 112*) setting is improper under V/F control, so the stall prevention function is activated. | Increase/decrease *Pr. 0 Torque boost* setting value by 0.5% increments to the setting. Deactivate stall prevention. | *60* |
| | The base frequency setting and the motor characteristic does not match. | For V/F control, set *Pr. 3 Base frequency*, *Pr. 47 Second V/F (base frequency)*, and *Pr.113 Third V/F (base frequency)*. | *101* |
| | | For vector control, set *Pr.84 Rated motor frequency*. | *80* |
| | Regeneration avoidance operation is performed | If the frequency becomes unstable during regeneration avoidance operation, decrease the setting of *Pr. 886 Regeneration avoidance voltage gain*. | *145* |
| Load | Stall prevention (torque limit) function is activated due to a heavy load. | Reduce the load weight. | — |
| Parameter setting | | Set *Pr. 22 Stall prevention operation level (Torque limit level)* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC☐).) | *104* (*105*) |
| Motor | | Check the capacities of the inverter and the motor. | — |

### 4.6.8 Speed varies during operation

When Advanced magnetic flux vector control, Real sensorless vector control, vector control or encoder feedback control is exercised, the output frequency varies with load fluctuation between 0 and 2Hz. This is a normal operation and is not a fault.

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| **Load** | Load varies during an operation. | Select Advanced magnetic flux vector control, Real sensorless vector control, vector control, or encoder feedback control. | *64*, *66*, 🕮 |
| **Input signal** | Frequency setting signal is varying. | Check the frequency setting signal. | — |
| | The frequency setting signal is affected by EMI. | Set filter to the analog input terminal using *Pr. 74 Input filter time constant*, *Pr. 822 Speed setting filter 1*. | *115* |
| | | Take countermeasures against EMI, such as using shielded wires for input signal lines. | 🕮 |
| | Malfunction is occurring due to the undesirable current generated when the transistor output unit is connected. | Use terminal PC (terminal SD when source logic) as a common terminal to prevent a malfunction caused by undesirable current. | *23* |
| | Multi-speed command signal is chattering. | Take countermeasures to suppress chattering. | — |
| | Feedback signal from the encoder is affected by EMI. | Place the encoder cable far from the EMI source such as main circuit and power supply voltage.<br>Earth (ground) the shield of the encoder cable to the enclosure using a metal P-clip or U-clip. | *31* |
| **Parameter setting** | Fluctuation of power supply voltage is too large. | Change the *Pr. 19 Base frequency voltage* setting (about 3%) under V/F control. | *101* |
| | *Pr.80 Motor capacity* and *Pr.81 Number of motor poles* are not appropriate for the motor capacity under Advanced magnetic flux vector control, Real sensorless vector control, vector control, or PM sensorless vector control. | Check the settings of *Pr.80 Motor capacity* and *Pr.81 Number of motor poles*. | *64*, *66* |
| | Wiring length exceeds 30m when Advanced magnetic flux vector control, Real sensorless vector control, vector control, or PM sensorless vector control is selected. | Perform offline auto tuning. | *80* |
| | Wiring length is too long for V/F control, and the a voltage drop occurs. | Adjust the *Pr. 0 Torque boost* setting by increasing with 0.5% increments for the low-speed operation. | *60* |
| | | Change the control method to Advanced magnetic flux vector control or Real sensorless vector control. | *64* |
| | Hunting occurs by the generated vibration, for example, when structural rigidity at load side is insufficient. | Disable automatic control functions, such as the energy saving operation, the fast-response current limit function, the torque limit, the regeneration avoidance function, Advanced magnetic flux vector control, Real sensorless vector control, vector control, encoder feedback control, droop control, the stall prevention, online auto tuning, the notch filter, and orientation control.<br>During the PID control, set smaller values to *Pr.129 PID proportional band* and *Pr.130 PID integral time*.<br>Lower the control gain, and adjust to increase the stability. | — |
| | | Change *Pr. 72 PWM frequency selection* setting. | *114* |

### 4.6.9 Operation mode is not changed properly

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Input signal | Start signal (STF or STR) is ON. | Check that the STF and STR signals are OFF. When either is ON, the operation mode cannot be changed. | 63 |
| Parameter setting | *Pr. 79* setting is improper. | When *Pr. 79 Operation mode selection* setting is "0" (initial value), the inverter is placed in the External operation mode at input power ON. To switch to the PU operation mode, press PU/EXT on the operation panel (press PU when the parameter unit (FR-PU04/FR-PU07) is used) . At other settings (1 to 4, 6, 7), the operation mode is limited accordingly. | 63 |
| | Operation mode and a writing device do not correspond. | Check *Pr. 79, Pr. 338, Pr. 339, Pr. 550, Pr. 551,* and select an operation mode suitable for the purpose. | 63, 132 |

### 4.6.10 Operation panel (FR-DU07) display is not operating

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Main circuit, Control circuit | Power is not input. | Input the power. | 9 |
| Front cover | Operation panel is not properly connected to the inverter. | Check if the inverter front cover is installed securely. The inverter cover may not fit properly when using wires whose size are 1.25mm$^2$ or larger, or when using many wires, and this could cause a contact fault of the operation panel. | 6 |

### 4.6.11 Motor current is too large

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Parameter setting | Torque boost (*Pr. 0, Pr. 46, Pr. 112*) setting is improper under V/F control, so the stall prevention function is activated. | Increase/decrease *Pr. 0 Torque boost* setting value by 0.5% increments to the setting. | 60 |
| | V/F pattern is improper when V/F control is performed. (*Pr. 3, Pr. 14, Pr. 19*) | Set rated frequency of the motor to *Pr. 3 Base frequency*. Use *Pr. 19 Base frequency voltage* to set the base voltage (e.g. rated motor voltage). | 101 |
| | | Change *Pr. 14 Load pattern selection* according to the load characteristic. | 103 |
| | Stall prevention (torque limit) function is activated due to a heavy load. | Reduce the load weight. | — |
| | | Set *Pr. 22 Stall prevention operation level (Torque limit level)* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC☐).) | 104 (105) |
| | | Check the capacities of the inverter and the motor. | — |
| | Auto tuning is not performed under Advanced magnetic flux vector control, Real sensorless vector control, or vector control. | Perform offline auto tuning. | 80 |
| | Offline auto tuning is not performed for the PM sensorless vector control with an IPM motor other than MM-CF. | Perform offline auto tuning for the IPM motor. | 77 |

### 4.6.12 Speed does not accelerate

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Input signal | Start command and frequency command are chattering. | Check if the start command and the frequency command are correct. | — |
| | The wiring length used for analog frequency command is too long, and it is causing a voltage (current) drop. | Perform analog input bias/gain calibration. | 📖 |
| | Input signal lines are affected by external EMI. | Take countermeasures against EMI, such as using shielded wires for input signal lines. | 📖 |
| Parameter setting | *Pr. 1, Pr. 2, Pr. 18, calibration parameter C2 to C7* settings are improper. | Check the settings of *Pr. 1 Maximum frequency and Pr. 2 Minimum frequency*. If you want to run the motor at 120Hz or higher, set *Pr. 18 High speed maximum frequency*. | *101* |
| | | Check the *calibration parameter C2 to C7* settings. | *121* |
| | A frequency higher than the maximum IPM motor speed (frequency) is set. | During PM sensorless vector control (MM-CF), the maximum frequency is limited to the maximum speed (frequency) of the IPM motor. | *187* |
| | The maximum voltage (current) input value is not set during the External operation. *(Pr.125, Pr.126, Pr.18)* | Check the *Pr.125 Terminal 2 frequency setting gain frequency* and *Pr.126 Terminal 4 frequency setting gain frequency* settings. To operate at 120Hz or higher, set *Pr.18 High speed maximum frequency*. | *98* |
| | Torque boost (*Pr. 0, Pr. 46, Pr. 112*) setting is improper under V/F control, so the stall prevention function is activated. | Increase/decrease *Pr. 0 Torque boost* setting value by 0.5% increments so that stall prevention does not occur. | *60* |
| | V/F pattern is improper when V/F control is performed. (*Pr. 3, Pr. 14, Pr. 19*) | Set rated frequency of the motor to *Pr. 3 Base frequency*. Use *Pr. 19* Base frequency voltage to set the base voltage (e.g. rated motor voltage). | *101* |
| | | Change *Pr. 14 Load pattern selection* according to the load characteristic. | *103* |
| | Stall prevention (torque limit) function is activated due to a heavy load. | Reduce the load weight. | — |
| | | Set *Pr. 22 Stall prevention operation level (Torque limit level)* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).) | *104* (*105*) |
| | | Check the capacities of the inverter and the motor. | — |
| | Auto tuning is not performed under Advanced magnetic flux vector control, Real sensorless vector control, or vector control. | Perform offline auto tuning. | *80* |
| | The setting of pulse train input is improper. | Check the specification of the pulse generator (open collector output or complementary output) and check the adjustment of the pulse train and frequency (*Pr. 385* and *Pr. 386*). | 📖 |
| | During PID control, output frequency is automatically controlled to make measured value = set point. | | 📖 |
| Main circuit | Brake resistor is connected across terminals P/+ and P1 or across P1 and PR by mistake. (22K or lower) | Remove the jumper across terminals PR and PX (7.5K or lower) and connect an option brake resistor (FR-ABR) across terminals P/+ and PR. | *9* |

### 4.6.13 Unable to write parameter setting

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| Input signal | Operation is being performed (signal STF or STR is ON). | Stop the operation.<br>When *Pr. 77* = "0" (initial value), write is enabled only during a stop. | *115* |
| Parameter setting | You are attempting to set the parameter in the External operation mode. | Choose the PU operation mode.<br>Or, set *Pr. 77* = "2" to enable parameter write regardless of the operation mode. | *115* |
| | Parameter is disabled by the *Pr. 77 Parameter write selection* setting. | Check *Pr. 77 Parameter write selection* setting. | *115* |
| | Key lock is activated by the *Pr. 161 Frequency setting/key lock operation selection* setting. | Check *Pr. 161 Frequency setting/key lock operation selection* setting. | *124* |
| | Operation mode and a writing device do not correspond. | Check *Pr. 79, Pr. 338, Pr. 339, Pr. 550, Pr. 551,* and select an operation mode suitable for the purpose. | *63*, *132* |
| | The user has attempted to set "25" in *Pr. 72 PWM frequency selection* during PM sensorless vector control.<br>The user has attempted to select the PM sensorless vector control while *Pr. 72* = "25". | The PM sensorless vector control cannot be selected while *Pr. 72* = "25". (A sine wave filter (MT-BSL/BSC) cannot be used under PM sensorless vector control.) | *114* |

### 4.6.14 Power lamp is not lit

| Check points | Possible cause | Countermeasures | Refer to page |
|---|---|---|---|
| **Main circuit, Control circuit** | Wiring or installation is improper. | Check for the wiring and the installation.<br>Power lamp is lit when power is input to the control circuit (R1/L11, S1/L21). | *11* |

# 5 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

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

**• Precautions for maintenance and inspection**

For some short time after the power is switched OFF, a high voltage remains in the smoothing capacitor. When accessing the inverter for inspection, wait for at least 10 minutes after the power supply has been switched OFF, and then make sure that the voltage across the main circuit terminals P/+ and N/− of the inverter is not more than 30VDC using a tester, etc.

## 5.1 Inspection item

### *5.1.1 Daily inspection*

Basically, check for the following faults during operation.
(1) Motor operation fault
(2) Improper installation environment
(3) Cooling system fault
(4) Unusual vibration and noise
(5) Unusual overheat and discoloration

### *5.1.2 Periodic inspection*

Check the areas inaccessible during operation and requiring periodic inspection.
Consult us for periodic inspection.
1) Check for cooling system fault..... Clean the air filter, etc.
2) Tightening check and retightening..... The screws and bolts may become loose due to vibration, temperature changes, etc.
Tighten them according to the specified tightening torque. *(Refer to page 14)*
3) Check the conductors and insulating materials for corrosion and damage.
4) Measure insulation resistance.
5) Check and change the cooling fan and relay.

### 5.1.3 Daily and periodic inspection

| Area of Inspection | Inspection Item | Description | Interval | | Corrective Action at Alarm Occurrence | Customer's Check |
|---|---|---|---|---|---|---|
| | | | Daily | Periodic *3 | | |
| General | Surrounding environment | Check the surrounding air temperature, humidity, dirt, corrosive gas, oil mist , etc. | ○ | | Improve environment | |
| | Overall unit | Check for unusual vibration and noise. | ○ | | Check alarm location and retighten | |
| | | Check for dirt, oil, and other foreign material.*1 | ○ | | Clean | |
| | Power supply voltage | Check that the main circuit voltages and control voltages are normal.*2 | ○ | | Inspect the power supply | |
| Main circuit | General | (1) Check with megger (across main circuit terminals and earth (ground) terminal). | | ○ | Contact the manufacturer | |
| | | (2) Check for loose screws and bolts. | | ○ | Retighten | |
| | | (3) Check for overheat traces on parts. | | ○ | Contact the manufacturer | |
| | | (4) Check for stains. | | ○ | Clean | |
| | Conductors, cables | (1) Check conductors for distortion. | | ○ | Contact the manufacturer | |
| | | (2) Check cable sheaths for breakage and deterioration (crack, discoloration, etc.). | | ○ | Contact the manufacturer | |
| | Transformer/reactor | Check for unusual odors and abnormal increase in whining sound. | ○ | | Stop the device and contact the manufacturer. | |
| | Terminal block | Check for damage. | | ○ | Stop the device and contact the manufacturer. | |
| | Smoothing aluminum electrolytic capacitor | (1) Check for liquid leakage. | | ○ | Contact the manufacturer | |
| | | (2) Check for safety valve projection and bulge. | | ○ | Contact the manufacturer | |
| | | (3) Visual check and judge by the life check of the main circuit capacitor. *(Refer to page 179)* | | ○ | | |
| | Relay/contactor | Check that the operation is normal and no chatter is heard. | | ○ | Contact the manufacturer | |
| | Resistor | (1) Check for crack in resistor insulation. | | ○ | Contact the manufacturer | |
| | | (2) Check for a break in the cable. | | ○ | Contact the manufacturer | |
| Control circuit protective circuit | Operation check | (1) Check that the output voltages across phases with the inverter operated alone is balanced. | | ○ | Contact the manufacturer | |
| | | (2) Check that no fault is found in protective and display circuits in a sequence protective operation test. | | ○ | Contact the manufacturer | |
| | Parts check: Overall | (1) Check for unusual odors and discoloration. | | ○ | Stop the device and contact the manufacturer. | |
| | | (2) Check for serious rust development. | | ○ | Contact the manufacturer | |
| | Parts check: Aluminum electrolytic capacitor | (1) Check for liquid leakage in a capacitor and deformation trace. | | ○ | Contact the manufacturer | |
| | | (2) Visual check and judge by the life check of the control circuit capacitor. *(Refer to page 179.)* | | ○ | | |
| Cooling system | Cooling fan | (1) Check for unusual vibration and noise. | ○ | | Replace the fan | |
| | | (2) Check for loose screws and bolts. | | ○ | Fix with the fan cover fixing screws. | |
| | | (3) Check for stains. | | ○ | Clean | |
| | Heatsink | (1) Check for clogging. | | ○ | Clean | |
| | | (2) Check for stains. | | ○ | Clean | |
| Display | Indication | (1) Check that display is normal. | ○ | | Contact the manufacturer | |
| | | (2) Check for stains. | | ○ | Clean | |
| | Meter | Check that reading is normal. | ○ | | Stop the device and contact the manufacturer. | |
| Load motor | Operation check | Check for vibration and abnormal increase in operation noise. | ○ | | Stop the device and contact the manufacturer. | |

*1 Oil component of the heat dissipation grease used inside the inverter may leak out. The oil component, however, is not flammable, corrosive, nor conductive and is not harmful to humans. Wipe off such oil component with a cloth, etc.

*2 It is recommended to install a device to monitor voltage for checking the power supply voltage to the inverter.

*3 One to two years of periodic inspection cycle is recommended. However, it differs according to the installation environment. Consult us for periodic inspection.

**CAUTION**

Continuous use of a leaked, deformed, or degraded smoothing aluminum electrolytic capacitor (as shown in the table above) may lead to a burst and breakage. Replace such capacitor without delay.

### 5.1.4 Display of the life of the inverter parts

The self-diagnostic alarm is output when the life span of the control circuit capacitor, cooling fan, each parts of the inrush current limit circuit is near its end. It gives an indication of replacement time .

**The life alarm output can be used as a guideline for life judgement.**

| Parts | Judgement Level |
|---|---|
| Main circuit capacitor | 85% of the initial capacity |
| Control circuit capacitor | Estimated 10% life remaining |
| Inrush current limit circuit | Estimated 10% life remaining (Power on: 100,000 times left) |
| Cooling fan | Less than 50% of the predetermined speed |

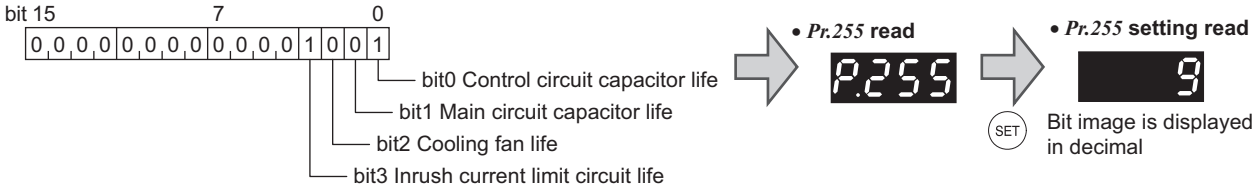
For the life check of the main circuit capacitor, the alarm signal (Y90) will not be output if a measuring method of (2) is not performed. *(Refer to page 180.)*

**REMARKS**

- Since repeated inrush currents at power ON will shorten the life of the converter circuit, frequent starts and stops of the magnetic contactor must be avoided.

#### (1) Display of the life alarm

- *Pr. 255 Life alarm status display* can be used to confirm that the control circuit capacitor, main circuit capacitor, cooling fan, and each parts of the inrush current limit circuit has reached the life alarm output level.




| *Pr. 255* (decimal) | Bit (binary) | Inrush Current Limit Circuit Life | Cooling Fan Life | Main Circuit Capacitor Life | Control Circuit Capacitor Life |
|---|---|---|---|---|---|
| 15 | 1111 | ○ | ○ | ○ | ○ |
| 14 | 1110 | ○ | ○ | ○ | × |
| 13 | 1101 | ○ | ○ | × | ○ |
| 12 | 1100 | ○ | ○ | × | × |
| 11 | 1011 | ○ | × | ○ | ○ |
| 10 | 1010 | ○ | × | ○ | × |
| 9 | 1001 | ○ | × | × | ○ |
| 8 | 1000 | ○ | × | × | × |
| 7 | 0111 | × | ○ | ○ | ○ |
| 6 | 0110 | × | ○ | ○ | × |
| 5 | 0101 | × | ○ | × | ○ |
| 4 | 0100 | × | ○ | × | × |
| 3 | 0011 | × | × | ○ | ○ |
| 2 | 0010 | × | × | ○ | × |
| 1 | 0001 | × | × | × | ○ |
| 0 | 0000 | × | × | × | × |

○: with alarm, ×: without alarm

**POINT**

Life check of the main circuit capacitor needs to be done by *Pr. 259*. (Refer to the following.)

### (2) Measuring method of life of the main circuit capacitor

- If the value of capacitor capacity measured before shipment is considered as 100%, *Pr. 255* bit1 is turned on when the measured value falls below 85%.
- Measure the capacitor capacity according to the following procedure and check the deterioration level of the capacitor capacity.
  1) Check that the motor is connected and at a stop.
  2) Set "1" (measuring start) in *Pr. 259*
  3) Switch power off. The inverter applies DC voltage to the motor to measure the capacitor capacity while the inverter is off.
  4) After confirming that the LED of the operation panel is off, power on again.
  5) Check that "3" (measuring completion) is set in *Pr. 259*, then read *Pr. 258* and check the life of the main circuit capacitor.

**REMARKS**

- When the main circuit capacitor life is measured under the following conditions, "forced end" (*Pr. 259* = "8") or "measuring error" (*Pr. 259* = "9") occurs or it remains in "measuring start" (*Pr. 259* = "1").
  When measuring, avoid the following conditions to perform. In addition, even when "measurement completion" (*Pr. 259* = "3") is confirmed under the following conditions, normal measurement can not be done.
  (a)FR-HC2, FR-CV, MT-RC or sine wave filter is connected.
  (b)Terminal R1/L11, S1/L21 or DC power supply is connected to the terminals P/+ and N/−.
  (c)Switch power on during measuring.
  (d)The motor is not connected to the inverter.
  (e)The motor is running.(The motor is coasting.)
  (f)The motor capacity is two rank smaller as compared to the inverter capacity.
  (g)The inverter is tripped or a fault occurred while power is off.
  (h)The inverter output is shut off with the MRS signal.
  (i)The start command is given while measuring.
- Operating environment: Surrounding air temperature (annual average 40°C (free from corrosive gas, flammable gas, oil mist, dust and dirt))
  Output current (80% of the inverter rated current)

**POINT**

For accurate life measurement of the main circuit capacitor, wait 3 hours or longer after turning OFF. The temperature left in the main circuit capacitor affects measurement.

## ⚠ WARNING

⚠ When measuring the main circuit capacitor capacity (*Pr. 259 Main circuit capacitor life measuring* = "1"), the DC voltage is applied to the motor for 1s at powering off. Never touch the motor terminal, etc. right after powering off to prevent an electric shock.

## *5.1.5 Cleaning*

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

**CAUTION**

Do not use solvent, such as acetone, benzene, toluene and alcohol, as they will cause the inverter surface paint to peel off.
The display, etc. of the operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07) are vulnerable to detergent and alcohol. Therefore, avoid using them for cleaning.

### 5.1.6 Replacement of parts

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

| Part Name | Estimated lifespan *1 | Description |
|---|---|---|
| Cooling fan | 10 years | Replace (as required) |
| Main circuit smoothing capacitor | 10 years *2 | Replace (as required) |
| On-board smoothing capacitor | 10 years *2 | Replace the board (as required) |
| Relays | – | as required |
| Fuse (160K or higher) | 10 years | Replace the fuse (as required) |

*1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C (without corrosive gas, flammable gas, oil mist, dust and dirt etc)
*2 Output current : 80% of the rated inverter current

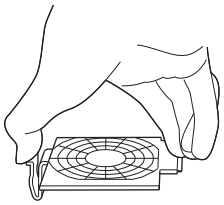
**CAUTION**

For parts replacement, consult the nearest Mitsubishi FA Center.

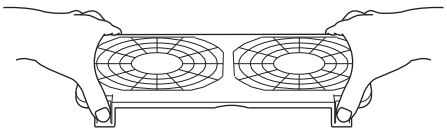
#### (1) Cooling fan

The replacement interval of the cooling fan used for cooling the parts generating heat such as the main circuit semiconductor is greatly affected by the surrounding air temperature. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be replaced immediately.

