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MITSUBISHI

FR-D700-NA

INVERTER

MITSUBISHI ELECTRIC

700 series

# INVERTER
# FR-D700
# INSTRUCTION MANUAL

## FR-D720-008 to 318 - NA
## FR-D740-012 to 160 - NA
## FR-D720S-008 to 100 - NA


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WIRING 2

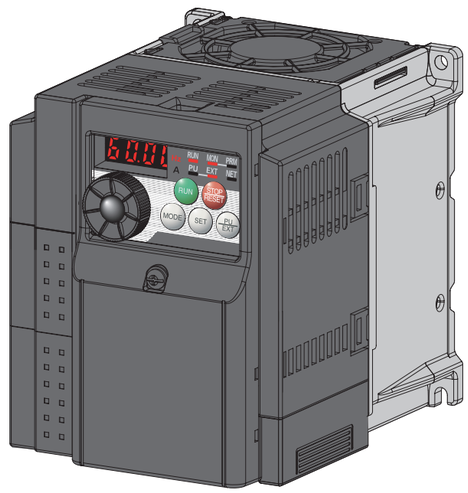
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INSTRUCTION MANUAL


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

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A



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**Thank you for choosing this Mitsubishi Inverter.**
**This Instruction Manual provides instructions for advanced use of the FR-D700 series inverters.**
**Incorrect handling might cause an unexpected fault. Before using the inverter, always read this instruction manual and the Installation Guideline [IB-0600367ENG] packed with the product carefully to use the equipment to its optimum performance.**

## This section is specifically about safety matters

**Do not attempt to install, operate, maintain or inspect the inverter until you have read through the Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.**
**In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".**

| | |
|---|---|
| **⚠WARNING** | **Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.** |
| **⚠CAUTION** | **Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.** |

**Note that even the ⚠CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.**

### 1. Electric Shock Prevention

**⚠WARNING**

- **While power is on or when the inverter is running, do not open the front cover. Otherwise you may get an electric shock.**
- **Do not run the inverter with the front cover or 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 access the charged inverter circuits and get an electric shock.**
- **Before starting wiring or inspection, switch off power, check to make sure that the operation panel indicator 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. 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)**
  **Use an neutral-point earthed (grounded) power supply for 400V class inverter in compliance with EN standard.**
- **Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.**
- **Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.**
- **Perform setting dial and key operations with dry hands to prevent an electric shock. Otherwise you may get an electric shock.**
- **Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.**
- **Do not change the cooling fan while power is on. It is dangerous to change the cooling fan while power is on.**
- **Do not touch the printed circuit board with wet hands. Otherwise, you may get an electric shock.**
- **When measuring the main circuit capacitor capacity, 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.**

### 2. Fire Prevention

**⚠CAUTION**

- **Install the inverter on a nonflammable wall without holes (so that nobody can touch 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, switch off the inverter power. A continuous flow of large current could cause a fire.**
- **When using a brake resistor, make up a sequence that will turn off power when an alarm signal is output. Otherwise, the brake resistor may excessively overheat due to damage of the brake transistor and such, causing a fire.**
- **Do not connect a resistor directly to the DC terminals P/+ and N/-. This could cause a fire.**



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**3.Injury Prevention**

**⚠CAUTION**

- Apply only the voltage specified in the instruction manual to each terminal. Otherwise, burst, damage, etc. may occur.
- Ensure that the cables are connected to the correct terminals. Otherwise, burst, damage, etc. may occur.
- Always make sure that polarity is correct to prevent damage, etc. Otherwise, burst, damage, etc. may occur.
- While power is on or for some time after power-off, do not touch the inverter as they will be extremely hot. Doing so can cause burns.