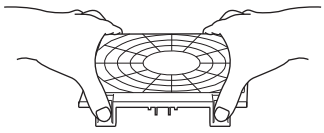
• Removal (FR-A720-1.5K to 90K, FR-A740-2.2K to 132K)
1) Push the hooks from above and remove the fan cover.



**FR-A720-1.5K to 3.7K**
**FR-A740-2.2K, 3.7K**

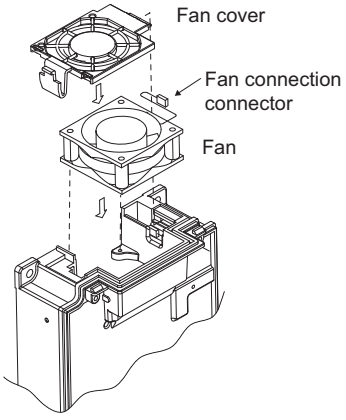


**FR-A720-5.5K to 22K**
**FR-A740-5.5K to 22K**

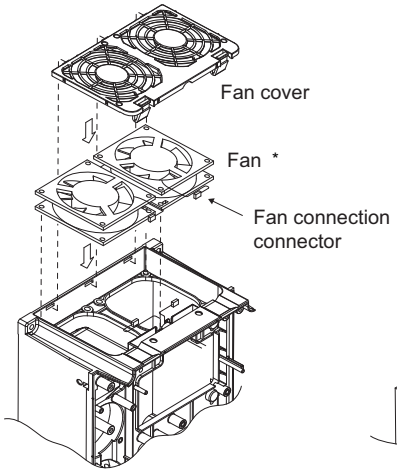


**FR-A720-30K or higher**
**FR-A740-30K to 132K**

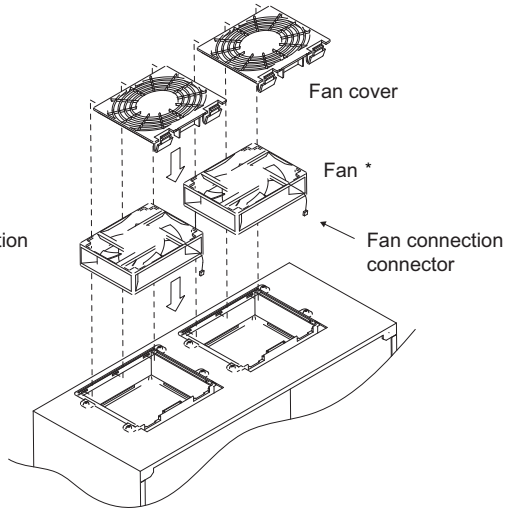
2) Disconnect the fan connectors.
3) Remove the fan.




**FR-A720-1.5K to 3.7K**
**FR-A740-2.2K, 3.7K**




**FR-A720-5.5K to 22K**
**FR-A740-5.5K to 22K**

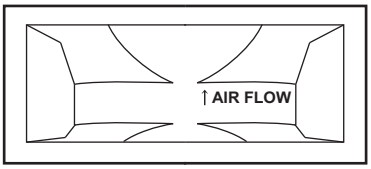



**FR-A720-30K or higher**
**FR-A740-30K to 132K**

* The number of cooling fans differs according to the inverter capacity.

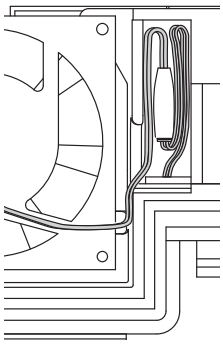
• Reinstallation (FR-A720-1.5K to 90K, FR-A740-2.2K to 132K)

1)After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.

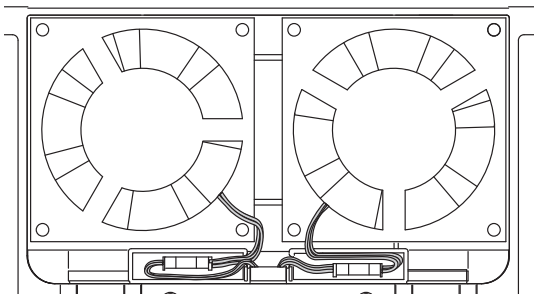



<Fan side face>

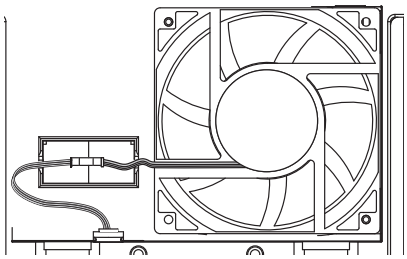
2)Reconnect the fan connectors.



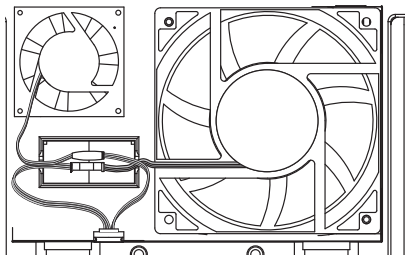
**FR-A720-1.5K to 3.7K**
**FR-A740-2.2K, 3.7K**



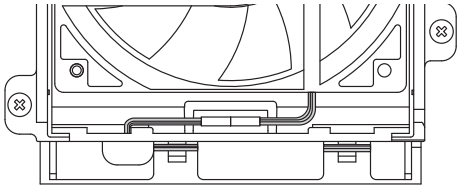
**FR-A720-5.5K to 11K**
**FR-A740-5.5K to 15K**



**FR-A720-15K, 18.5K**
**FR-A740-18.5K, 22K**

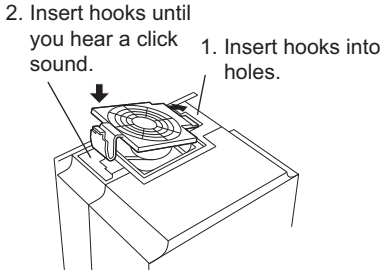


**FR-A720-22K**

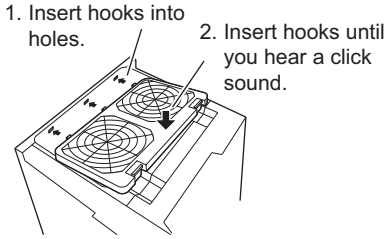


**FR-A720-30K or higher**
**FR-A740-30K to 132K**

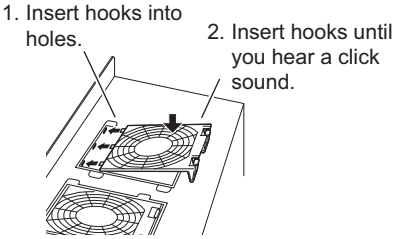
3) Reinstall the fan cover.




**FR-A720-1.5K to 3.7K**
**FR-A740-2.2K, 3.7K**




**FR-A720-5.5K to 22K**
**FR-A740-5.5K to 22K**

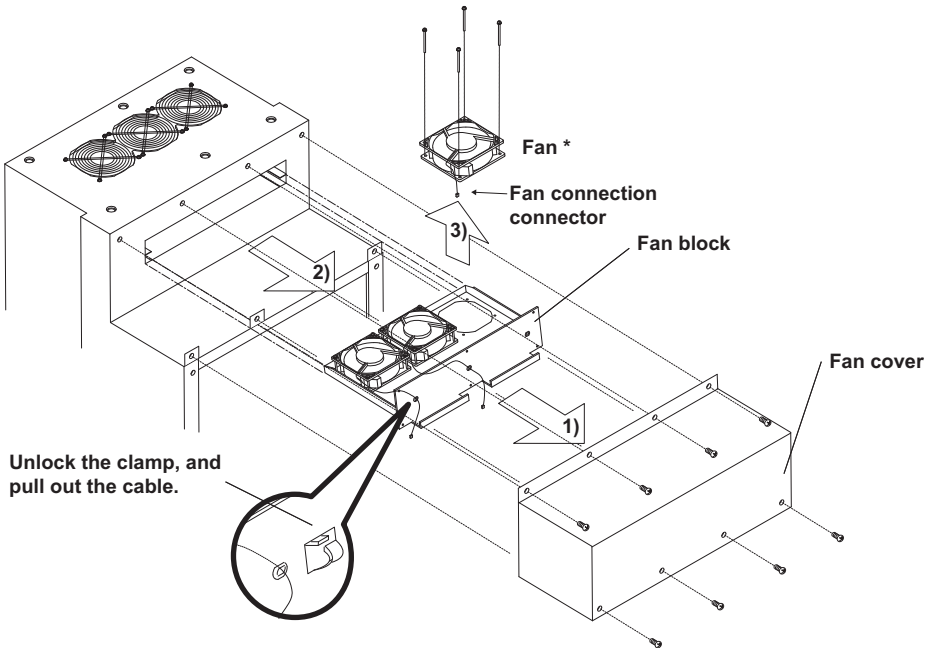



**FR-A720-30K or higher**
**FR-A740-30K to 132K**

**CAUTION**

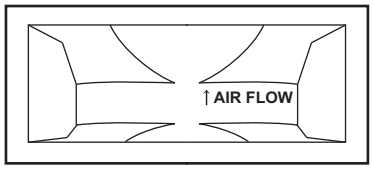
- Installing the fan in the opposite of air flow direction can cause the inverter life to be shorter.
- Prevent the cable from being caught when installing a fan.
- Switch the power off before replacing fans. Since the inverter circuits are charged with voltage even after power off, replace fans only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

• Removal (FR-A740-160K or higher)
1) Remove a fan cover.
2) After removing a fan connector, remove a fan block.
3) Remove the fan. (Make sure to remove the fan cable from the clamp of the fan block beforehand.)




* The number of cooling fans differs according to the inverter capacity.

• Reinstallation (FR-A740-160K or higher)
1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.




**<Fan side face>**

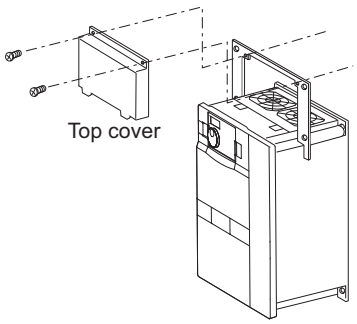
2) Install fans referring to the above figure.

**CAUTION**

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

### (2) Replacement procedure of the cooling fan when using a heatsink protrusion attachment (FR-A7CN)

When replacing a cooling fan, remove a top cover of the heatsink protrusion attachment and perform replacement. After replacing the cooling fan, replace the top cover in the original position.



### (3) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc.
The replacement intervals greatly vary with the surrounding air temperature and operating conditions. When the inverter is operated in air-conditioned, normal environment conditions, replace the capacitors about every 10 years.
The appearance criteria for inspection are as follows:
1) Case: Check the side and bottom faces for expansion
2) Sealing plate: Check for remarkable warp and extreme crack.
3) Check for external crack, discoloration, fluid leakage, etc. Judge that the capacitor has reached its life when the measured capacitance of the capacitor reduced below 80% of the rating.

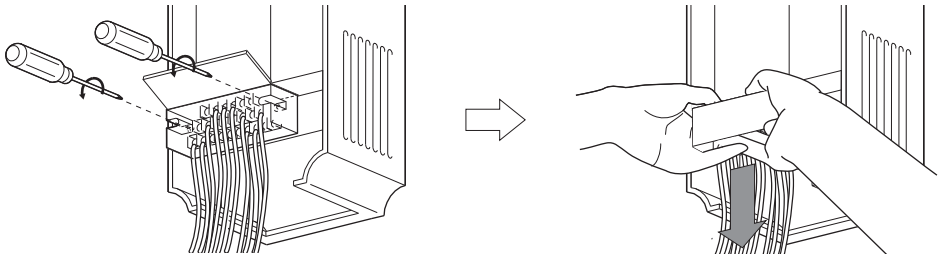
*Refer to page 180 to perform the life check of the main circuit capacitor.*

### (4) Relays

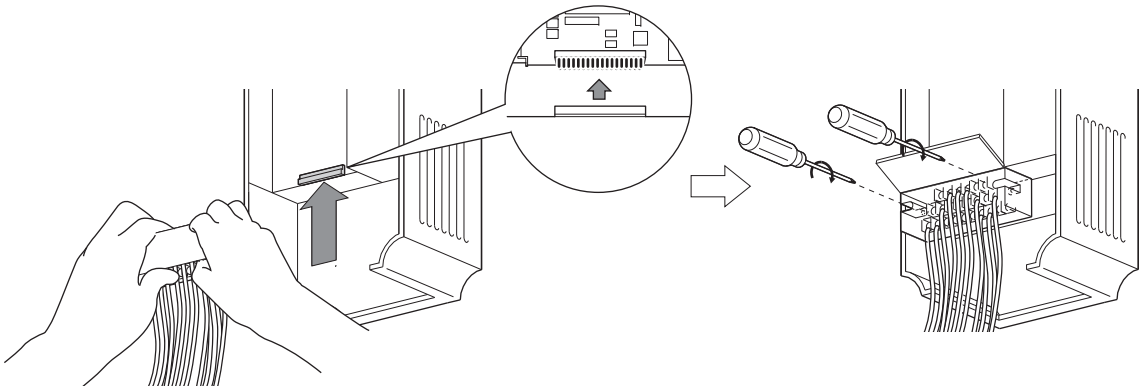
To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

## *5.1.7 Inverter replacement*

The inverter can be replaced with the control circuit wiring kept connected. Before replacement, remove the wiring cover of the inverter.
1) Loosen the two mounting screws in both ends of the control circuit terminal block. (These screws cannot be removed.) Pull down the terminal block from behind the control circuit terminals.



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



**CAUTION**

Before starting inverter replacement, switch power OFF, wait for at least 10 minutes, and then check the voltage with a tester and such to ensure safety.

# 6 SPECIFICATIONS

## 6.1 Inverter rating

### ●200V class

| Model FR-A720-□□K | | | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 | 75 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applicable motor capacity (kW) *1 | | | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 | 75 | 90 |
| Output | Rated capacity (kVA) *2 | | 1.1 | 1.9 | 3.1 | 4.2 | 6.7 | 9.2 | 12.6 | 17.6 | 23.3 | 29 | 34 | 44 | 55 | 67 | 82 | 110 | 132 |
| | Rated current (A) *3 | | 3 | 5 | 8 | 11 | 17.5 | 24 | 33 | 46 | 61 | 76 | 90 | 115 | 145 | 175 | 215 | 288 (245) | 346 (294) |
| | Overload current rating *4 | | 150% 60s, 200% 3s (inverse-time characteristics) surrounding air temperature 50°C | | | | | | | | | | | | | | | | |
| | Rated voltage *5 | | Three-phase 200 to 240V | | | | | | | | | | | | | | | | |
| | Regenerative braking torque | Maximum value/ permissible duty | 150% torque/ 3%ED*6 | | | 100% torque/ 3%ED*6 | | 100% torque/ 2%ED*6 | | 20% torque/ continuous *6 | | | | 20% torque/ continuous | | | | 10% torque/ continuous | |
| Power supply | Rated input AC voltage/frequency | | Three-phase 200 to 220V 50Hz, 200 to 240V 60Hz | | | | | | | | | | | | | | | | |
| | Permissible AC voltage fluctuation | | 170 to 242V 50Hz,170 to 264V 60Hz | | | | | | | | | | | | | | | | |
| | Permissible frequency fluctuation | | ±5% | | | | | | | | | | | | | | | | |
| | Power supply capacity (kVA) *7 | | 1.5 | 2.5 | 4.5 | 5.5 | 9 | 12 | 17 | 20 | 28 | 34 | 41 | 52 | 66 | 80 | 100 | 110 | 132 |
| Protective structure (JEM 1030) *9 | | | Enclosed type (IP20) *8 | | | | | | | | | | | Open type (IP00) | | | | | |
| Cooling system | | | Self-cooling | | Forced air cooling | | | | | | | | | | | | | | |
| Approx. mass (kg) | | | 1.9 | 2.3 | 3.8 | 3.8 | 3.8 | 7.1 | 7.1 | 7.5 | 13 | 13 | 14 | 23 | 35 | 35 | 58 | 70 | 70 |

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

*2. The rated output capacity indicated assumes that the output voltage is 220V.

*3. When operating the inverter of 75K or higher with a value larger than 2kHz set in *Pr. 72 PWM frequency selection*, the rated output current is the value in parentheses.

*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 pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.

*6. With the dedicated external brake resistor FR-ABR (option), the 0.4K and 0.75K, 1.5K to 7.5K, 11K to 22K will achieve the performance of 150% torque/ 10%ED, 100% torque/10%ED and 100% torque/6%ED respectively.

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

*8. When the hook of the inverter front cover is cut off for installation of the plug-in option, protective structure of the inverter changes to an open type (IP00).

*9. FR-DU07:IP40 (except for the PU connector)

## ●400V class

| Model FR-A740-□□K | | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applicable motor capacity (kW) *1 | | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 |
| Output | Rated capacity (kVA) *2 | 1.1 | 1.9 | 3 | 4.6 | 6.9 | 9.1 | 13 | 17.5 | 23.6 | 29 | 32.8 | 43.4 | 54 | 65 | 84 |
| | Rated current (A) | 1.5 | 2.5 | 4 | 6 | 9 | 12 | 17 | 23 | 31 | 38 | 44 | 57 | 71 | 86 | 110 |
| | Overload current rating *4 | 150% 60s, 200% 3s (inverse-time characteristics) surrounding air temperature 50°C | | | | | | | | | | | | | | |
| | Rated voltage *5 | Three-phase 380 to 480V | | | | | | | | | | | | | | |
| | Regenerative braking torque / Maximum value/ permissible duty | 100% torque/2%ED*6 | | | | | | | 20% torque/continuous *6 | | | | 20% torque/continuous | | | |
| Power supply | Rated input AC voltage/frequency | Three-phase 380 to 480V 50Hz/60Hz | | | | | | | | | | | | | | |
| | Permissible AC voltage fluctuation | 323 to 528V 50Hz/60Hz | | | | | | | | | | | | | | |
| | Permissible frequency fluctuation | ±5% | | | | | | | | | | | | | | |
| | Power supply capacity (kVA) *7 | 1.5 | 2.5 | 4.5 | 5.5 | 9 | 12 | 17 | 20 | 28 | 34 | 41 | 52 | 66 | 80 | 100 |
| Protective structure *9 | | Enclosed type (IP20) *8 | | | | | | | | | | | Open type (IP00) | | | |
| Cooling system | | Self-cooling | | | Forced air cooling | | | | | | | | | | | |
| Approx. mass (kg) | | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 7.1 | 7.1 | 7.5 | 7.5 | 13 | 13 | 23 | 35 | 35 | 37 |

| Model FR-A740-□□K | | 75 | 90 | 110 | 132 | 160 | 185 | 220 | 250 | 280 | 315 | 355 | 400 | 450 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applicable motor capacity (kW) *1 | | 75 | 90 | 110 | 132 | 160 | 185 | 220 | 250 | 280 | 315 | 355 | 400 | 450 | 500 |
| Output | Rated capacity (kVA) *2 | 110 | 137 | 165 | 198 | 248 | 275 | 329 | 367 | 417 | 465 | 521 | 587 | 660 | 733 |
| | Rated current (A)*3 | 144 (122) | 180 (153) | 216 (184) | 260 (221) | 325 (276) | 361 (307) | 432 (367) | 481 (409) | 547 (465) | 610 (519) | 683 (581) | 770 (655) | 866 (736) | 962 (818) |
| | Overload current rating *4 | 150% 60s, 200% 3s (inverse-time characteristics) surrounding air temperature 50°C | | | | | | | | | | | | | |
| | Rated voltage*5 | Three-phase 380 to 480V | | | | | | | | | | | | | |
| | Regenerative braking torque / Maximum value/ permissible duty | 10% torque/continuous | | | | | | | | | | | | | |
| Power supply | Rated input AC voltage/frequency | Three-phase 380 to 480V 50Hz/60Hz | | | | | | | | | | | | | |
| | Permissible AC voltage fluctuation | 323 to 528V 50Hz/60H | | | | | | | | | | | | | |
| | Permissible frequency fluctuation | ±5% | | | | | | | | | | | | | |
| | Power supply capacity (kVA) *7 | 110 | 137 | 165 | 198 | 248 | 275 | 329 | 367 | 417 | 465 | 521 | 587 | 660 | 733 |
| Protective structure (JEM 1030) *9 | | Open type (IP00) | | | | | | | | | | | | | |
| Cooling system | | Forced air cooling | | | | | | | | | | | | | |
| Approx. mass (kg) | | 50 | 57 | 67 | 72 | 110 | 110 | 175 | 175 | 175 | 260 | 260 | 370 | 370 | 370 |

*1. The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.
*2. The rated output capacity indicated assumes that the output voltage is 440V.
*3. When operating the inverter of 75K or higher with a value larger than 2kHz set in *Pr. 72 PWM frequency selection*, the rated output current is the value in parentheses.
*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 pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
*6. With the dedicated external brake resistor FR-ABR-H (option), the 0.4K to 7.5K and 11K to 22K will achieve the performance of 100% torque/10%ED and 100% torque/6%ED respectively.
*7. The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).
*8. When the hook of the inverter front cover is cut off for installation of the plug-in option, protective structure of the inverter changes to an open type (IP00).
*9. FR-DU07:IP40 (except for the PU connector)

# 6.2 Motor rating

## (1) Vector control dedicated motor SF-V5RU (1500r/min series)

### ●200V class

| Motor type SF-V5RU□□K | | 1 | 2 | 3 | 5 | 7 | 11 | 15 | 18 | 22 | 30 | 37 | 45 | 55 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applicable inverter model FR-A720-□□K | | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 | 75 |
| Rated output (kW) | | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 *1 | 37 *1 | 45 *1 | 55 |
| Rated torque (N•m) | | 9.55 | 14.1 | 23.6 | 35.0 | 47.7 | 70.0 | 95.5 | 118 | 140 | 191 | 235 | 286 | 350 |
| Maximum torque 150% 60s (N•m) | | 14.3 | 21.1 | 35.4 | 52.4 | 71.6 | 105 | 143 | 176 | 211 | 287 | 353 | 429 | 525 |
| Rated speed (r/min) | | 1500 | | | | | | | | | | | | |
| Maximum speed (r/min) | | 3000 *2 | | | | | | | | | | | | 2400 |
| Frame No. | | 90L | 100L | 112M | 132S | 132M | 160M | 160L | 180M | 180M | 200L | 200L | 200L | 225S |
| Inertia moment J ($\times 10^{-4}$kg•m$^2$) | | 67.5 | 105 | 175 | 275 | 400 | 750 | 875 | 1725 | 1875 | 3250 | 3625 | 3625 | 6850 |
| Noise *5 | | 75dB or less | | | | | | | | | 80dB or less | | | 85dB or less |
| Cooling fan (with thermal protector) *7 *8 | Voltage | Single-phase 200V/50Hz<br>Single-phase 200V to 230V/60Hz | | | | | Three-phase 200V/50Hz<br>Three-phase 200 to 230V/60Hz | | | | | | | |
| | Input *3 | 36/55W (0.26/0.32A) | | | 22/28W (0.11/0.13A) | | 55/71W (0.39/0.39A) | | | | 100/156W (0.47/0.53A) | | | 85/130W (0.46/0.52A) |
| | Recommended thermal setting | 0.36A | | | 0.18A | | 0.51A | | | | 0.69A | | | 0.68A |
| Surrounding air temperature, humidity | | -10 to +40°C (non-freezing), 90%RH or less (non-condensing) | | | | | | | | | | | | |
| Structure (Protective structure) | | Totally enclosed forced draft system<br>(Motor: IP44, cooling fan: IP23S) *4 | | | | | | | | | | | | |
| Detector | | Encoder 2048P/R, A phase, B phase, Z phase +12VDC power supply *6 | | | | | | | | | | | | |
| Equipment | | Encoder, thermal protector, fan | | | | | | | | | | | | |
| Heat resistance class | | F | | | | | | | | | | | | |
| Vibration rank | | V10 | | | | | | | | | | | | |
| Approx. mass (kg) | | 24 | 33 | 41 | 52 | 62 | 99 | 113 | 138 | 160 | 238 | 255 | 255 | 320 |

### ●400V class

| Motor type SF-V5RUH□□K | | 1 | 2 | 3 | 5 | 7 | 11 | 15 | 18 | 22 | 30 | 37 | 45 | 55 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Applicable inverter model FR-A740-□□K | | 2.2 | 2.2 | 3.7 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 | 75 |
| Rated output (kW) | | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 *1 | 37 *1 | 45 *1 | 55 |
| Rated torque (N•m) | | 9.55 | 14.1 | 23.6 | 35.0 | 47.7 | 70.0 | 95.5 | 118 | 140 | 191 | 235 | 286 | 350 |
| Maximum torque 150% 60s (N•m) | | 14.3 | 21.1 | 35.4 | 52.4 | 71.6 | 105 | 143 | 176 | 211 | 287 | 353 | 429 | 525 |
| Rated speed (r/min) | | 1500 | | | | | | | | | | | | |
| Maximum speed (r/min) | | 3000 *2 | | | | | | | | | | | | 2400 |
| Frame No. | | 90L | 100L | 112M | 132S | 132M | 160M | 160L | 180M | 180M | 200L | 200L | 200L | 225S |
| Inertia moment J ($\times 10^{-4}$kg•m$^2$) | | 67.5 | 105 | 175 | 275 | 400 | 750 | 875 | 1725 | 1875 | 3250 | 3625 | 3625 | 6850 |
| Noise *5 | | 75dB or less | | | | | | | | | 80dB or less | | | 85dB or less |
| Cooling fan (with thermal protector) *7 *8 | Voltage | Single-phase 200V/50Hz<br>Single-phase 200V to 230V/60Hz | | | | | Three-phase 380 to 400V/50Hz<br>Three-phase 400 to 460V/60Hz | | | | | | | |
| | Input *3 | 36/55W (0.26/0.32A) | | | 22/28W (0.11/0.13A) | | 55/71W (0.19/0.19A) | | | | 100/156W (0.27/0.30A) | | | 85/130W (0.23/0.26A) |
| | Recommended thermal setting | 0.36A | | | 0.18A | | 0.25A | | | | 0.39A | | | 0.34A |
| Surrounding air temperature, humidity | | -10 to +40°C (non-freezing), 90%RH or less (non-condensing) | | | | | | | | | | | | |
| Structure (Protective structure) | | Totally enclosed forced draft system<br>(Motor: IP44, cooling fan: IP23S) *4 | | | | | | | | | | | | |
| Detector | | Encoder 2048P/R, A phase, B phase, Z phase +12VDC power supply *6 | | | | | | | | | | | | |
| Equipment | | Encoder, thermal protector, fan | | | | | | | | | | | | |
| Heat resistance class | | F | | | | | | | | | | | | |
| Vibration rank | | V10 | | | | | | | | | | | | |
| Approx. mass (kg) | | 24 | 33 | 41 | 52 | 62 | 99 | 113 | 138 | 160 | 238 | 255 | 255 | 320 |

*1 80% output in the high-speed range. (The output is reduced when the speed is 2400r/min or more. Contact us separately for details.)
*2 A dedicated motor of 3.7kW or less can be run at the maximum speed of 3600 r/min. Consult our sales office when using the motor at the maximum speed.
*3 Power (current) at 50Hz/60Hz.
*4 Since a motor with brake has a window for gap check, the protective structure of both the cooling fan section and brake section is IP20. S of IP23S is an additional code indicating the condition that protection from water intrusion is established only when a cooling fan is not operating.
*5 The value when high carrier frequency is set (*Pr.72* = 6, *Pr.240* = 0).
*6 The 12V power supply or the control terminal option (FR-A7PS) is required as the power supply for the encoder.
*7 The cooling fan is equipped with a thermal protector. The cooling fan stops when the coil temperature exceeds the specified value in order to protect the fan motor. A restrained cooling fan or degraded fan motor insulation could be causes for the rise in coil temperature.The cooling fan re-starts when the coil temperature drops to normal.
*8 The voltage and input values are the standard specifications of the cooling fan in free air. When the cooling fan is used with a motor, it requires more energy to perform its work, and thus the above input values become slightly larger. The cooling fan can, however, be used as it is without causing problems. When a thermal relay is to be prepared at the customer's side, use the recommended thermal relay settings.

## (2) Vector control dedicated motor SF-THY

| Motor type | | | SF-THY | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Applicable inverter | | | FR-A720-□□K | FR-A740-□□K | | | | | | |
| | | | 90 | 90 | 110 | 132 | 160 | 185 | 220 | 280 |
| Rated output (kW) | | | 75 | 75 | 90 | 110 | 132 | 160 | 200 | 250 |
| Rated torque (kgf･m) | | | 48.7 | 48.7 | 58.4 | 71.4 | 85.7 | 103.9 | 129.9 | 162.3 |
| (N･m) | | | 477 | 477 | 572 | 700 | 840 | 1018 | 1273 | 1591 |
| Maximum torque(kgf･m) | | | 73.0 | 73.0 | 87.6 | 107.1 | 128.5 | 155.8 | 194.8 | 243.4 |
| 150%60s (N･m) | | | 715 | 715 | 858 | 1050 | 1260 | 1527 | 1909 | 2386 |
| Rated speed (r/min) | | | 1500 | 1500 | | | | | | |
| Maximum speed (r/min) | | | 2400 | 2400 | 1800 | | | | | |
| Frame No. | | | 250MD | 250MD | 250MD | 280MD | 280MD | 280MD | 280L | 315H |
| Inertia moment J (kg･m$^2$) | | | 1.1 | 1.1 | 1.7 | 2.3 | 2.3 | 4.0 | 3.8 | 5.0 |
| Noise | | | 90dB | 90dB | | | 95dB | | | |
| Cooling fan | Voltage | | Three-phase, 200V/50Hz, 200V/60Hz, 220V/60Hz (400V class cooling fan is available upon order) | | | | | | | |
| | Input (W) | 50Hz | 750 | 400 | 400 | 400 | 400 | 400 | 750 | 750 |
| | | 60Hz | | 750 | 750 | 750 | 750 | 750 | 1500 | 1500 |
| Approx. mass (kg) | | | 610 | 610 | 660 | 870 | 890 | 920 | 1170 | 1630 |
| Common specifications | Surrounding air temperature, humidity | | -10 to +40°C (non-freezing), 90%RH or less (non-condensing) | | | | | | | |
| | Structure | | Totally enclosed forced draft system | | | | | | | |
| | Detector | | Encoder 2048P/R, A phase, B phase, Z phase +12VDC power supply *1 | | | | | | | |
| | Equipment | | Encoder, thermal protector*2, fan | | | | | | | |
| | Insulation | | Class F | | | | | | | |
| | Vibration rank | | V10 | | | | | | | |
| | Dedicated encoder | Resolution | 2048 pulse/rev | | | | | | | |
| | | Power supply voltage | 12VDC±10% | | | | | | | |
| | | Current consumption | 90mA | | | | | | | |
| | | Output signal form | A, B phases (90° phase shift) Z phase: 1 pulse/rev | | | | | | | |
| | | Output circuit | Complementary (constant voltage output matched by emitter follow) | | | | | | | |
| | | Output voltage | "H" level: Power supply voltage 9V or more ($I_{OH}$: -20mA)<br>"L" level: Power supply voltage 3V or less ($I_{OL}$: 20mA) | | | | | | | |

*1 The 12V power supply or the control terminal option (FR-A7PS) is required as the power supply for the encoder.

*2 A motor with a thermal protector is also available. Contact your sales representative.

### (3) IPM motor MM-CF

| Item \ Motor | | 2000r/min Series | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | MM-CF 52(C)(B) | MM-CF 102(C)(B) | MM-CF 152(C)(B) | MM-CF 202(C)(B) | MM-CF 352(C)(B) | MM-CF 502(C) | MM-CF 702(C) |
| Compatible inverter | FR-A720-☐ | 0.4K | 0.75K | 1.5K | 2.2K | 3.7K | 5.5K | 7.5K |
| | | 0.75K *6 | 1.5K *6 | 2.2K *6 | 3.7K *6 | 5.5K *6 | 7.5K *6 | 11K *6 |
| Continuous characteristics *1 | Rated output [kW] | 0.5 | 1.0 | 1.5 | 2.0 | 3.5 | 5.0 | 7.0 |
| | Rated torque [N•m] | 2.39 | 4.78 | 7.16 | 9.55 | 16.70 | 23.86 | 33.41 |
| Rated speed *1 [r/min] | | 2000 | | | | | | |
| Max. speed [r/min] | | 3000 | | | | | | |
| Instantaneous permissible speed [r/min] | | 3450 | | | | | | |
| Max. torque [N•m] | | 4.78 | 9.56 | 14.32 | 19.09 | 33.41 | 47.73 | 66.82 |
| Inertia moment J *5 [×$10^{-4}$kg•$m^2$] | | 6.6 (7.0) | 13.7 (14.9) | 20.0 (21.2) | 45.5 (48.9) | 85.6 (89.0) | 120.0 | 160.0 |
| Recommended ratio of load inertia moment to motor shaft inertia moment *2 | | 100 times max. | | | 50 times max. | | | |
| Rated current [A] | | 1.81 | 3.70 | 5.22 | 7.70 | 12.5 | 20.5 | 27.0 |
| Insulation rank | | Class F | | | | | | |
| Structure | | Totally-enclosed, self-cooling (protective system:IP44 *3, IP65 *3, *4) | | | | | | |
| Environmental conditions | Surrounding air temperature and humidity | -10C° to +40C° (non-freezing) • 90%RH or less (non-condensing) | | | | | | |
| | Storage temperature and humidity | -20C° to +70C° (non-freezing) • 90%RH or less (non-condensing) | | | | | | |
| | Ambience | Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust and dirt | | | | | | |
| | Altitude | Max. 1000m above sea level | | | | | | |
| | Vibration | X: 9.8m/$s^2$, Y: 24.5m/$s^2$ | | | | | | |
| Mass *5 [kg] | | 5.1 (7.8) | 7.2 (11) | 9.3 (13) | 13 (20) | 19 (28) | 27 | 36 |

*1 When the power supply voltage drops, we cannot guarantee the above output and rated speed.

*2 When the load torque is 20% of the motor rating. The permissible load inertia moment ratio is smaller when the load torque is larger. Consult us if the load inertia moment ratio exceeds the above value.

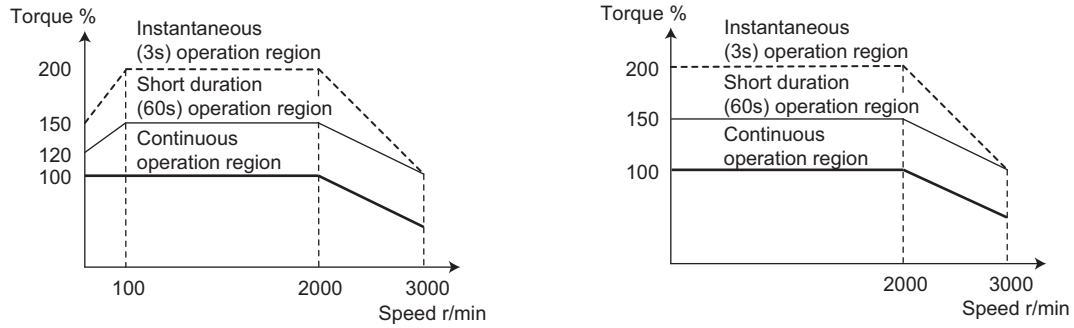
*3 This does not apply to the shaft through portion.

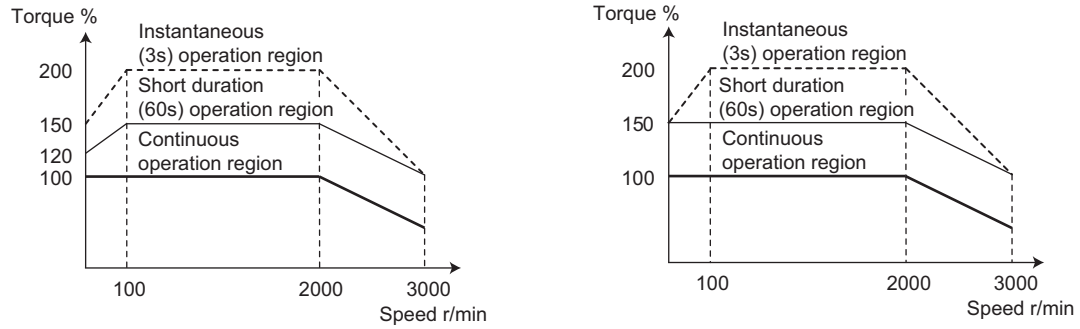
*4 Value for MM-CF☐2C.

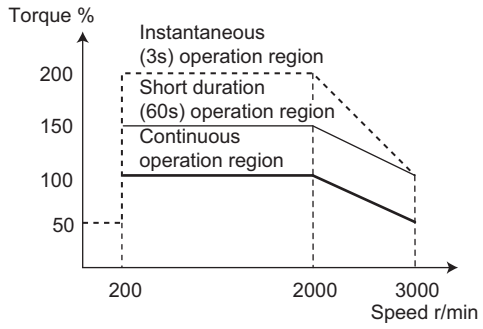
*5 The value for MM-CF☐2B is indicated in parentheses.

*6 Applicable one-rank higher inverters for the lifted low-speed range torque operation.

## Torque characteristics

<table>
<tr><th colspan="2">Under high frequency superposition control</th></tr>
<tr><td>MM-CF<br>1.5kW or<br>lower</td><td>
With one rank higher inverter<br>


</td></tr>
<tr><td>MM-CF<br>2.0kW or<br>higher</td><td>
With one rank higher inverter<br>


<br>* Zero speed up to a 150% instantaneous output torque
</td></tr>
<tr><th colspan="2">During current synchronization operation</th></tr>
<tr><td>MM-CF<br>all<br>capacities</td><td>


</td></tr>
</table>

# 6.3 Common specifications

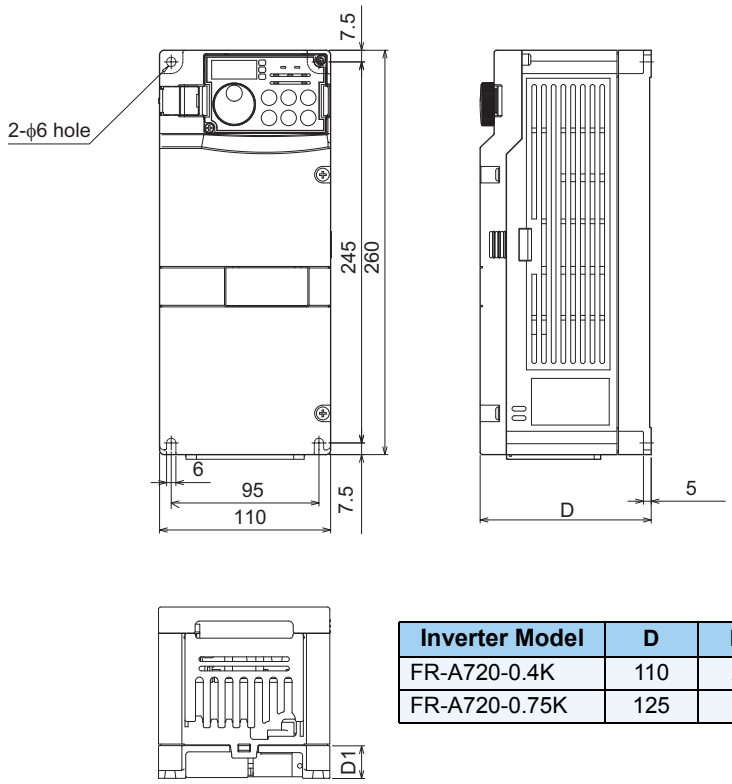
| | | | |
|---|---|---|---|
| Control specifications | Control method | | Soft-PWM control/high carrier frequency PWM control (V/F control, Advanced magnetic flux vector control and Real sensorless vector control are available) / vector control *1 / PM sensorless vector control |
| | Output frequency range | | 0.2 to 400Hz (The maximum frequency is 120Hz under Real sensorless vector control and vector control.) |
| | Frequency setting resolution | Analog input | 0.015Hz/60Hz (terminal 2, 4: 0 to 10V/12bit)<br>0.03Hz/60Hz (terminal 2, 4: 0 to 5V/11bit, 0 to 20mA/about 11bit, terminal 1: 0 to ±10V/12bit)<br>0.06Hz/60Hz (terminal 1: 0 to ±5V/11bit) |
| | | Digital input | 0.01Hz |
| | Frequency accuracy | Analog input | Within ±0.2% of the max. output frequency (25°C±10°C) |
| | | Digital input | Within 0.01% of the set output frequency |
| | Voltage/frequency characteristics | | Base frequency can be set from 0 to 400Hz Constant torque/variable torque pattern or adjustable 5 points V/F can be selected |
| | Starting torque *11 | | 200% at 0.3Hz (0.4K to 3.7K), 150% at 0.3Hz (5.5K or higher) (under Real sensorless vector control or vector control *1) |
| | Torque boost | | Manual torque boost |
| | Acceleration/deceleration time setting | | 0 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode, backlash measures acceleration/deceleration mode are available. |
| | DC injection brake (induction motor) | | Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) can be changed |
| | Stall prevention operation level | | Operation current level can be set (0 to 220% adjustable), whether to use the function or not can be selected |
| | Torque limit level | | Torque limit value can be set (0 to 400% variable) |
| Operation specifications | Frequency setting signal | Analog input | • Terminal 2, 4: 0 to 10V, 0 to 5V, 4 to 20mA (0 to 20mA) can be selected• Terminal 1: -10 to +10V, -5 to +5V can be selected |
| | | Digital input | Input using the setting dial of the operation panel or parameter unit<br>Four-digit BCD or 16-bit binary (when used with option FR-A7AX) |
| | Start signal | | Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected. |
| | Input signals (twelve terminals) | | The following signals can be assigned to *Pr. 178 to Pr. 189 (input terminal function selection)*: multi speed selection, remote setting, stop-on-contact, second function selection, third function selection, terminal 4 input selection, JOG operation selection, selection of automatic restart after instantaneous power failure, flying start, external thermal relay input, inverter run enable signal (FR-HC2/FR-CV connection), FR-HC2 connection (instantaneous power failure detection), PU operation/external inter lock signal, external DC injection brake operation start, PID control enable terminal, brake opening completion signal, PU operation/External operation switchover, load pattern selection forward rotation reverse rotation boost, V/F switchover, load torque high-speed frequency, S-pattern acceleration/deceleration C switchover, pre-excitation/servo on, output stop, start self-holding selection, control mode switchover, torque limit selection, start-time tuning start external input, torque bias selection 1, 2*1, P/PI control switchover, forward rotation command, reverse rotation command, inverter reset, PTC thermistor input, PID forward reverse operation switchover, PU-NET operation switchover, NET-External operation switchover, command source switchover, simple position pulse train sign, simple position droop pulse clear, DC feeding operation permission, DC feeding cancel, magnetic flux decay output shutoff, proximity dog *3, 0V voltage calibration request *5. |
| | Pulse train input | | 100kpps |
| | Operational functions | | Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, polarity reversible operation, automatic restart after instantaneous power failure operation, electronic bypass operation, forward/reverse rotation prevention, remote setting, brake sequence, second function, third function, multi-speed operation, original operation continuation at instantaneous power failure, stop-on-contact control, load torque high speed frequency control, droop control, regeneration avoidance, slip compensation, operation mode selection, offline auto tuning function, online auto tuning function, PID control, computer link operation (RS-485), motor end orientation *1, machine end orientation *2, pre-excitation, notch filter, machine analyzer *1, easy gain tuning, speed feed forward, and torque bias *1 |
| | Output signals<br>Open collector output (5 terminals)<br>Relay output (2 terminals) | Operating status | The following signals can be assigned to *Pr. 190 to Pr. 196 (output terminal function selection)*: inverter running, inverter running/start command on, up-to-frequency, instantaneous power failure/undervoltage, overload warning, output frequency (speed) detection, second output frequency (speed) detection, third output frequency (speed) detection, regenerative brake pre-alarm, electronic thermal relay function pre-alarm, PU operation mode, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward rotation reverse rotation output, electronic bypass MC1, electronic bypass MC2, electronic bypass MC3, orientation complete *1, orientation fault *1, brake opening request, fan fault output, heatsink overheat pre-alarm, deceleration at an instantaneous power failure, PID control activated, motor temperature detection *4, PM sensorless vector control *5, during retry, PID output interruption, during 0V voltage calibration *5, position control preparation ready *1, DC feeding, life alarm, fault output 1, 2, 3 (power-off signal), power savings average value update timing, current average monitor, maintenance timer alarm, remote output, forward rotation output *1, reverse rotation output *1, low speed detection, torque detection, regenerative status output *1, start-time tuning completion, in-position completion *1, alarm output and fault output. Alarm code of the inverter can be output (4 bit) from the open collector. |
| | | When used with the FR-A7AY, FR-A7AR (option) | In addition to above, the following signal can be assigned to *Pr.313 to Pr. 319 (extension output terminal function selection)*: control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life. (only positive logic can be set for extension terminals of the FR-A7AR) |
| | Pulse train output | | 50kpps |
| | For meter<br>Pulse train output (Max. 2.4kHz: one terminal)<br>Analog output (Max. 10VDC: one terminal) | | The following signals can be assigned to *Pr. 54 FM terminal function selection (pulse train output)* and *Pr. 158 AM terminal function selection (analog output)*: output frequency, motor current (steady or peak value), output voltage, frequency setting, operation speed, motor torque, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, reference voltage output, motor load factor, motor temperature *4, power saving effect, regenerative brake duty, PID set point, PID measured value, motor output, torque command, torque current command, and torque monitor. |
| Indication | Operation panel (FR-DU07)<br>Parameter unit (FR-PU07) | Operating status | The following operating status can be displayed: Output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, motor torque, overload, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, position pulse, cumulative energization time, orientation status *1, actual operation time, motor load factor, cumulative power, energy saving effect, cumulative saving power, regenerative brake duty, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, input terminal option monitor*6, output terminal option monitor *6, option fitting status *7, terminal assignment status *7, torque command, torque current command, feed back pulse *1, motor output, SSCNET III communication status *3, motor temperature *4 |
| | | Fault record | Fault definition is displayed when a fault occurs, the output voltage/current/frequency/cumulative energization time right before the fault occurs and past 8 fault records are stored. |
| | | Interactive guidance | Function (help) for operation guide *7 |
| Protective/ warning function | | Protective function | Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, instantaneous power failure occurrence, undervoltage, input phase loss *10, motor overload, output side earth (ground) fault overcurrent, output short circuit, main circuit element overheat, output phase loss, external thermal relay operation *10, PTC thermistor operation *10, option fault, parameter error, PU disconnection, retry count excess *10, CPU fault, operation panel power supply short circuit, 24VDC power output short circuit, output current detection value excess *10, inrush current limit circuit fault, communication fault (inverter), USB fault, opposite rotation deceleration fault*10, analog input fault, brake transistor alarm, speed deviation large *1*10, overspeed *1*10, position error large *1*10, signal loss detection *1*10, brake sequence fault*10, encoder phase error *1*10, loss of synchronism *10 |
| | | Warning function | Fan fault, overcurrent stall prevention, overvoltage stall prevention, regenerative brake pre-alarm *10, electronic thermal relay function pre-alarm, PU stop, maintenance timer alarm *10, parameter write error, copy operation error, operation panel lock, password locked, parameter copy alarm, speed limit indication |
| Environment | Surrounding air temperature | | -10°C to +50°C (non-freezing) |
| | Ambient humidity | | 90%RH maximum (non-condensing) |
| | Storage temperature *8 | | -20°C to +65°C |
| | Atmosphere | | Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.) |
| | Altitude/vibration | | Maximum 1000m above sea level for standard operation. 5.9m/s$^2$ or less *9 at 10 to 55Hz (directions of X, Y, Z axes) |

*1 Available only when the option (FR-A7AP/FR-A7AL) is mounted.
*2 Available only when the option (FR-A7AL) is mounted.
*3 Available only when the option (FR-A7NS) is mounted.
*4 Available only when the option (FR-A7AZ) is mounted and SF-V5RU□□□□□T/A is used.
*5 Available only when the option (FR-A7AD) is mounted.
*6 Can be displayed only on the operation panel (FR-DU07).
*7 Can be displayed only on the parameter unit (FR-PU07).
*8 Temperature applicable for a short period in transit, etc.
*9 2.9m/s$^2$ or less for the 160K or higher.
*10 This protective function is not available in the initial status.
*11 For PM sensorless vector control, refer to *page 209*.

# 6.4 Outline dimension drawings

## *6.4.1 Inverter outline dimension drawings*

●FR-A720-0.4K, 0.75K

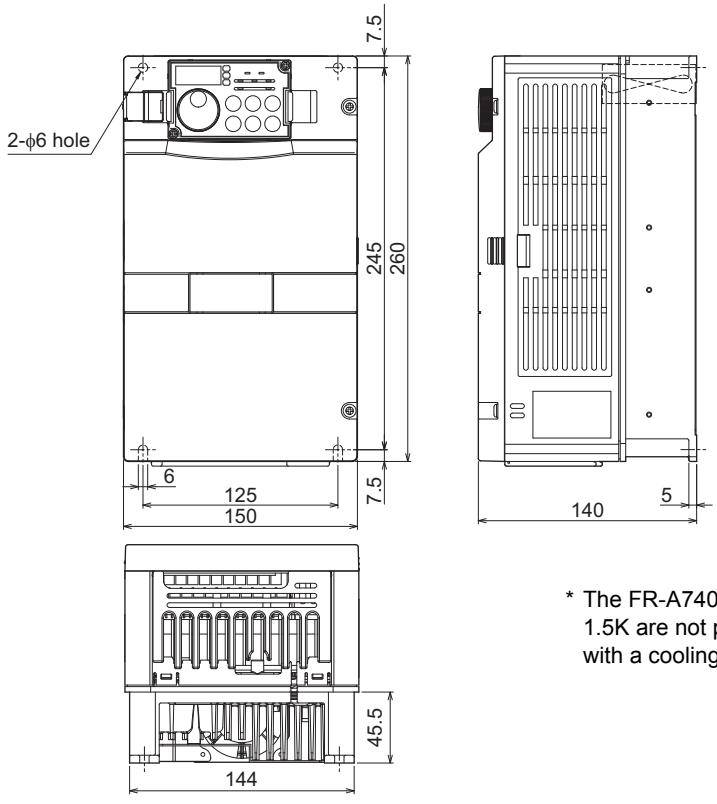



| Inverter Model | D | D1 |
|---|---|---|
| FR-A720-0.4K | 110 | 21 |
| FR-A720-0.75K | 125 | 36 |

(Unit: mm)

●FR-A720-1.5K, 2.2K, 3.7K

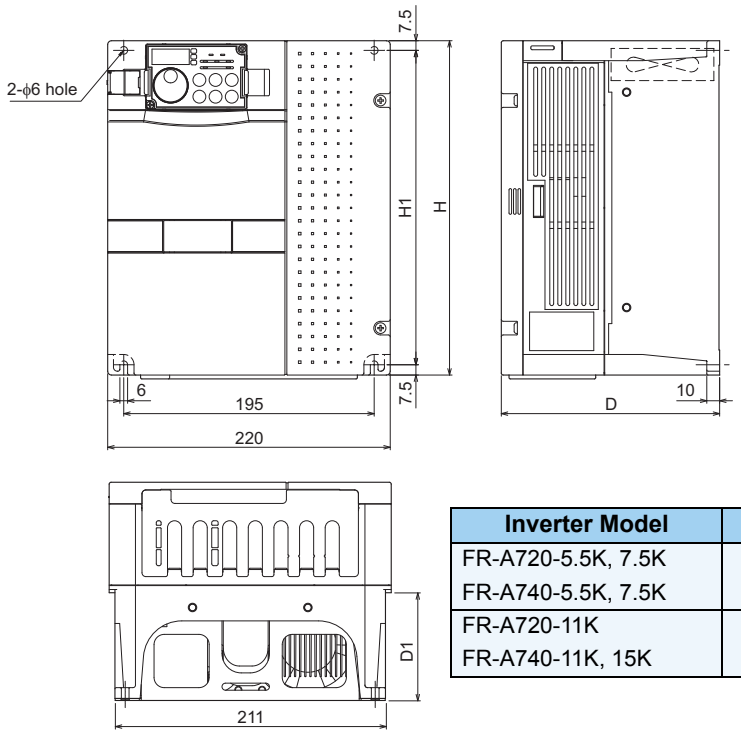
●FR-A740-0.4K, 0.75K, 1.5K, 2.2K, 3.7K




* The FR-A740-0.4K to 1.5K are not provided with a cooling fan.

(Unit: mm)

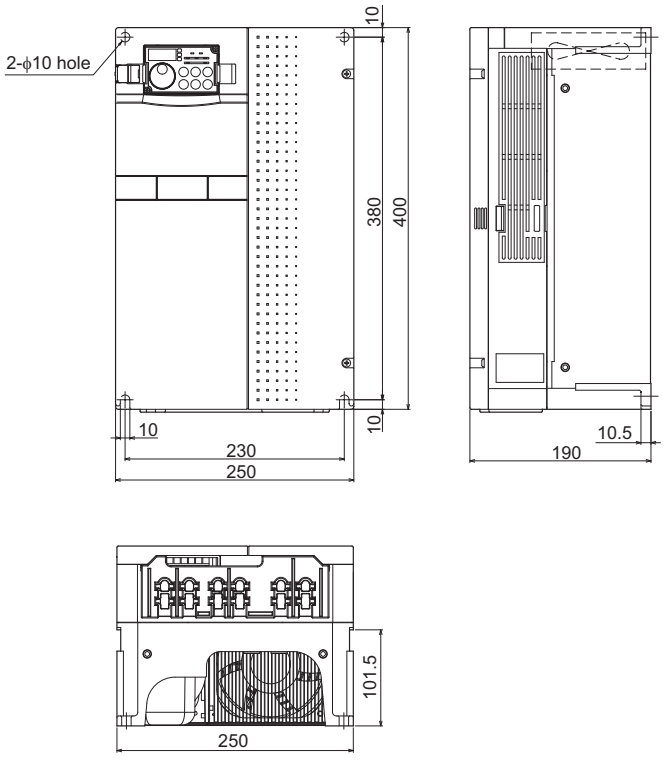
●FR-A720-5.5K, 7.5K, 11K
●FR-A740-5.5K, 7.5K, 11K, 15K




| Inverter Model | H | H1 | D | D1 |
|---|---|---|---|---|
| FR-A720-5.5K, 7.5K<br>FR-A740-5.5K, 7.5K | 260 | 245 | 170 | 84 |
| FR-A720-11K<br>FR-A740-11K, 15K | 300 | 285 | 190 | 101.5 |

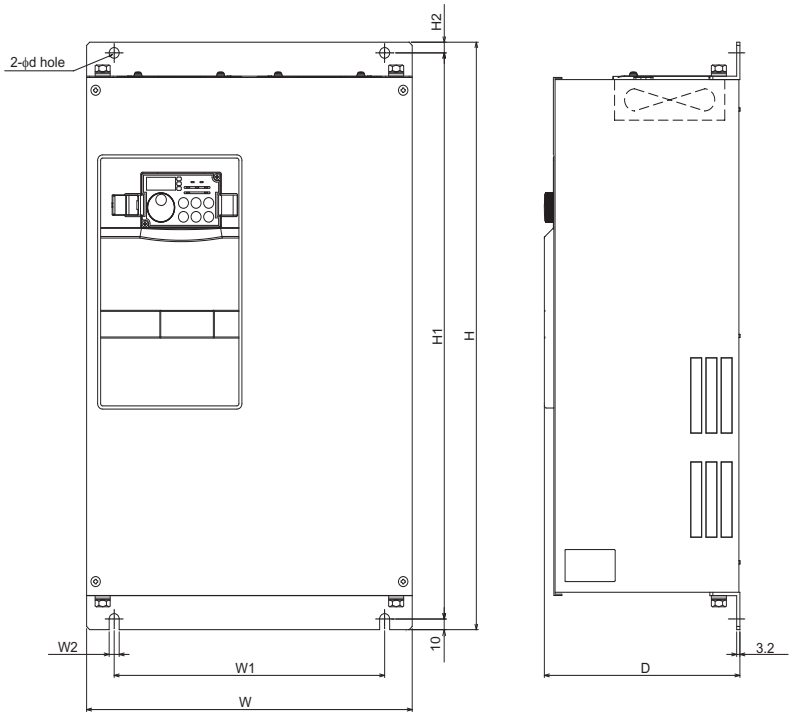
(Unit: mm)

●FR-A720-15K, 18.5K, 22K
●FR-A740-18.5K, 22K




(Unit: mm)

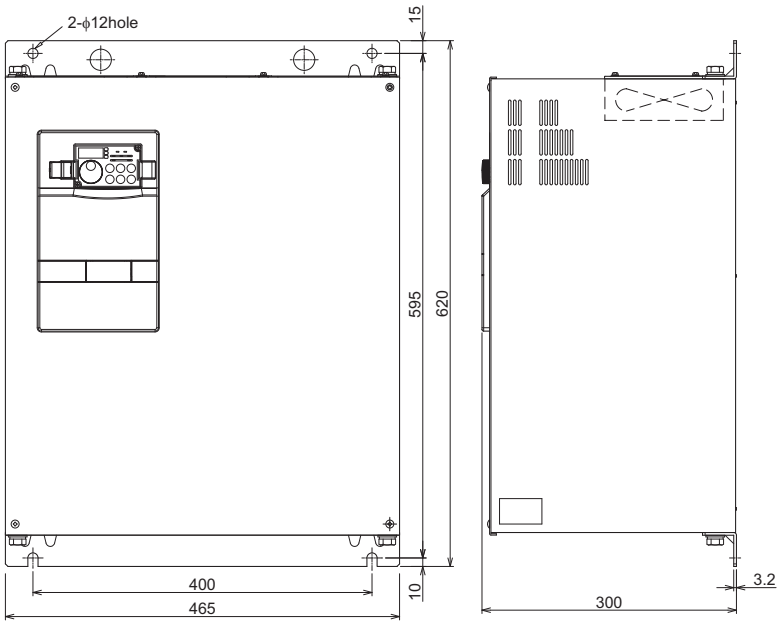
●FR-A720-30K, 37K, 45K, 55K
●FR-A740-30K, 37K, 45K, 55K



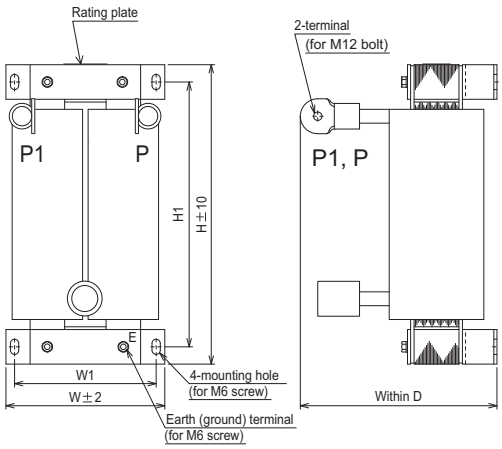

| Inverter Model | W | W1 | W2 | H | H1 | H2 | d | D |
|---|---|---|---|---|---|---|---|---|
| FR-A720-30K<br>FR-A740-30K | 325 | 270 | 10 | 550 | 530 | 10 | 10 | 195 |
| FR-A720-37K, 45K<br>FR-A740-37K, 45K, 55K | 435 | 380 | 12 | 550 | 525 | 15 | 12 | 250 |
| FR-A720-55K | 465 | 410 | 12 | 700 | 675 | 15 | 12 | 250 |

(Unit: mm)

●FR-A740-75K, 90K



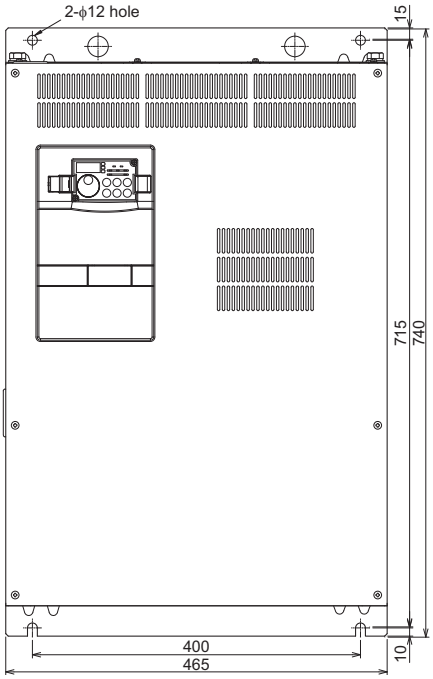

●DC reactor supplied



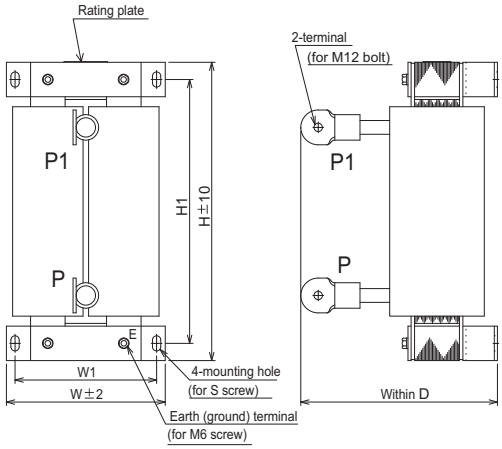

| DC Reactor Model | W | W1 | H | H1 | D | Mass (Kg) |
|---|---|---|---|---|---|---|
| FR-HEL-H75K<br>(FR-A740-75K) | 140 | 120 | 320 | 295 | 185 | 16 |
| FR-HEL-H90K<br>(FR-A740-90K) | 150 | 130 | 340 | 310 | 190 | 20 |

(Unit: mm)

●FR-A720-75K, 90K
●FR-A740-110K, 132K



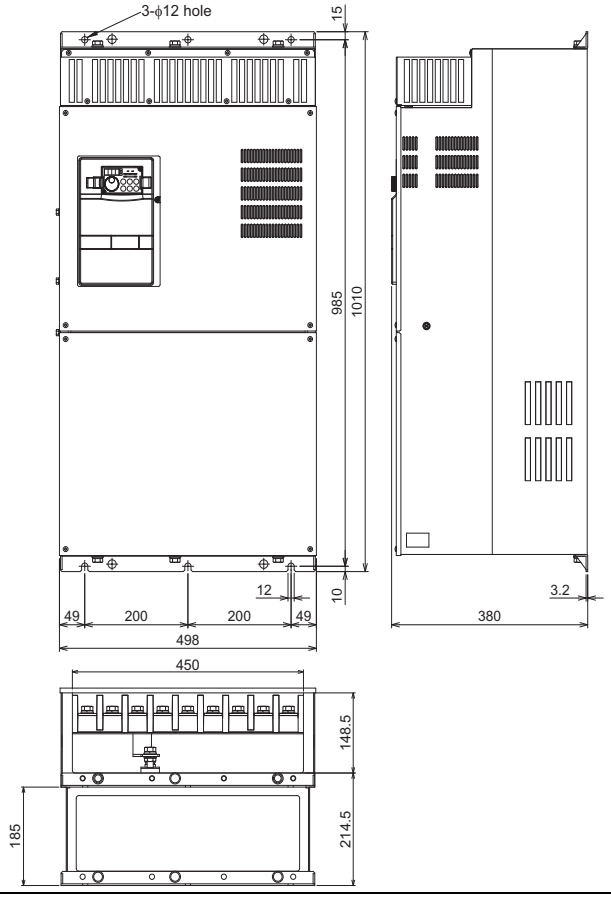

●DC reactor supplied



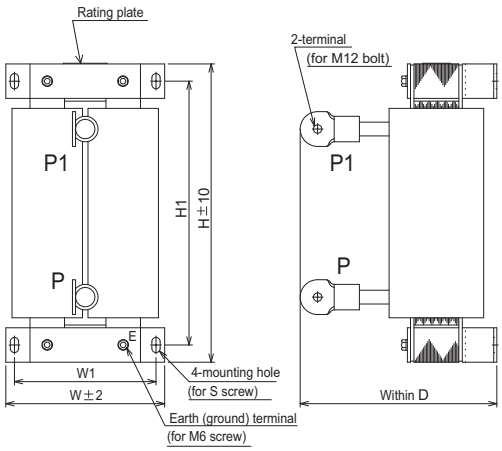

| DC Reactor Model | W | W1 | H | H1 | D | S | Mass (kg) |
|---|---|---|---|---|---|---|---|
| FR-HEL-75K (FR-A720-75K) | 150 | 130 | 340 | 310 | 190 | M6 | 17 |
| FR-HEL-90K (FR-A720-90K) | 150 | 130 | 340 | 310 | 200 | M6 | 19 |
| FR-HEL-H110K (FR-A740-110K) | 150 | 130 | 340 | 310 | 195 | M6 | 22 |
| FR-HEL-H132K (FR-A740-132K) | 175 | 150 | 405 | 370 | 200 | M8 | 26 |

(Unit: mm)

●FR-A740-160K, 185K



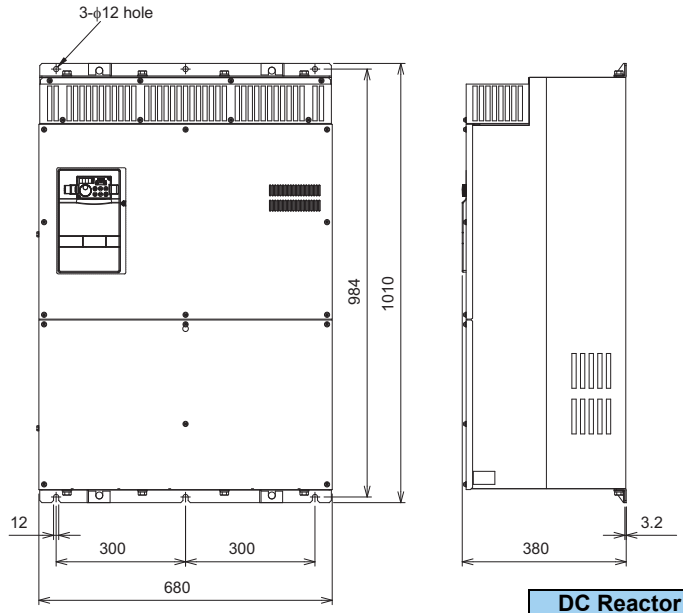

●DC reactor supplied



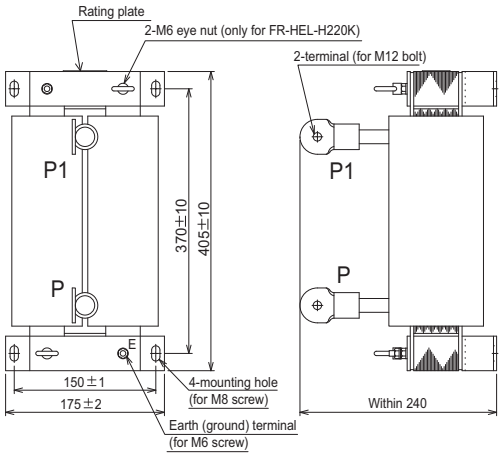

| DC Reactor Model | W | W1 | H | H1 | D | S | Mass (kg) |
|---|---|---|---|---|---|---|---|
| FR-HEL-H160K (FR-A740-160K) | 175 | 150 | 405 | 370 | 205 | M8 | 28 |
| FR-HEL-H185K (FR-A740-185K) | 175 | 150 | 405 | 370 | 240 | M8 | 29 |

(Unit: mm)

●FR-A740-220K, 250K, 280K




●DC reactor supplied

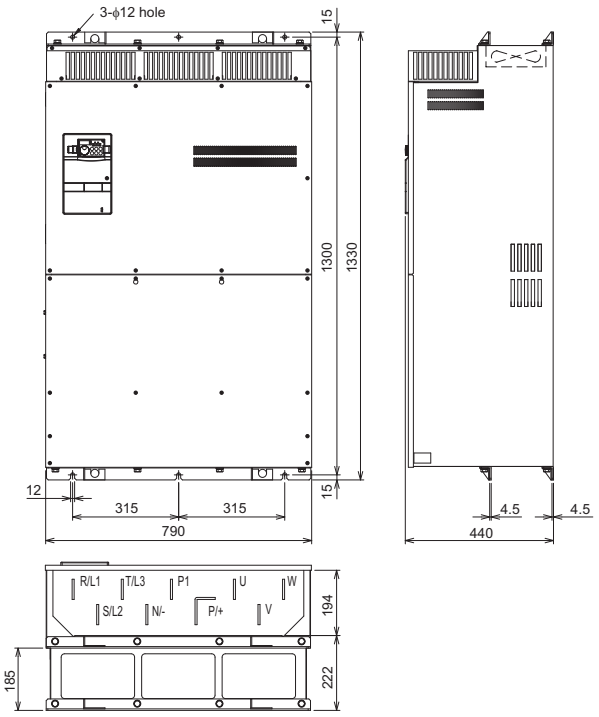



* Remove the eye nut after installation of the product.

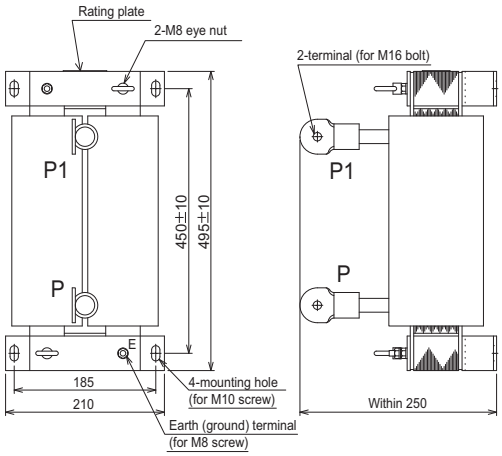
| DC Reactor Model | W | W1 | H | H1 | D | S | S1 | S2 | φ | Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| FR-HEL-H220K (FR-A740-220K) | 175 | 150 | 405 | 370 | 240 | M8 | M6 | M6 | M12 | 30 |
| FR-HEL-H250K (FR-A740-250K) | 190 | 165 | 440 | 400 | 250 | M8 | M8 | M8 | M12 | 35 |
| FR-HEL-H280K (FR-A740-280K) | 190 | 165 | 440 | 400 | 255 | M8 | M8 | M8 | M16 | 38 |

(Unit: mm)

●FR-A740-315K, 355K




●DC reactor supplied

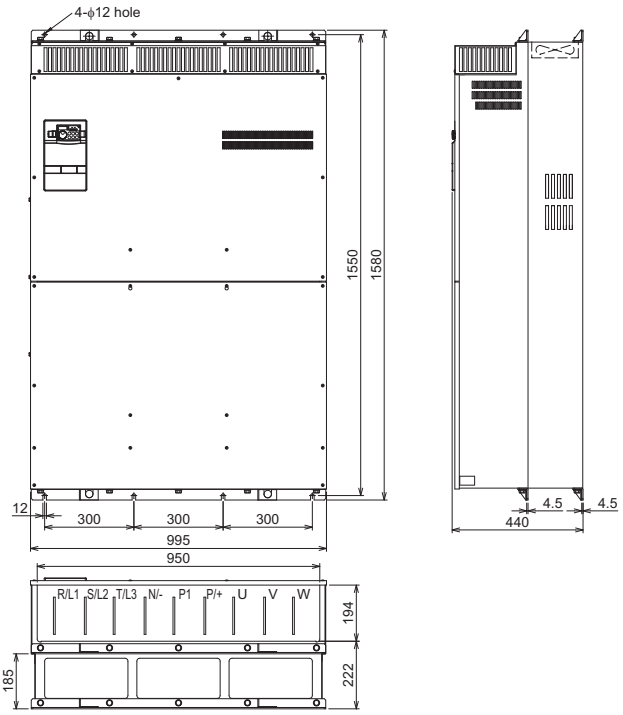



* Remove the eye nut after installation of the product.

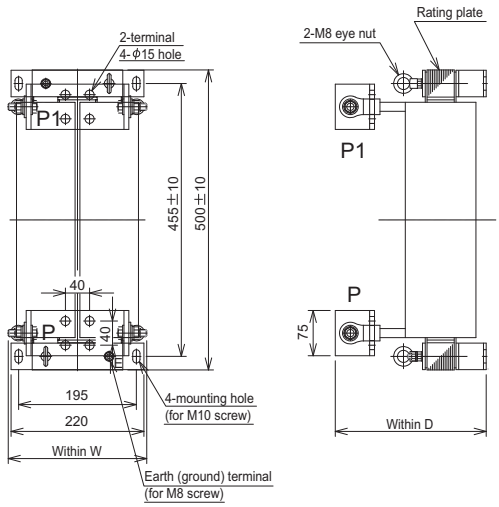
| DC Reactor Model | Mass (kg) |
|---|---|
| FR-HEL-H315K (FR-A740-315K) | 42 |
| FR-HEL-H355K (FR-A740-355K) | 46 |

(Unit: mm)

●FR-A740-400K, 450K, 500K



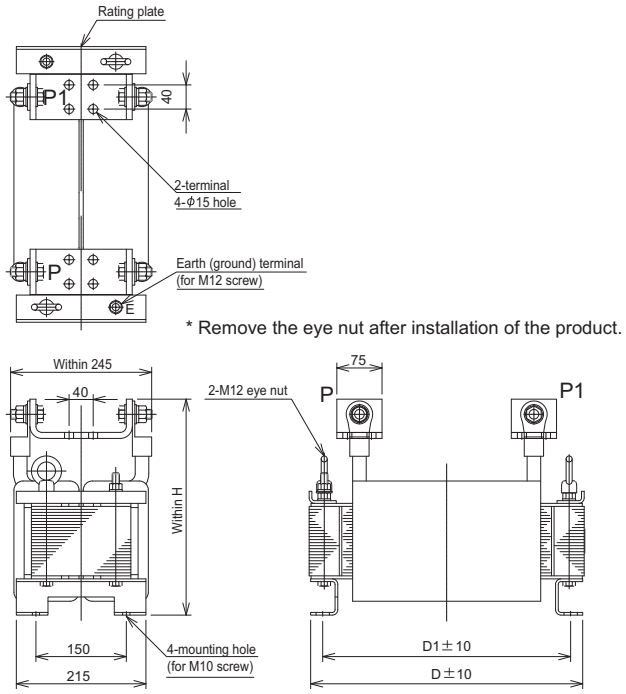

●DC reactor supplied




* Remove the eye nut after installation of the product.

| DC Reactor Model | W | D | Mass (kg) |
|---|---|---|---|
| FR-HEL-H400K (FR-A740-400K) | 235 | 250 | 50 |
| FR-HEL-H450K (FR-A740-450K) | 240 | 270 | 57 |

●DC reactor supplied



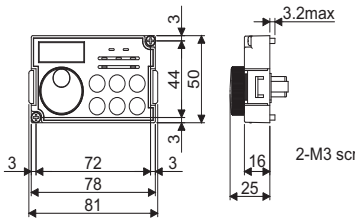

* Remove the eye nut after installation of the product.

| DC Reactor Model | H | D | D1 | Mass (kg) |
|---|---|---|---|---|
| FR-HEL-H500K (FR-A740-500K) | 345 | 455 | 405 | 67 |

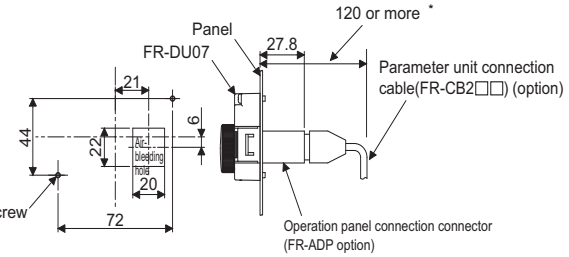
(Unit: mm)

● Operation panel (FR-DU07)

<Outline drawing>




<Panel cutting dimension drawing>

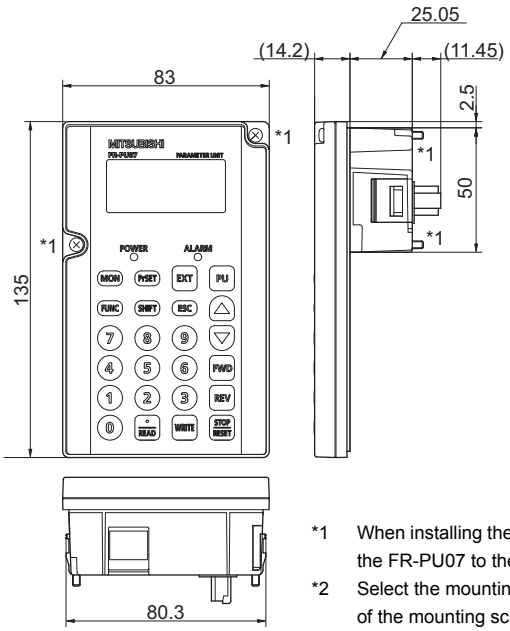



* Denotes the space required to connect an optional parameter unit connection cable (FR-CB2□□). When using another cable, leave the space required for the cable specification.

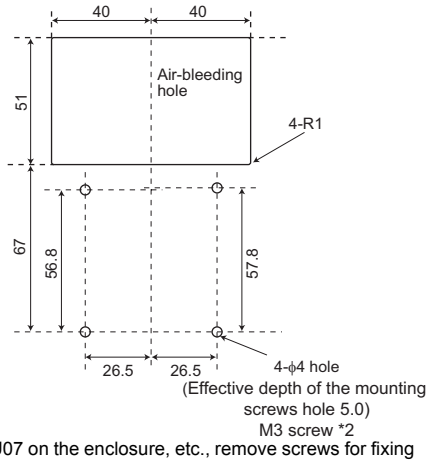
(Unit: mm)

● Parameter unit (option) (FR-PU07)

<Outline drawing>




<Panel cutting dimension drawing>




*1 When installing the FR-PU07 on the enclosure, etc., remove screws for fixing the FR-PU07 to the inverter or fix the screws to the FR-PU07 with M3 nuts.

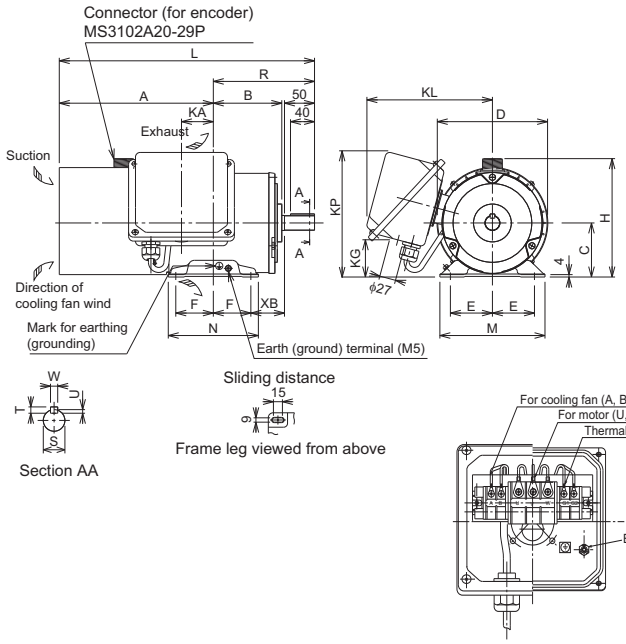
*2 Select the mounting screws whose length will not exceed the effective depth of the mounting screw hole.

(Unit: mm)

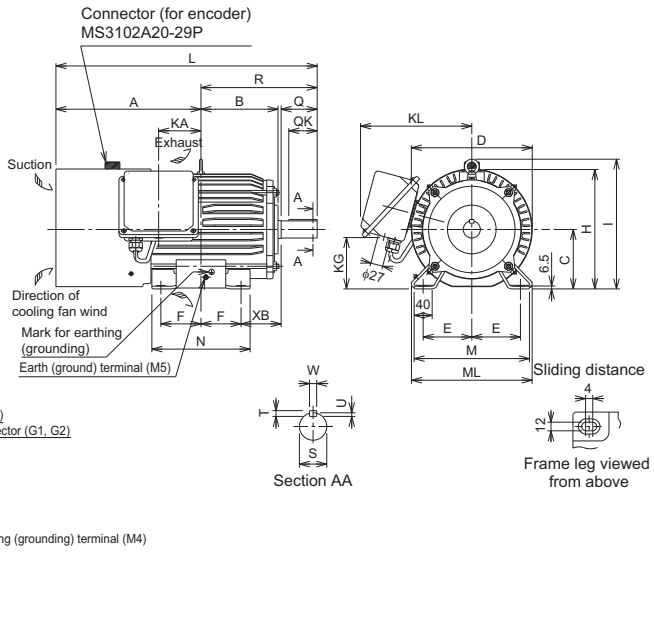
## 6.4.2 Dedicated motor outline dimension drawings

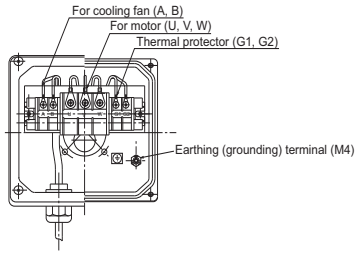
### ●Dedicated motor (SF-V5RU(H)) outline dimension drawings (standard horizontal type)

**Frame Number 90L**
**SF-V5RU(H) 1K**

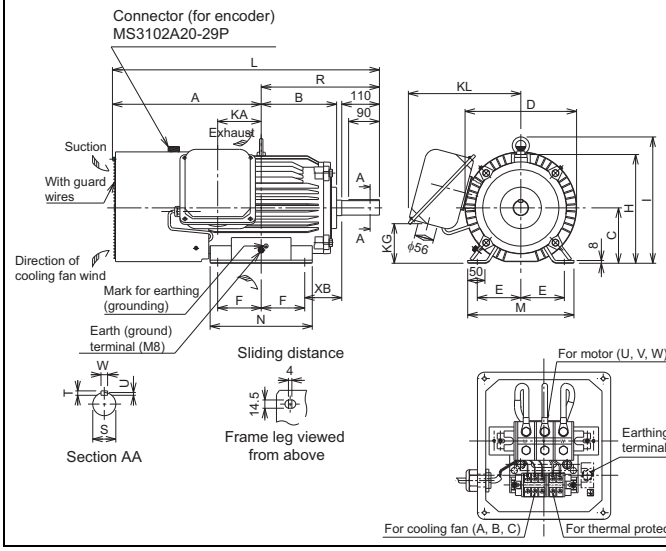



**Frame Number 100L, 112M, 132S, 132M**
**SF-V5RU(H) 2K, 3K, 5K, 7K**



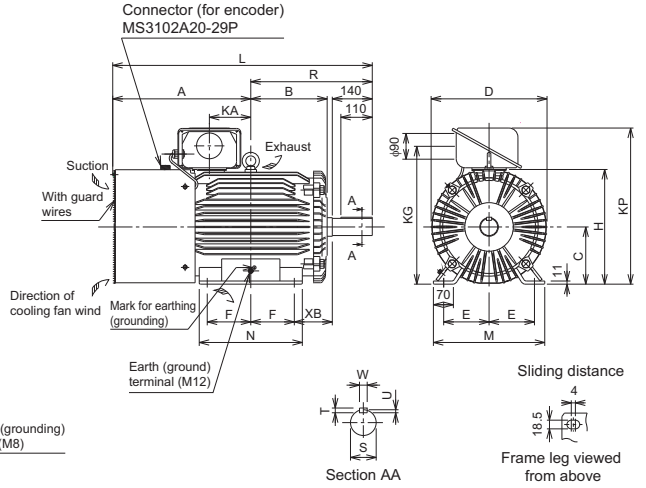

**Frame Number 160M, 160L, 180M, 180L**
**SF-V5RU(H) 11K, 15K, 18K, 22K**







**Frame Number 200L, 225S**
**SF-V5RU(H) 30K, 37K, 45K, 55K**




Make sure to earth the earth terminal of the frame installation foot as well as the earth terminal in the terminal box.

Dimensions table

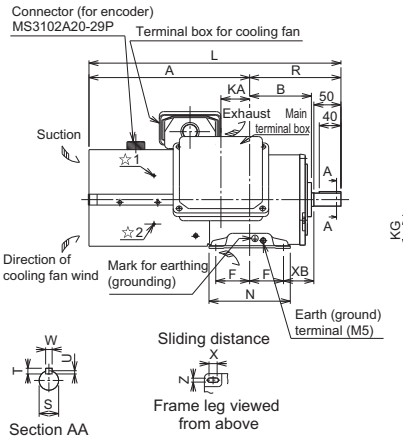
(Unit: mm)

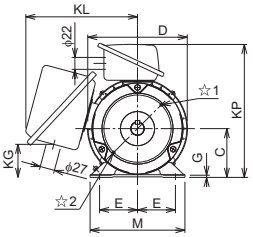
| SF-V5RU □K | SF-V5RU □K1 | SF-V5RU □K3 | SF-V5RU □K4 | Frame No. | Mass (kg) | Motor | | | | | | | | | | | | | | | | | | | | | | Terminal Screw Size | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A | B | C | D | E | F | H | I | KA | KG | KL(KP) | L | M | ML | N | XB | Q | QK | R | S | T | U | W | U,V,W | A,B,(C) | G1,G2 |
| 1 | — | — | — | 90L | 24 | 256.5 | 114 | 90 | 183.6 | 70 | 62.5 | 198 | — | 53 | 65 | 220(210) | 425 | 175 | — | 150 | 56 | — | — | 168.5 | 24j6 | 7 | 4 | 8 | M6 | M4 | M4 |
| 2 | 1 | — | — | 100L | 33 | 284 | 128 | 100 | 207 | 80 | 70 | 203.5 | 230 | 65 | 78 | 231 | 477 | 200 | 212 | 180 | 63 | 60 | 45 | 193 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 |
| 3 | 2 | 1 | — | 112M | 41 | 278 | 135 | 112 | 228 | 95 | 70 | 226 | 253 | 69 | 93 | 242 | 478 | 230 | 242 | 180 | 70 | 60 | 45 | 200 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 |
| 5 | 3 | 2 | — | 132S | 52 | 303 | 152 | 132 | 266 | 108 | 70 | 265 | 288 | 75 | 117 | 256 | 542 | 256 | 268 | 180 | 89 | 80 | 63 | 239 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 |
| 7 | 5 | 3 | 1 | 132M | 62 | 322 | 171 | 132 | 266 | 108 | 89 | 265 | 288 | 94 | 117 | 256 | 580 | 256 | 268 | 218 | 89 | 80 | 63 | 258 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 |
| 11 | 7 | 5 | 2 | 160M | 99 | 412 | 198 | 160 | 318 | 127 | 105 | 316 | 367 | 105 | 115 | 330 | 735 | 310 | — | 254 | 108 | — | — | 323 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 |
| 15 | 11 | 7 | 3 | 160L | 113 | 434 | 220 | 160 | 318 | 127 | 127 | 316 | 367 | 127 | 115 | 330 | 779 | 310 | — | 298 | 108 | — | — | 345 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 |
| 18 | — | — | — | 180M | 138 | 438.5 | 225.5 | 180 | 363 | 139.5 | 120.5 | 359 | 410 | 127 | 139 | 352 | 790 | 335 | — | 285 | 121 | — | — | 351.5 | 48k6 | 9 | 5.5 | 14 | M8 | M4 | M4 |
| 22 | 15 | 11 | — | | 160 | | | | | | | | | | | | | | | | | | | | | | | | | |
| — | 18 | 15 | 5 | 180L | 200 | 457.5 | 242.5 | 180 | 363 | 139.5 | 139.5 | 359 | 410 | 146 | 139 | 352 | 828 | 335 | — | 323 | 121 | — | — | 370.5 | 55m6 | 10 | 6 | 16 | M8 | M4 | M4 |
| 30 | — | — | 7 | 200L | 238 | 483.5 | 267.5 | 200 | 406 | 159 | 152.5 | 401 | — | 145 | 487 | (546) | 909 | 390 | — | 361 | 133 | — | — | 425.5 | 60m6 | 11 | 7 | 18 | M10 | M4 | M4 |
| 37, 45 | 22, 30 | 18, 22 | — | | 255 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 55 | 37 | 30 | 11, 15 | 225S | 320 | 500 | 277 | 225 | 446 | 178 | 143 | 446 | — | 145 | 533 | (592) | 932 | 428 | — | 342 | 149 | — | — | 432 | 65m6 | 11 | 7 | 18 | M10 | M4 | M4 |

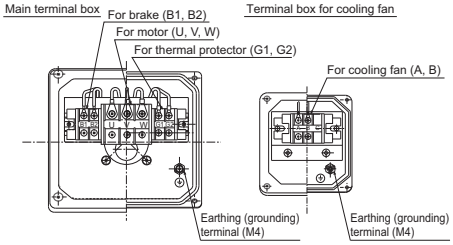
Note) 1. Install a motor of the frame number 180 or higher on a floor by keeping its axis horizontal.
2. Leave an enough clearance between the fan suction port and wall to ensure adequate cooling. Also, check that the ventilation direction of a fan is from the opposite load side to the load side.
3 The size difference of top and bottom of the shaft center height is $^{0}_{-0.5}$
4 The 400V class motor has -H at the end of its type name.

## ●Dedicated motor (SF-V5RU(H)) outline dimension drawings (standard horizontal type with brake)

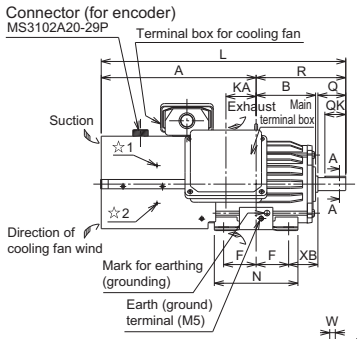
**Frame Number 90L**
**SF-V5RU(H) 1KB**

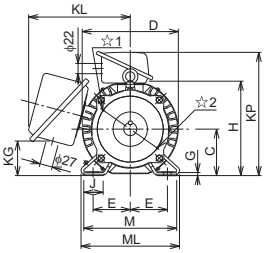


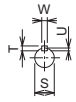



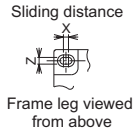




**Frame Number 100L, 112M, 132S, 132M**
**SF-V5RU(H) 2KB, 3KB, 5KB, 7KB**

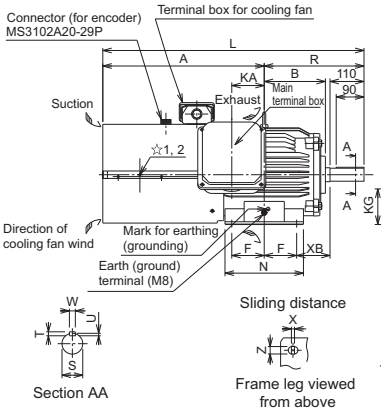


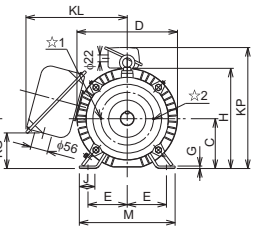



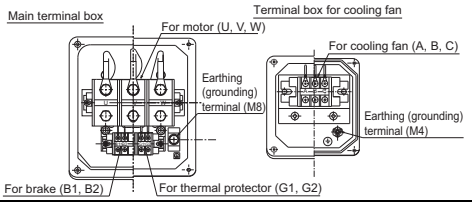



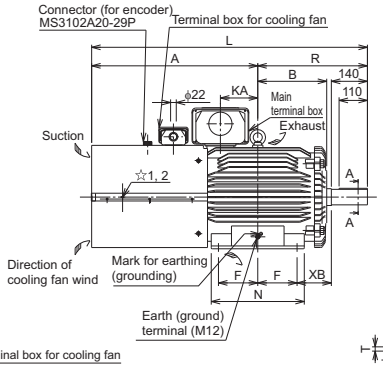

**Frame Number 160M, 160L, 180M, 180L**
**SF-V5RU(H) 11KB, 15KB, 18KB, 22KB**

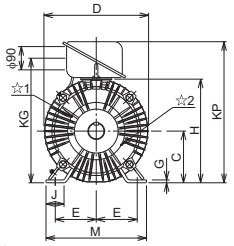


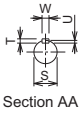



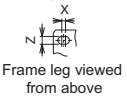




**Frame Number 200L, 225S**
**SF-V5RU(H) 30KB, 37KB, 45KB, 55KB**




☆ indicates an inserting position of a bolt with hex head holes for manual opening.
Make sure to earth the earth terminal of the frame installation foot as well as the earth terminal in the terminal box.

Dimensions table

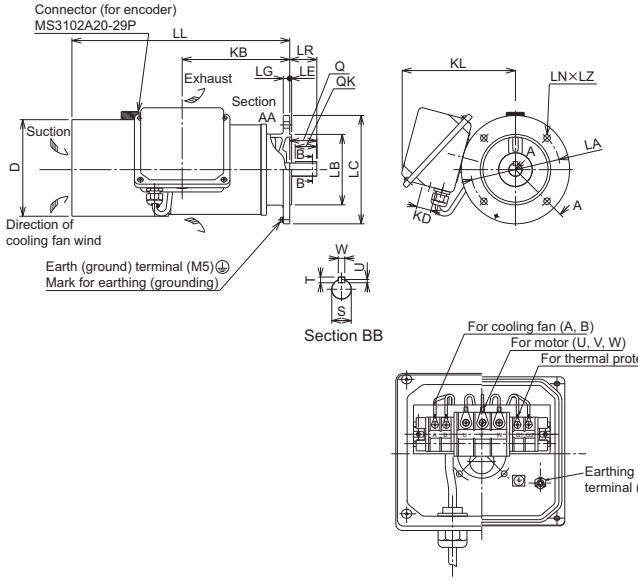
(Unit: mm)

| SF-V5RU □KB | SF-V5RU □K1B | SF-V5RU □K3B | SF-V5RU □K4B | Frame No. | Mass (kg) | Motor | | | | | | | | | | | | | | | | | | | | | Shaft End | | | | | | | Terminal Screw Size | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A | B | C | D | E | F | G | H | I | J | KA | KD | KG | KL | KP | L | M | ML | N | X | XB | Z | Q | QK | R | S | T | U | W | U,V,W | A,B,(C) | G1,G2 | B1,B2 |
| 1 | — | — | — | 90L | 29 | 296.5 | 114 | 90 | 183.6 | 70 | 62.5 | 4 | — | — | — | 53 | 27 | 65 | 220 | 245 | 465 | 175 | — | 150 | 15 | 56 | 9 | 50 | 40 | 168.5 | 24j6 | 7 | 4 | 8 | M6 | M4 | M4 | M4 |
| 2 | 1 | — | — | 100L | 46 | 333.5 | 128 | 100 | 207 | 80 | 70 | 6.5 | — | — | 40 | 65 | 27 | 78 | 231 | 265 | 526.5 | 200 | 212 | 180 | 4 | 63 | 12 | 60 | 45 | 193 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 | M4 |
| 3 | 2 | 1 | — | 112M | 53 | 355 | 135 | 112 | 228 | 95 | 70 | 6.5 | — | — | 40 | 69 | 27 | 93 | 242 | 290 | 555 | 230 | 242 | 180 | 4 | 70 | 12 | 60 | 45 | 200 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 | M4 |
| 5 | 3 | 2 | — | 132S | 70 | 416 | 152 | 132 | 266 | 108 | 70 | 6.5 | — | — | 40 | 75 | 27 | 117 | 256 | 329 | 655 | 256 | 268 | 180 | 4 | 89 | 12 | 80 | 63 | 239 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 | M4 |
| 7 | 5 | 3 | 1 | 132M | 80 | 435 | 171 | 132 | 266 | 108 | 89 | 6.5 | — | — | 40 | 94 | 27 | 117 | 256 | 329 | 693 | 256 | 268 | 218 | 4 | 89 | 12 | 80 | 63 | 258 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 | M4 |
| 11 | 7 | 5 | 2 | 160M | 140 | 522.5 | 198 | 160 | 318 | 127 | 105 | 8 | — | — | 50 | 105 | 56 | 115 | 330 | 391 | 845.5 | 310 | — | 254 | 4 | 108 | 14.5 | 110 | 90 | 323 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 | M4 |
| 15 | 11 | 7 | 3 | 160L | 155 | 544.5 | 220 | 160 | 318 | 127 | 127 | 8 | — | — | 50 | 127 | 56 | 115 | 330 | 391 | 889.5 | 310 | — | 298 | 4 | 108 | 14.5 | 110 | 90 | 345 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 | M4 |
| 18 | — | — | — | 180M | 185 | 568.5 | 225.5 | 180 | 363 | 139.5 | 120.5 | 8 | — | — | 50 | 127 | 56 | 139 | 352 | 428 | 920 | 335 | — | 285 | 4 | 121 | 14.5 | 110 | 90 | 351.5 | 48k6 | 9 | 5.5 | 14 | M8 | M4 | M4 | M4 |
| 22 | 15 | 11 | — | | 215 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| — | 18 | 15 | 5 | 180L | 255 | 587.5 | 242.5 | 180 | 363 | 139.5 | 139.5 | 8 | — | — | 50 | 146 | 56 | 139 | 352 | 428 | 958 | 335 | — | 323 | 4 | 121 | 14.5 | 110 | 90 | 370.5 | 55m6 | 10 | 6 | 16 | M8 | M4 | M4 | M4 |
| 30 | — | — | 7 | 200L | 305 | 644.5 | 267.5 | 200 | 406 | 159 | 152.5 | 11 | — | — | 70 | 145 | 90 | 487 | — | 546 | 1070 | 390 | — | 361 | 4 | 133 | 18.5 | 140 | 110 | 425.5 | 60m6 | 11 | 7 | 18 | M10 | M4 | M4 | M4 |
| 37, 45 | 22, 30 | 18, 22 | — | | 330 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 55 | 37 | 30 | 11, 15 | 225S | 395 | 659 | 277 | 225 | 446 | 178 | 143 | 11 | — | — | 70 | 145 | 90 | 533 | — | 592 | 1091 | 428 | — | 342 | 4 | 149 | 18.5 | 140 | 110 | 432 | 65m6 | 11 | 7 | 18 | M10 | M4 | M4 | M4 |

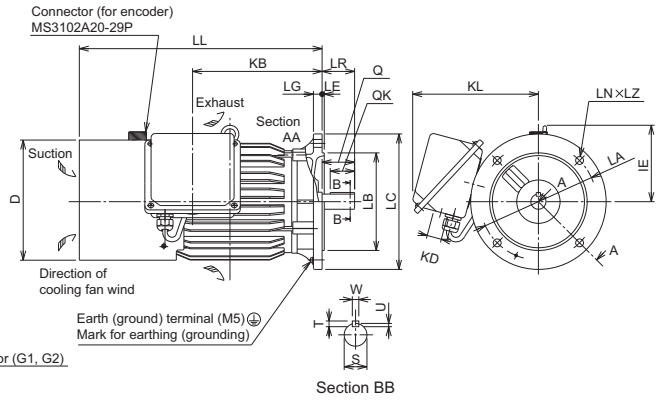
Note) 1. Install the motor on the floor and use it with the shaft horizontal.
2. Leave an enough clearance between the fan suction port and wall to ensure adequate cooling.
Also, check that the ventilation direction of a fan is from the opposite load side to the load side.
3 The size difference of top and bottom of the shaft center height is $^{0}_{-0.5}$
4 The 400V class motor has -H at the end of its type name.
5. Since a brake power device is a stand-alone, install it inside the enclosure.
(This device should be arranged at the customer side.)

## ●Dedicated motor (SF-V5RU(H)) outline dimension drawings (flange type)

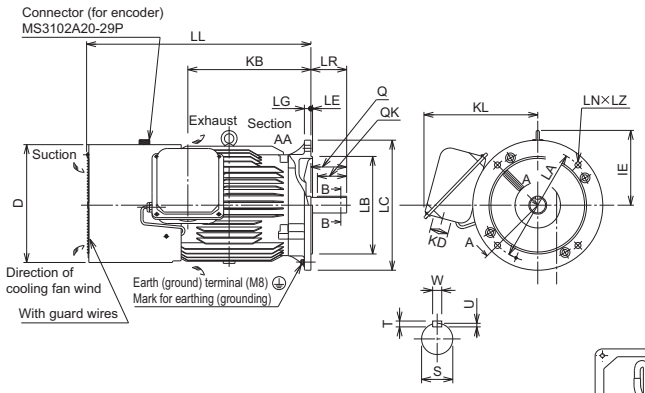
**Frame Number 90L**
**SF-V5RUF(H) 1K**



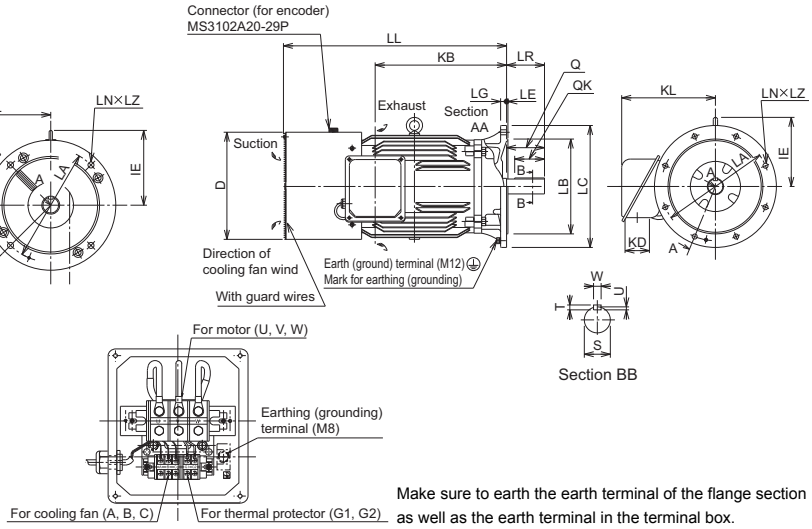

**Frame Number 100L, 112M, 132S, 132M**
**SF-V5RUF(H) 2K , 3K , 5K , 7K**




**Frame Number 160M, 160L, 180M, 180L**
**SF-V5RUF(H) 11K , 15K , 18K , 22K**




**Frame Number 200L**
**SF-V5RUF(H) 30K , 37K , 45K**




Make sure to earth the earth terminal of the flange section as well as the earth terminal in the terminal box.

### Dimensions table

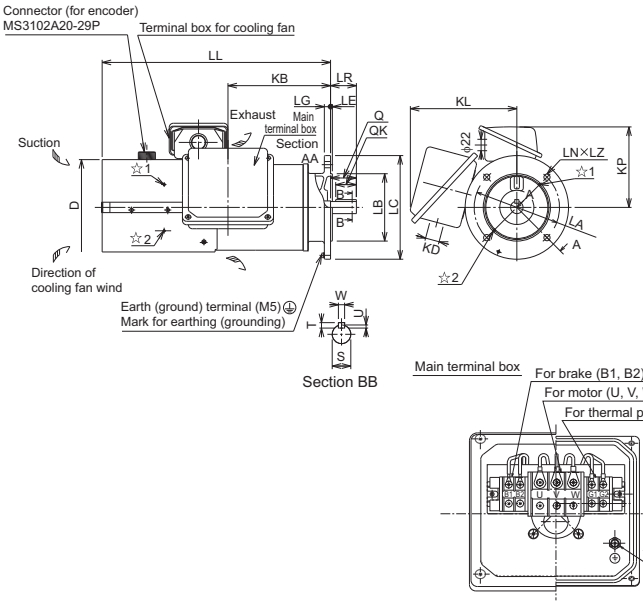
(Unit: mm)

| SF-V5RU F□K | SF-V5RU F□K1 | SF-V5RU F□K3 | SF-V5RU F□K4 | Flange Number | Frame No. | Mass (kg) | Motor | | | | | | | | | | | | | Shaft End | | | | | | | Terminal Screw Size | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | D | IE | KB | KD | KL | LA | LB | LC | LE | LG | LL | LN | LZ | LR | Q | QK | S | T | U | W | U,V,W | A,B,(C) | G1,G2 |
| 1 | — | — | — | FF165 | 90L | 26.5 | 183.6 | — | 198.5 | 27 | 220 | 165 | 130j6 | 200 | 3.5 | 12 | 402 | 4 | 12 | 50 | 50 | 40 | 24j6 | 7 | 4 | 8 | M6 | M4 | M4 |
| 2 | 1 | — | — | FF215 | 100L | 37 | 207 | 130 | 213 | 27 | 231 | 215 | 180j6 | 250 | 4 | 16 | 432 | 4 | 14.5 | 60 | 60 | 45 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 |
| 3 | 2 | 1 | — | FF215 | 112M | 46 | 228 | 141 | 239 | 27 | 242 | 215 | 180j6 | 250 | 4 | 16 | 448 | 4 | 14.5 | 60 | 60 | 45 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 |
| 5 | 3 | 2 | — | FF265 | 132S | 65 | 266 | 156 | 256 | 27 | 256 | 265 | 230j6 | 300 | 4 | 20 | 484 | 4 | 14.5 | 80 | 80 | 63 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 |
| 7 | 5 | 3 | 1 | FF265 | 132M | 70 | 266 | 156 | 294 | 27 | 256 | 265 | 230j6 | 300 | 4 | 20 | 522 | 4 | 14.5 | 80 | 80 | 63 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 |
| 11 | 7 | 5 | 2 | FF300 | 160M | 110 | 318 | 207 | 318 | 56 | 330 | 300 | 250j6 | 350 | 5 | 20 | 625 | 4 | 18.5 | 110 | 110 | 90 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 |
| 15 | 11 | 7 | 3 | FF300 | 160L | 125 | 318 | 207 | 362 | 56 | 330 | 300 | 250j6 | 350 | 5 | 20 | 669 | 4 | 18.5 | 110 | 110 | 90 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 |
| 18 | — | — | — | FF350 | 180M | 160 | 363 | 230 | 378.5 | 56 | 352 | 350 | 300j6 | 400 | 5 | 20 | 690 | 4 | 18.5 | 110 | 110 | 90 | 48k6 | 9 | 5.5 | 14 | M8 | M4 | M4 |
| 22 | 15 | 11 | — | | | 185 | | | | | | | | | | | | | | | | | | | | | | | |
| — | 18 | 15 | 5 | FF350 | 180L | 225 | 363 | 230 | 416.5 | 56 | 352 | 350 | 300j6 | 400 | 5 | 20 | 728 | 4 | 18.5 | 110 | 110 | 90 | 55m6 | 10 | 6 | 16 | M8 | M4 | M4 |
| 30 | — | — | 7 | FF400 | 200L | 270 | 406 | 255 | 485 | 90 | 346 | 400 | 350j6 | 450 | 5 | 22 | 823.5 | 8 | 18.5 | 140 | 140 | 110 | 60m6 | 11 | 7 | 18 | M10 | M4 | M4 |
| 37, 45 | 22, 30 | 18, 22 | — | | | 290 | | | | | | | | | | | | | | | | | | | | | | | |

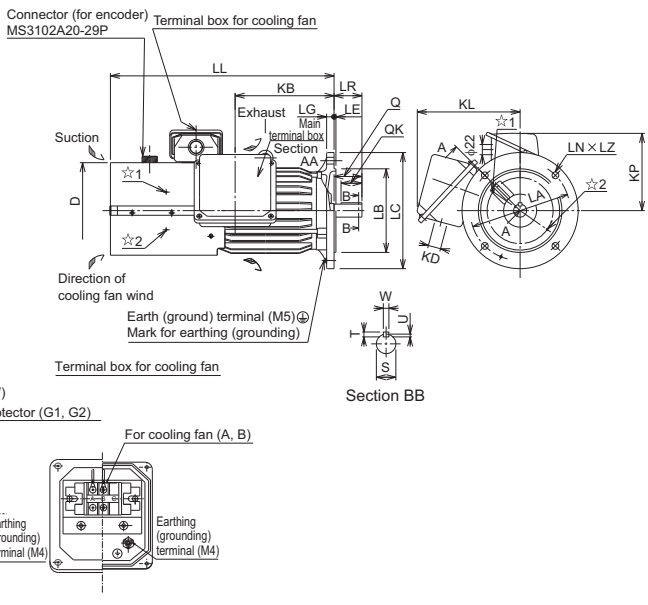
Note) 1. A motor of the frame number 180 or higher cannot be installed to the ceiling (by keeping its axis vertical).
For use under the shaft, the protection structure of the cooling fan is IP20.
2. Leave an enough clearance between the fan suction port and wall to ensure adequate cooling.
Also, check that the ventilation direction of a fan is from the opposite load side to the load side.
3 The size difference of top and bottom of the shaft center height is $^{0}_{-0.5}$
4 The 400V class motor has -H at the end of its type name.

## ●Dedicated motor (SF-V5RU(H)) outline dimension drawings (flange type with brake)

**Frame Number 90L**
**SF-V5RUF(H) 1KB**



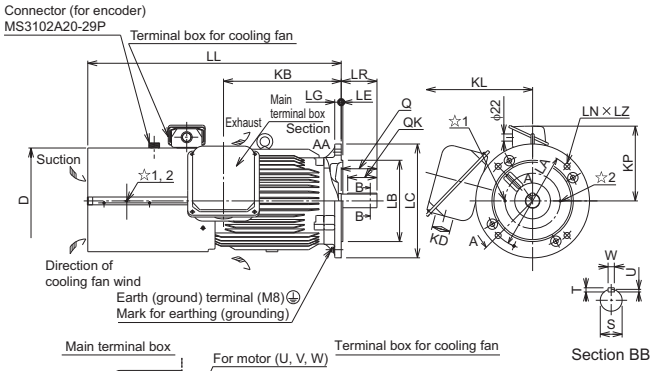

**Frame Number 100L, 112M, 132S, 132M**
**SF-V5RUF(H) 2KB , 3KB , 5KB , 7KB**

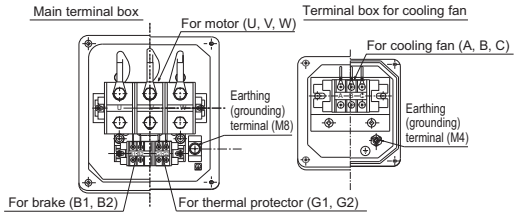






**Frame Number 160M, 160L**
**SF-V5RUF(H) 11KB , 15KB**




☆ indicates an inserting position of a bolt with hex head holes for manual opening.

Make sure to earth the earth terminal of the flange section as well as the earth terminal in the terminal box.

### Dimensions table

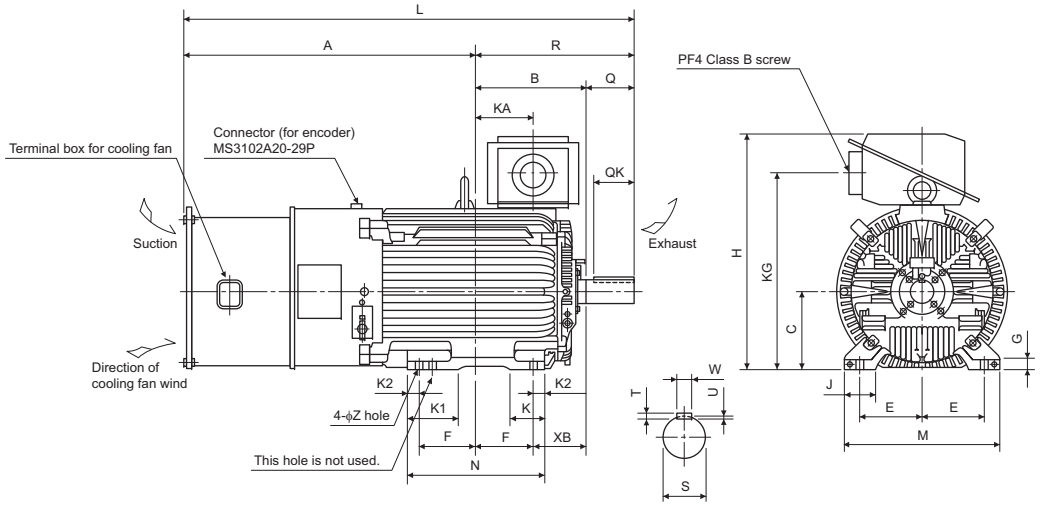
(Unit: mm)

| SF-V5RU F□KB | SF-V5RU F□K1B | SF-V5RU F□K3B | SF-V5RU F□K4B | Flange Number | Frame No. | Mass (kg) | Motor | | | | | | | | | | | | | Shaft End | | | | | | | Terminal Screw Size | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | D | KB | KD | KL | KP | LA | LB | LC | LE | LG | LL | LN | LZ | LR | Q | QK | S | T | U | W | U,V,W | A,B,(C) | B1,B2 | G1,G2 |
| 1 | — | — | — | FF165 | 90L | 31.5 | 183.6 | 198.5 | 27 | 220 | 155 | 165 | 130j6 | 200 | 3.5 | 12 | 442 | 4 | 12 | 50 | 50 | 40 | 24j6 | 7 | 4 | 8 | M6 | M4 | M4 | M4 |
| 2 | 1 | — | — | FF215 | 100L | 50 | 207 | 213 | 27 | 231 | 165 | 215 | 180j6 | 250 | 4 | 16 | 481.5 | 4 | 14.5 | 60 | 60 | 45 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 | M4 |
| 3 | 2 | 1 | — | FF215 | 112M | 58 | 228 | 239 | 27 | 242 | 178 | 215 | 180j6 | 250 | 4 | 16 | 525 | 4 | 14.5 | 60 | 60 | 45 | 28j6 | 7 | 4 | 8 | M6 | M4 | M4 | M4 |
| 5 | 3 | 2 | — | FF265 | 132S | 83 | 266 | 256 | 27 | 256 | 197 | 265 | 230j6 | 300 | 4 | 20 | 597 | 4 | 14.5 | 80 | 80 | 63 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 | M4 |
| 7 | 5 | 3 | 1 | FF265 | 132M | 88 | 266 | 294 | 27 | 256 | 197 | 265 | 230j6 | 300 | 4 | 20 | 635 | 4 | 14.5 | 80 | 80 | 63 | 38k6 | 8 | 5 | 10 | M6 | M4 | M4 | M4 |
| 11 | 7 | 5 | 2 | FF300 | 160M | 151 | 318 | 318 | 56 | 330 | 231 | 300 | 250j6 | 350 | 5 | 20 | 735.5 | 4 | 18.5 | 110 | 110 | 90 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 | M4 |
| 15 | 11 | 7 | 3 | FF300 | 160L | 167 | 318 | 362 | 56 | 330 | 231 | 300 | 250j6 | 350 | 5 | 20 | 779.5 | 4 | 18.5 | 110 | 110 | 90 | 42k6 | 8 | 5 | 12 | M8 | M4 | M4 | M4 |

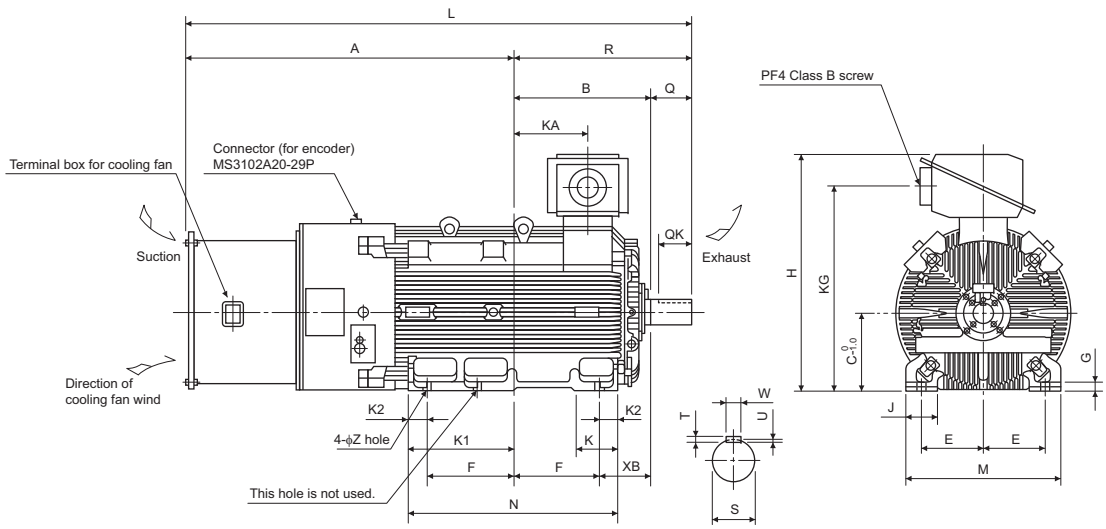
Note) 1. Install the motor on the wall and use it with the shaft horizontal.
2. Leave an enough clearance between the fan suction port and wall to ensure adequate cooling.
Also, check that the ventilation direction of a fan is from the opposite load side to the load side.
3 The size difference of top and bottom of the shaft center height is $^{0}_{-0.5}$
4 The 400V class motor has -H at the end of its type name.
5. Since a brake power device is a stand-alone, install it inside the enclosure.
(This device should be arranged at the customer side.)

## ●Dedicated motor (SF-THY) outline dimension drawings (1500r/min series)

**Frame Number 250MD, 280MD**
**75kW to 160kW**




**Frame Number 280L, 315H**
**200kW, 250kW**




Dimensions table

(Unit: mm)

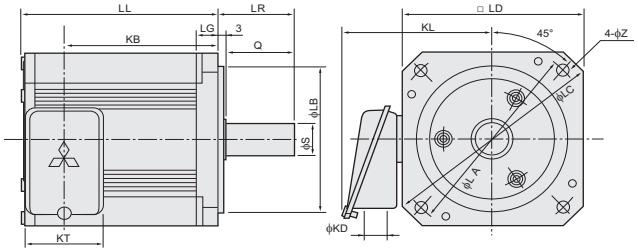
| Output | Frame No. | Mass (kg) | Motor | | | | | | | | | | | | | | | | | | | | Shaft End Size | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | F | G | H | J | K | K1 | K2 | L | M | N | R | Z | XB | KA | KG | Q | QK | S | W | T | U |
| 75 | 250MD | 610 | 988.5 | 340.5 | 250 | 557 | 203 | 174.5 | 30 | 775 | 100 | 130 | 168 | 50 | 1471 | 486 | 449 | 482.5 | 24 | 168 | 157.5 | 635 | 140 | 110 | ϕ75m6 | 20 | 12 | 7.5 |
| 90 | 250MD | 660 | 988.5 | 340.5 | 250 | 557 | 203 | 174.5 | 30 | 775 | 100 | 130 | 168 | 50 | 1471 | 486 | 449 | 482.5 | 24 | 168 | 157.5 | 635 | 140 | 110 | ϕ75m6 | 20 | 12 | 7.5 |
| 110 | 280MD | 870 | 1049.5 | 397.5 | 280 | 607 | 228.5 | 209.5 | 30 | 845 | 110 | 130 | 181 | 40 | 1619 | 560 | 449 | 569.5 | 24 | 190 | 210.5 | 705 | 170 | 140 | ϕ85m6 | 22 | 14 | 9 |
| 132 | 280MD | 890 | 1049.5 | 397.5 | 280 | 607 | 228.5 | 209.5 | 30 | 845 | 110 | 130 | 181 | 40 | 1619 | 560 | 449 | 569.5 | 24 | 190 | 210.5 | 705 | 170 | 140 | ϕ85m6 | 22 | 14 | 9 |
| 160 | 280MD | 920 | 1049.5 | 397.5 | 280 | 607 | 228.5 | 209.5 | 30 | 845 | 110 | 130 | 181 | 40 | 1619 | 560 | 499 | 569.5 | 24 | 190 | 210.5 | 705 | 170 | 140 | ϕ85m6 | 22 | 14 | 9 |
| 200 | 280L | 1170 | 1210.5 | 416.5 | 280 | 652 | 228.5 | 228.5 | 30 | 885 | 110 | 160 | 160 | 75 | 1799 | 560 | 607 | 588.5 | 24 | 190 | 214.5 | 745 | 170 | 140 | ϕ85m6 | 22 | 14 | 9 |
| 250 | 315H | 1630 | 1343 | 565 | 315 | 717 | 254 | 355 | 35 | 965 | 130 | 175 | 428 | 80 | 2084 | 636 | 870 | 741 | 28 | 216 | 306 | 825 | 170 | 140 | ϕ95m6 | 25 | 14 | 9 |

Note) The tolerance of the top and bottom of the center shaft height *C is $^{0}_{-0.5}$ for the 250 frame and $^{0}_{-1.0}$ for the 280 frame or more.

## ●IPM motor (MM-CF) outline dimension

### MM-CF[] (Standard)

[Unit mm]

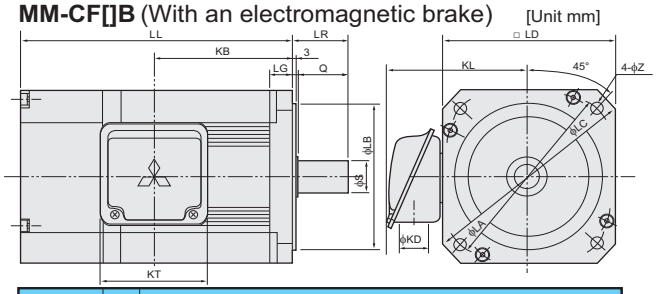



| Model | Output (kW) | Dimensions | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | LL | ϕLA | ϕLB | ϕLC | □LD | LG | KB | ϕKD | KL | KT | ϕZ | LR | Q | ϕS |
| MM-CF52 | 0.5 | 97 | 145 | 110h7 | 165 | 130 | 12 | 62 | 22 | 110 | 56 | 9 | 55 | 50 | 24h6 |
| MM-CF102 | 1.0 | 122 | | | | | | 87 | | | | | | | |
| MM-CF152 | 1.5 | 147 | | | | | | 112 | | | | | | | |
| MM-CF202 | 2.0 | 128 | 200 | 114.3 $^{0}_{-0.025}$ | 230 | 176 | 18 | 81.5 | 27 | 141 | 93 | 13.5 | 79 | 75 | 35 $^{+0.010}_{0}$ |
| MM-CF352 | 3.5 | 170 | | | | | | 123.5 | | | | | | | |
| MM-CF502 | 5.0 | 224 | | | | | | 172.5 | | | | | | | |
| MM-CF702 | 7.0 | 299 | | | | | | 247.5 | | | | | | | |

The outline dimensions may be changed. When precise outline dimensions are required, contact your sales representative.

### MM-CF[]B (With an electromagnetic brake)

[Unit mm]

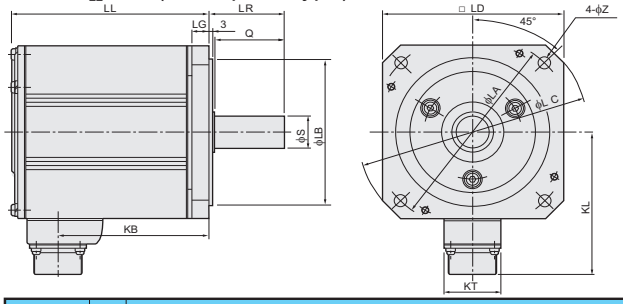



| Model | Output (kW) | Dimensions | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | LL | ϕLA | ϕLB | ϕLC | □LD | LG | KB | ϕKD | KL | KT | ϕZ | LR | Q | ϕS |
| MM-CF52B | 0.5 | 159 | 145 | 110h7 | 165 | 130 | 12 | 58 | 22 | 108 | 80 | 9 | 55 | 50 | 24h6 |
| MM-CF102B | 1.0 | 184 | | | | | | 83 | | | | | | | |
| MM-CF152B | 1.5 | 209 | | | | | | 108 | | | | | | | |
| MM-CF202B | 2.0 | 231 | 200 | 114.3 $^{0}_{-0.025}$ | 230 | 176 | 18 | 97.5 | 27 | 141 | 93 | 13.5 | 79 | 75 | 35 $^{+0.010}_{0}$ |
| MM-CF352B | 3.5 | 279 | | | | | | 139.5 | | | | | | | |

The outline dimensions may be changed. When precise outline dimensions are required, contact your sales representative.

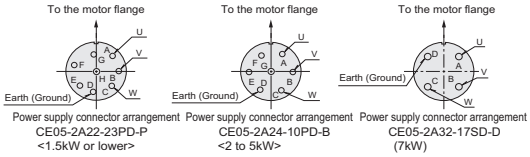
### MM-CF[]C (Waterproof type)

[Unit mm]



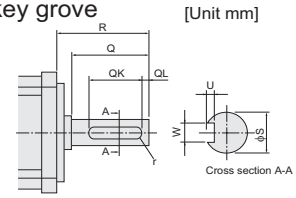

| Model | Output (kW) | Dimensions | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | LL | ϕLA | ϕLB | ϕLC | □LD | LG | KB | KL | KT | ϕZ | LR | Q | ϕS |
| MM-CF52C | 0.5 | 97 | 145 | 110h7 | 165 | 130 | 12 | 57.5 | 111 | 41 | 9 | 55 | 50 | 24h6 |
| MM-CF102C | 1.0 | 122 | | | | | | 82.5 | | | | | | |
| MM-CF152C | 1.5 | 147 | | | | | | 107.5 | | | | | | |
| MM-CF202C | 2.0 | 128 | 200 | 114.3 $^{0}_{-0.025}$ | 230 | 176 | 18 | 83.3 | 141 | 46 | 13.5 | 79 | 75 | 35 $^{+0.010}_{0}$ |
| MM-CF352C | 3.5 | 170 | | | | | | 125.3 | | | | | | |
| MM-CF502C | 5.0 | 224 | | | | | | 179.3 | | | | | | |
| MM-CF702C | 7.0 | 299 | | | | | | 249.3 | 150 | 58 | | | | |

The outline dimensions may be changed. When precise outline dimensions are required, contact your sales representative.




### With key grove

[Unit mm]




| Motor | Dimensions | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ϕS | R | Q | W | QK | QL | U | r |
| MM-CF52 to 152 | 24h6 | 55 | 50 | 8 $^{0}_{-0.036}$ | 36 | 5 | 4 $^{+0.2}_{0}$ | 4 |
| MM-CF202 to 702 | 35 $^{+0.010}_{0}$ | 79 | 75 | 10 $^{0}_{-0.036}$ | 55 | 5 | 5 $^{+0.2}_{0}$ | 5 |

# 6.5 Heatsink protrusion attachment procedure

When encasing the inverter in an enclosure, the generated heat amount in an enclosure can be greatly reduced by installing the heatsink portion of the inverter outside the enclosure. When installing the inverter in a compact enclosure, etc., this installation method is recommended.

## *6.5.1 When using a heatsink protrusion attachment (FR-A7CN)*

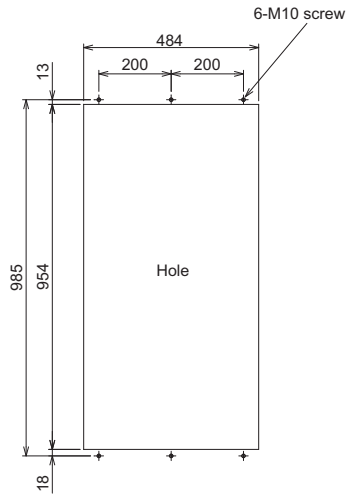
For the FR-A720-1.5K to 90K, FR-A740-0.4K to 132K, a heatsink can be protruded outside the enclosure using a heatsink protrusion attachment (FR-A7CN). (For the FR-A740-160K or higher, attachment is not necessary when the heatsink is to be protruded.)
For a panel cut dimension drawing and an installation procedure of the heatsink protrusion attachment (FR-A7CN) to the inverter, refer to a manual of "heatsink protrusion attachment".

## *6.5.2 Protrusion of heatsink of the FR-A740-160K or higher*

(1) Panel cutting

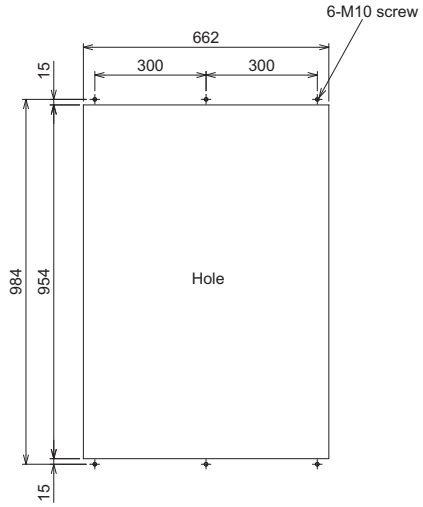
Cut the panel of the enclosure according to the inverter capacity.

**• FR-A740-160K, 185K**



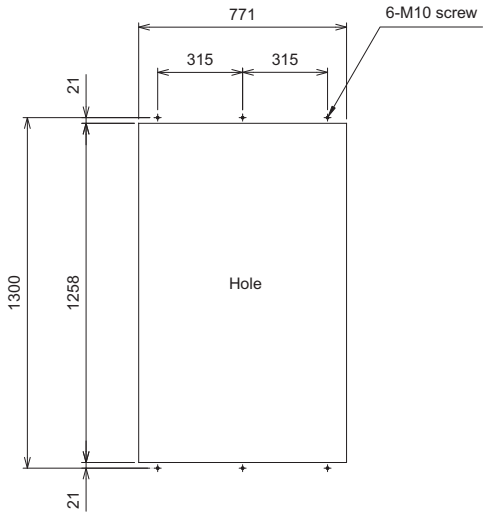

Unit: mm

**• FR-A740-220K, 250K, 280K**



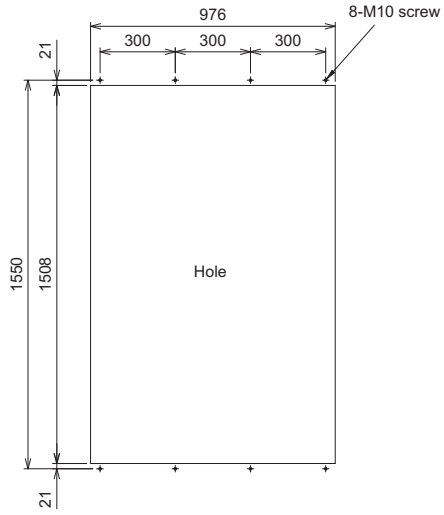

Unit: mm

**• FR-A740-315K, 355K**




Unit: mm

**• FR-A740-400K, 450K, 500K**

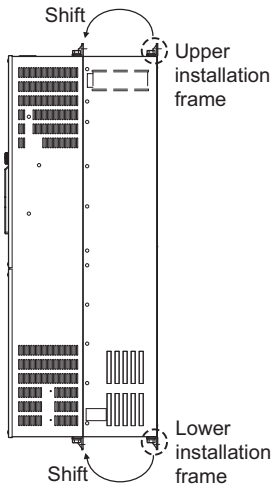



Unit: mm

(2) Shift and removal of a rear side installation frame

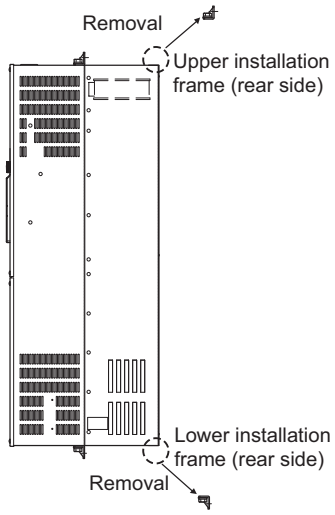
- **FR-A740-160K to 280K**

One installation frame is attached to each of the upper and lower parts of the inverter. Change the position of the rear side installation frame on the upper and lower sides of the inverter to the front side as shown on the right. When changing the installation frames, make sure that the installation orientation is correct.



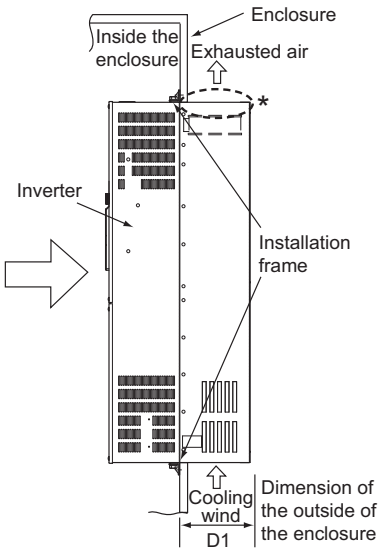

- **FR-A740-315K or higher**

Two installation frames each are attached to the upper and lower parts of the inverter. Remove the rear side installation frame on the upper and lower sides of the inverter as shown on the right.

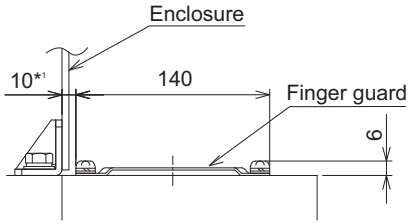



(3) Installation of the inverter

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




* For the FR-A740-160K or higher, there are finger guards behind the enclosure. Therefore, the thickness of the panel should be less than 10mm (*1) and also do not place anything around finger guards to avoid contact with the finger guards.




| Inverter Model | D1 |
|---|---|
| FR-A740-160K, 185K | 185 |
| FR-A740-220K to 500K | 184 |

Unit: mm

**CAUTION**

- Having a cooling fan, the cooling section which comes out of the enclosure cannot be used in the environment of water drops, oil, mist, dust, etc.
- Be careful not to drop screws, dust etc. into the inverter and cooling fan section.

# APPENDICES

## Appendix 1 For customers who are replacing the older model with this inverter

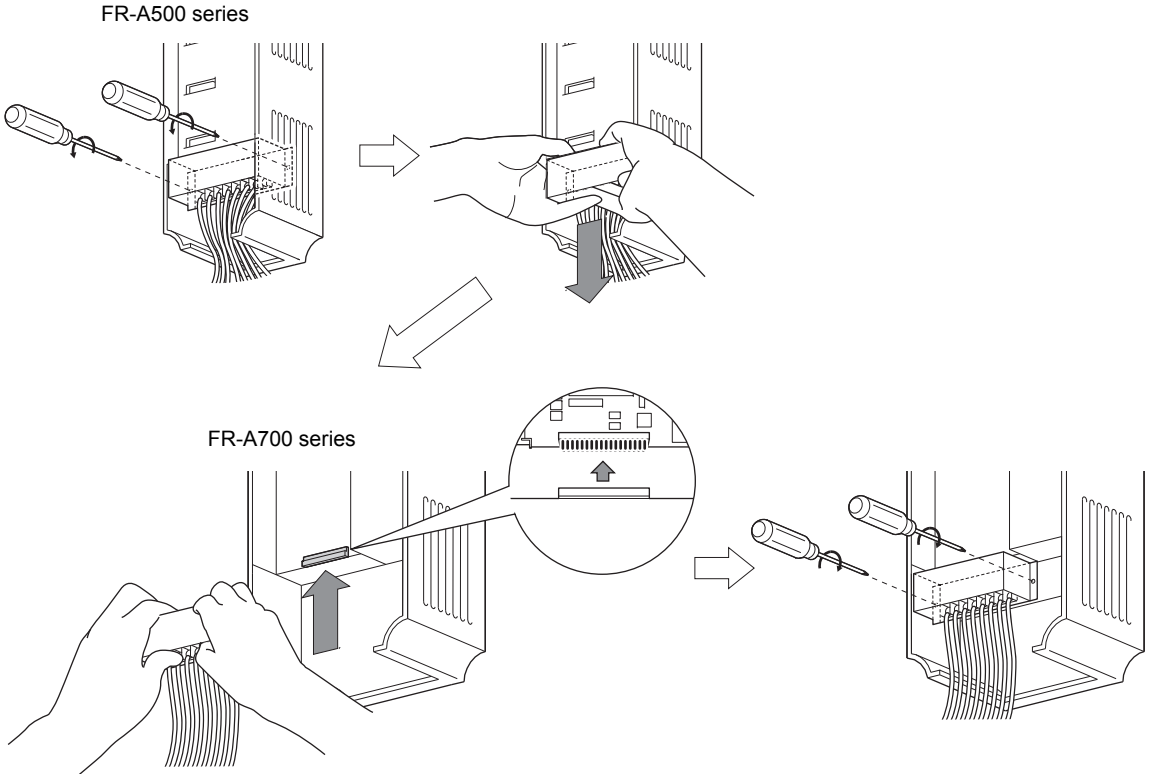
### *Appendix 1-1 Replacement of the FR-A500 series*

#### (1) Instructions for installation

1) Removal procedure of the front cover was changed. (with screws) Please note. *(Refer to page 6.)*
2) Removal procedure of the operation panel was changed. (with screws) Please note. *(Refer to page 6.)*
3) Plug-in options of the A500 series are not compatible.
4) Operation panel (FR-DU04) cannot be used.
5) Setup software (FR-SW0-SETUP/FR-SW1-SETUP) cannot be used.

#### (2) Wiring instructions

1) The control circuit terminal block can be used for the FR-A700 series without removing wiring.
   Note that the wiring cover (0.4K to 22K) is not compatible.




(Note that the relay output 2 (A2, B2, C2) specific for the FR-A700 series cannot be used with the FR-A500 series terminals.)

#### (3) Instructions for continuous use of the FR-PU04 (parameter unit)

1) For the FR-A700 series, many functions (parameters) have been added. When setting these parameters, the parameter name and setting range are not displayed. User initial value list and user clear of the HELP function cannot be used.
2) For the FR-A700 series, many protective functions have been added. These functions activate, but all faults are displayed as "Fault 14". When the faults history has been checked, "E.14" appears. Added faults display will not appear on the parameter unit.
3) User initial value setting cannot be used.
4) User registration/clear (user group 2) cannot be used.
5) Parameter copy/verification function cannot be used.

#### (4) Parameter resetting

The setup software (FR Configurator) is useful for the FR-A700.

### (5) Main differences and compatibilities with the FR-A500(L) series

| Item | | FR-A500(L) | FR-A700 |
|---|---|---|---|
| Added functions | Control method | V/F control<br>Advanced magnetic flux vector control | V/F control<br>Advanced magnetic flux vector control<br>Real sensorless vector control<br>Vector control<br>(used with a plug-in option FR-A7AP/FR-A7AL)<br>PM sensorless vector control |
| | PID control | PID action set point setting<br>*(Pr. 133)* | Addition of "9999" to PID action set point (*Pr. 133*) setting<br>(a value input from terminal 2 is a set point) |
| Changed functions | Intelligent mode selection | *Pr. 60* | Parameter number change<br>*(Pr. 60 Energy saving control selection)*<br>*(Pr. 292 Automatic acceleration/deceleration)* |
| | Motor poles | Number of motor poles<br>*(Pr. 81 , Pr. 144)* | Setting the number of motor poles in Number of motor poles (*Pr. 81*) automatically changes the speed setting switchover (*Pr. 144*) setting. |
| | User group | User group 1 (16 parameters), User group 2 (16 parameters) (*Pr.160*, *Pr.173 to Pr.175*) | User group (16 parameters) only<br>Setting methods were partially changed<br>(*Pr.160*, *Pr.172 to Pr.173*) |
| | Communication option | Performing the parameter clear or all parameter clear (H5A96 or HAA99) from the DeviceNet communication option (FR-A5ND) clears the *Pr. 345* and *Pr. 346* settings. | Performing the parameter clear or all parameter clear (H5A96 or HAA99) from the DeviceNet communication option (FR-A7ND) does not clear the *Pr. 345* and *Pr. 346* settings. |
| Deleted functions | User initial value setting *(Pr. 199)* | Available | Not available<br>Substitutable with the copy function of the operation panel (FR-DU07) |
| | Long wiring mode | *Pr. 240* setting 10, 11 | Setting is not necessary<br>(*Pr. 240* settings "10" and "11" were cleared) |
| | Program operation | *Pr. 200 to Pr. 231* | Function was cleared |
| Terminal block | | Removable terminal block | Removable terminal block<br>Upward compatibility (FR-A500 terminal block mountable) |
| PU | | FR-PU04, DU04 | FR-PU07<br>FR-DU07<br>FR-PU04 (Some functions, such as parameter copy, are unavailable.)<br>FR-DU04 unavailable |
| Plug-in options | | Dedicated plug-in option (incompatible) | |
| | | Computer link, relay output option<br>FR-A5NR | Built into the inverter<br>(RS-485 terminals, relay output 2 points) |
| Installation size | | · FR-A720-0.4K to 90K, FR-A740-0.4K to 7.5K, 18.5K to 55K, 110K, 160K are compatible in mounting dimensions.<br>For the FR-A740-11K, 15K, an optional intercompatibility attachment (FR-AAT) is necessary.<br>· Heatsink protrusion attachment is not compatible.<br>Also, the panel cut dimension of 3.7K or lower, 200V class 30K, 55K or higher, 400V class 11K, 15K, 75K or higher is not compatible. | |

## *Appendix 1-2 Replacement of the FR-A200 <EXCELLENT> series*

### Instructions for installation

- When using the mounting holes of the FR-A200(E) series, FR-A5AT (intercompatibility attachment) is necessary.

# Appendix 2 Specification comparisons between the PM sensorless vector control and the induction motor control

| Item | PM sensorless vector control (MM-CF) | | Induction motor control |
|---|---|---|---|
| Applicable motor | IPM motor MM-CF series (0.5 to 7.0kW) *(Refer to page 189.)*<br>IPM motors other than the MM-CF are also applicable with tuning. (The motor capacity must be equal to or one rank lower than the inverter capacity.) * | | Induction motor<br>(The motor capacity must be equal to or one rank lower than the inverter capacity.) |
| Starting torque | High frequency superposition control | 200% (with 1.5kW or lower MM-CF: 200%, with 2.0kW or higher: 150%) | 200% (0.4 to 3.7K)<br>150% (5.5K or higher)<br>Under Real sensorless vector control or vector control |
| | Current synchronization operation | 50% | |
| Zero speed | High frequency superposition control | Available (Use a one rank higher inverter for zero-speed 200%) | Available under Real sensorless vector control or vector control |
| | Current synchronization operation | Not available | |
| Carrier frequency | High frequency superposition control | 6kHz (*Pr. 72* = "0 to 9"),<br>10kHz (*Pr. 72* = "10 to 13"), or<br>14kHz (*Pr. 72* = "14, 15")<br>(Even if 10kHz or higher is set, the frequency will be 6kHz in the low-speed range. 2kHz is not selectable.) | 55K or lower: a value between 0.75kHz and 14.5kHz<br>75K or higher: 0.75kHz to 6kHz |
| | Current synchronization operation | 2kHz (*Pr. 72* = "0 to 5"),<br>6kHz (*Pr. 72* = "6 to 9"),<br>10kHz (*Pr. 72* = "10 to 13"), or<br>14kHz (*Pr. 72* = "14, 15")<br>(Even if 10kHz or higher is set, the frequency will be 6kHz in the low-speed range.) | |
| Automatic restart after instantaneous power failure | No startup waiting time.<br>The use with the regeneration avoidance function or with the retry function is recommended. | | Startup waiting time exists. |
| Startup delay | Startup delay of about 0.1s (for magnetic pole position detection) | | No startup delay (when the online auto tuning at start is disabled) |
| Commercial power supply operation of the motor | Cannot be driven by the commercial power supply. | | Can be driven by the commercial power supply (other than vector control dedicated motor) |
| Operation during coasting | While the motor is coasting, potential is generated across motor terminals. | | While the motor is coasting, potential is not generated across motor terminals. |
| Torque control | Not available | | Available under Real sensorless vector control or vector control |
| Position control | High frequency superposition control | Available (Sensorless) | Available under vector control |
| | Current synchronization operation | Not available | |

* To perform PM sensorless vector control on an IPM motor other than MM-CF, contact your sales representative.

**CAUTION**

- Before wiring, make sure that the motor is stopped. Otherwise you may get an electric shock.
- Never connect an IPM motor to the commercial power supply.
- No slippage occurs with an IPM motor because of its characteristic. If an IPM motor, which took over an induction motor, is driven at the same speed as for the induction motor, the rotation speed of the IPM motor becomes faster by the amount of the induction motor's slippage. Adjust the speed command to run the IPM motor at the same speed as the induction motor, as required.

# Appendix 3 Instructions for UL and cUL compliance

(Conforming standard UL 508C, CSA C22.2 No.14)

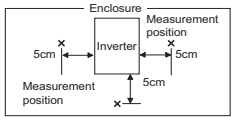
## (1) General Precaution

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.

## (2) Environment

Before installation, check that the environment meets following specifications.

| | |
|---|---|
| **Surrounding Air Temperature *1** | Constant torque: -10°C to + 50°C (non-freezing)   |
| **Ambient humidity** | 90%RH or less (non-condensing) |
| **Storage temperature** | -20°C to + 65°C |
| **Ambience** | Indoors (No corrosive and flammable gases, oil mist, dust and dirt.) |
| **Altitude, vibration** | Below 1000m, 5.9m/s$^2$ or less*2 at 10 to 55Hz (directions of X, Y, Z axes) |

*1 Surrounding Air Temperature is a temperature measured at a measurement position in an enclosure. Ambient Temperature is a temperature outside an enclosure.

*2 2.9m/s$^2$ or less for the 160K or higher

## (3) Installation

This inverter is UL-listed as a product for use in an enclosure.
Design an enclosure so that the inverter surrounding air temperature, humidity and atmosphere satisfy the specifications. *(Refer to page 191.)*

### Branch Circuit Protection

For installation in the United States, Class RK5, Class J, Class CC, Class L, Class T or any faster acting fuses or UL 489 Molded Case Circuit Breaker (MCCB) must be provided, in accordance with the National Electrical Code and any applicable local codes.
For installation in Canada, Class RK5, Class J, Class CC, Class L, Class T or any faster acting fuses or UL 489 Molded Case Circuit Breaker (MCCB) must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.
For the FR-A740-75K to 500K, Class RK5, Class J, Class CC, Class L or Class T fuses or UL 489 Molded CaseCircuit Breaker (MCCB) must be provided.

| FR-A720-□□K | | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated fuse voltage(V) | | 240V or more | | | | | | | | | | | | | | |
| Fuse maximum allowable rating (A)* | Without power factor improving reactor | 15 | 20 | 30 | 40 | 60 | 80 | 150 | 175 | 200 | 225 | 300 | 350 | 400 | 500 | 500 |
| | With power factor improving reactor | 15 | 20 | 20 | 30 | 50 | 70 | 125 | 150 | 200 | 200 | 250 | 300 | 350 | 400 | 500 |
| Molded case circuit breaker (MCCB) maximum allowable rating (A)* | | 15 | 15 | 20 | 25 | 40 | 60 | 80 | 110 | 150 | 175 | 225 | 250 | 350 | 400 | 500 |

| FR-A720-□□K | | 75 | 90 |
|---|---|---|---|
| Rated fuse voltage(V) | | 240V or more | |
| Fuse maximum allowable rating (A)* | Without power factor improving reactor | — | — |
| | With power factor improving reactor | 600 | 700 |
| Molded case circuit breaker (MCCB) maximum allowable rating (A)* | | 700 | 800 |

| FR-A740-□□K | | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 | 55 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated fuse voltage(V) | | 480V or more | | | | | | | | | | | | | | |
| Fuse maximum allowable rating (A)* | Without power factor improving reactor | 6 | 10 | 15 | 20 | 30 | 40 | 70 | 80 | 90 | 110 | 150 | 175 | 200 | 250 | 300 |
| | With power factor improving reactor | 6 | 10 | 10 | 15 | 25 | 35 | 60 | 70 | 90 | 100 | 125 | 150 | 175 | 200 | 250 |
| Molded case circuit breaker (MCCB) maximum allowable rating (A)* | | 15 | 15 | 15 | 15 | 20 | 30 | 40 | 50 | 70 | 90 | 100 | 125 | 150 | 200 | 250 |

* Maximum allowable rating by US National Electrical Code.
Exact size must be chosen for each installation.

Class RK5 or Class T or Class L fuses or UL 489 Molded Case Circuit Breaker (MCCB) must be provided.

| FR-A740-□□K | | 75 | 90 | 110 | 132 | 160 | 185 | 220 | 250 | 280 | 315 | 355 | 400 | 450 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated fuse voltage(V) | | 500V or more | | | | | | | | | | | | | |
| Fuse maximum allowable rating (A)* | Without power factor improving reactor | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | With power factor improving reactor | 300 | 350 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1350 | 1500 | 1800 |
| Molded case circuit breaker (MCCB) maximum allowable rating (A)* | | 350 | 450 | 500 | 600 | 800 | 800 | 1000 | 1200 | 1200 | 1200 | 1600 | 1600 | 2000 | 2000 |

* Maximum allowable rating by US National Electrical Code.
Exact size must be chosen for each installation.

### (4) Wiring of the power supply and motor

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 crimping terminals. Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

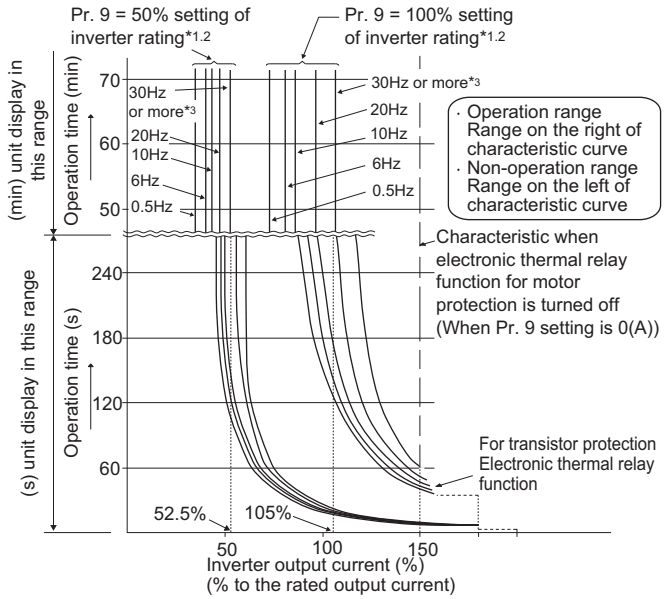
### (5) Short circuit ratings

- 200V class
  Suitable For Use in A Circuit Capable Of Delivering Not More Than 100kA rms Symmetrical Amperes, 264V Maximum.
- 400V class
  55K or lower
  Suitable For Use in A Circuit Capable Of Delivering Not More Than 100kA rms Symmetrical Amperes, 528V Maximum.
  75K or higher
  Suitable For Use in A Circuit Capable Of Delivering Not More Than 100kA rms Symmetrical Amperes, 550V Maximum.

## (6) Motor overload protection

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

Electronic thermal relay function operation characteristic




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)

When using the Mitsubishi constant-torque motor

1) Set "1" or any of "13" to "18", "50", "53", "54" in *Pr. 71*.
   (This provides a 100% continuous torque characteristic in the low-speed range.)
2) Set the rated current of the motor in *Pr. 9*.

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

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

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

**CAUTION**

- 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 operated by a single inverter, protection cannot be provided by the electronic thermal relay function. Install an external thermal relay to each motor.
- 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 the external thermal relay.
- Electronic thermal relay may not function when 5% or less of inverter rated current is set to electronic thermal relay setting.
- Motor over temperature sensing is not provided by the drive.
- The use of the FR-A700 with an IPM motor is not certified by the UL not cUL.

# Appendix 4 Instructions for compliance with the EU Directives

The EU Directives are issued to standardize different national regulations of the EU Member States and to facilitate free movement of the equipment, whose safety is ensured, in the EU territory.
Since 1996, compliance with the EMC Directive that is one of the EU Directives has been legally required. Since 1997, compliance with the Low Voltage Directive, another EU Directive, has been also legally required. When a manufacturer confirms its equipment to be compliant with the EMC Directive and the Low Voltage Directive, the manufacturer must declare the conformity and affix the CE marking.

- **The authorized representative in the EU**

  The authorized representative in the EU is shown below.
  Name: Mitsubishi Electric Europe B.V.
  Address: Gothaer Strasse 8, 40880 Ratingen, Germany

- Note

  We declare that this inverter conforms with the EMC Directive in industrial environments and affix the CE marking on the inverter. When using the inverter in a residential area, take appropriate measures and ensure the conformity of the inverter used in the residential area.

## (1) EMC Directive

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

- EMC Directive: 2004/108/EC
- Standard(s): EN61800-3:2004 (Second environment / PDS Category "C3")

Note: First environment

Environment including residential buildings. Includes buildings directly connected without a transformer to the low voltage power supply network which supplies power to residential buildings.

Second environment

Environment including all buildings except buildings directly connected without a transformer to the low voltage power supply network which supplies power to residential buildings.

- Note

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

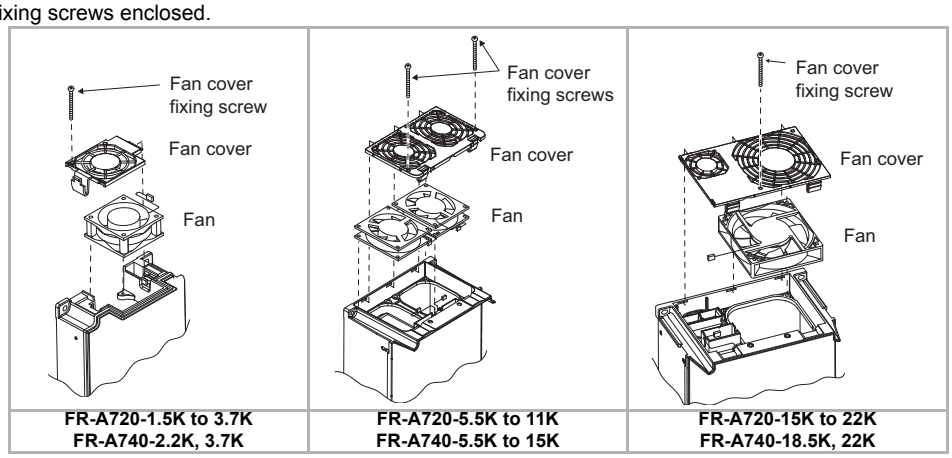
  * The inverter is equipped with a built-in EMC filter. Set the EMC filter valid. (The EMC filter is invalid when shipped from the factory. (The FR-A720-0.4K and 0.75K are always valid.) For details, *refer to page 10.*)
  * Connect the inverter to an earthed power supply.
  * Install a motor and a control cable written in the EMC Installation Manual (BCN-A21041-204) according to the instruction.
  * The cable length between the inverter and the motor is 5 m maximum.
  * Confirm that the inverter conforms with the EMC Directive as the industrial drives application for final installation.
  * This inverter does not conform with the EU Directives when used with an IPM motor.

## (2) Low Voltage Directive

We have self-confirmed our inverters as products compliant to the Low Voltage Directive (Conforming standard EN 50178) and affix the CE marking on the inverters.

Outline of instructions

* Do not use an earth leakage current breaker as an electric shock protector without connecting the equipment to the earth. Connect the equipment to the earth securely.
* Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)
* Use the cable sizes on *page 14* under the following conditions.
  · Surrounding air temperature: 40°C maximum
  If conditions are different from above, select appropriate wire according to EN60204 Appendix C TABLE 5.
* Use a tinned (plating should not include zinc) crimping terminal to connect the earth (ground) cable. When tightening the screw, be careful not to damage the threads.
  For use as a product compliant with the Low Voltage Directive, use PVC cable whose size is indicated on *page 14*.
* Use the moulded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.
* When using an earth leakage current breaker, use a residual current operated protective device (RCD) of type B (breaker which can detect both AC and DC). If not, provide double or reinforced insulation between the inverter and other equipment, or put a transformer between the main power supply and inverter.
* Use the inverter under the conditions of overvoltage category II (usable regardless of the earth (ground) condition of the power supply), overvoltage category III (usable with the earthed-neutral system power supply, 400V class only) and pollution degree 2 or lower specified in IEC60664.
  · To use the inverter of 30K or higher (IP00) under the conditions of pollution degree 2, install it in the enclosure of IP 2X or higher.
  · To use the inverter under the conditions of pollution degree 3, install it in the enclosure of IP54 or higher.
  · To use the inverter of 22K or lower (IP20) outside of an enclosure in the environment of pollution degree 2, fix a fan cover with fan cover fixing screws enclosed.




| FR-A720-1.5K to 3.7K<br>FR-A740-2.2K, 3.7K | FR-A720-5.5K to 11K<br>FR-A740-5.5K to 15K | FR-A720-15K to 22K<br>FR-A740-18.5K, 22K |
|---|---|---|

* On the input and output of the inverter, use cables of the type and size set forth in EN60204 Appendix C.
* The operating capacity of the relay outputs (terminal symbols A1, B1, C1, A2, B2, C2) should be 30VDC, 0.3A. (Relay outputs have basic isolation from the inverter internal circuit.)
* Control circuit terminals on *page 9* are safely isolated from the main circuit.
* Environment

| | During Operation | In Storage | During Transportation |
|---|---|---|---|
| Surrounding air temperature | -10°C to +50°C | -20°C to +65°C | -20°C to +65°C |
| Ambient humidity | 90% RH or less | 90% RH or less | 90% RH or less |
| Maximum altitude | 1000m | 1000m | 10000m |

* This inverter does not conform with the EU Directives when used with an IPM motor.

MEMO

REVISIONS

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

| Print Date | *Manual Number | Revision |
|---|---|---|
| Jun. 2005 | IB(NA)-0600225ENG-A | First edition |
| Aug. 2005 | IB(NA)-0600225ENG-B | Addition<br>· FR-A720-75K, 90K<br>· FR-A740-0.4K to 160K |
| Sep. 2005 | IB(NA)-0600225ENG-C | Addition<br>FR-A740-185K to 500K<br>Compatible with the FR-A7AP<br>· Orientation control<br>· Encoder feedback control<br>· Vector control |
| Feb. 2007 | IB(NA)-0600225ENG-D | Addition<br>· Pr. 539 Modbus-RTU communication check time interval<br>· Setting value "4" of Pr. 17 MRS input selection<br>· Setting values "10, 11" of Pr. 495 Remote output selection<br>Modification<br>· Change in specification of a voltage/current input switch and addition of a switch to the 3.7K or lower. |
| Mar. 2010 | IB(NA)-0600225ENG-E | Addition<br>· Pr. 296 Password lock level<br>· Pr. 297 Password lock/unlock<br>· Setting value "1" of Pr. 419 Position command source selection<br>· Setting value "2" of Pr. 804 Torque command source selection<br>· Failsafe<br>Modification<br>· 4.6 Check first when you have a trouble<br>· Instructions for compliance with the EU Directives |
| Jun. 2011 | IB(NA)-0600225ENG-F | Addition<br>· 3.2.7 Energy saving operation for fans and pumps (Pr. 14, Pr. 60)<br>· Setting value "2" of Pr. 850 Brake operation selection<br>· Setting values "11, 13" of Pr. 270 Stop-on contact/load torque high-speed frequency control selection<br>· Motor temperature detection signal (Y55)<br>· Motor temperature monitor<br>· Compliance with the Radio Waves Act (South Korea) |
| Mar. 2015 | IB(NA)-0600225ENG-G | Addition<br>· Pr. 147 Acceleration/deceleration time switching frequency<br>· Setting value "9999" of Pr. 551 PU mode operation command source selection<br>· PM sensorless vector control<br>· Setting values "10, 11" of Pr. 154 Voltage reduction selection during stall prevention operation<br>· Pr. 870 Speed detection hysteresis<br>· Pr. 994 Droop break point gain, Pr. 995 Droop break point torque<br>· Pr. 999 Automatic parameter setting<br>Modification<br>· Setting range of Pr. 885 Regeneration avoidance compensation frequency limit value<br>· UL standards (changes in sentences regarding fuse selection for 75K or higher and motor overload protection) |

### ⚠ For Maximum Safety

- Mitsubishi inverters are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.
- When considering this product for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest Mitsubishi sales representative.
- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to prevent serious accidents when it is used in facilities where breakdowns of the product are likely to cause a serious accident.
- Please do not use this product for loads other than three-phase induction motors.

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

| | |
|---|---|
| MODEL | FR-A700<br>INSTRUCTION MANUAL (BASIC) |
| MODEL CODE | 1A2-P09 |

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