## 4. Additional Instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.

**(1) Transportation and mounting**

**⚠CAUTION**

- Transport the product using the correct method that corresponds to the weight. Failure to observe this could lead to injuries.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the instruction manual.
- Do not install or operate the inverter if it is damaged or has parts missing.
- 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.
- Check the inverter mounting orientation is correct.
- Prevent other conductive bodies such as screws and metal fragments or other flammable substance such as oil from entering the inverter.
- As the inverter is a precision instrument, do not drop or subject it to impact.
- Use the inverter under the following environmental conditions: Otherwise, the inverter may be damaged.

| | | |
|---|---|---|
| Environment | Surrounding air temperature | -10°C to +50°C (14°F to 122°F) (non-freezing) |
| | Ambient humidity | 90%RH maximum (non-condensing) |
| | Storage temperature | -20°C to +65°C (-4°F to 149°F) *1 |
| | Atmosphere | Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt) |
| | Altitude/ vibration | Maximum 1000m (3280.80feet) above sea level for standard operation. After that derate by 3% for every extra 500m (1640.40feet) up to 2500m (8202feet) (91%). 5.9m/s$^2$ or less |

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

**(2) Wiring**

**⚠CAUTION**

- Do not install a power factor correction capacitor or surge suppressor/capacitor type 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 will affect the direction of rotation of the motor.

**(3) Trial run**

**⚠CAUTION**

- Before starting operation, confirm and adjust the parameters. A failure to do so may cause some machines to make unexpected motions.

**(4) Usage**

**⚠WARNING**

- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after trip.
- Since pressing STOP RESET key may not stop output depending on the function setting status, provide a circuit and switch separately to make an emergency stop (power off, mechanical brake operation for emergency stop, etc).
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the equipment.
- 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 product.

**⚠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.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power factor correction capacitor and generator.
- When a 400V class motor is inverter-driven, please use an insulation-enhanced motor or measures taken to suppress surge voltages. Surge voltages 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, reset the required parameters before starting operations. Each parameter returns to the initial value.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.
- For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.



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**(5) Emergency stop**

| ⚠CAUTION |
|---|
| ● Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.<br>● When the breaker on the inverter input 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.<br>● When any protective function is activated, take the appropriate corrective action, then reset the inverter, and resume 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) Disposal**

| ⚠CAUTION |
|---|
| ● Treat as industrial waste. |

| General instruction |
|---|
| Many of the diagrams and drawings in this Instruction Manual show the inverter without a cover, or partially open. Never operate the inverter in this manner. Always replace the cover and follow this Instruction Manual when operating the inverter. |



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# 1 OUTLINE

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


**1.1 Product checking and parts identification ..... 2**
**1.2 Inverter and peripheral devices ..... 3**
**1.3 Removal and reinstallation of the cover ..... 5**
**1.4 Installation of the inverter and enclosure design ..... 8**


<Abbreviations>

PU ..... Operation panel and parameter unit (FR-PU04/FR-PU07)
Inverter ..... Mitsubishi inverter FR-D700 series
FR-D700 ..... Mitsubishi inverter FR-D700 series
Pr. ..... Parameter number
PU operation ..... Operation using the PU (operation panel/FR-PU04/FR-PU07)
External operation ..... Operation using the control circuit signals
Combined operation ..... Operation using both the PU (operation panel/FR-PU04/FR-PU07) and external operation
Operation panel for E500, PA02..... FR-E500 series operation panel (FR-PA02-02)
Mitsubishi standard motor ..... SF-JR
Mitsubishi constant-torque motor ... SF-HRCA

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**REMARKS** :Additional helpful contents and relations with other functions are stated

**NOTE** :Contents requiring caution or cases when set functions are not activated are stated.

**POINT** :Useful contents and points are stated.

**Parameters referred to** : related parameters are stated.






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## 1.1 Product checking and parts identification

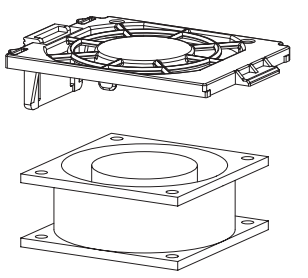
Unpack the inverter and check the capacity plate on the front cover and the rating plate on the inverter side face to ensure that the product agrees with your order and the inverter is intact.

**●Inverter type**

FR - D740 - 036 - NA

| Symbol | Voltage class |
|---|---|
| D720 | Three-phase 200V class |
| D740 | Three-phase 400V class |
| D720S | Single-phase 200V class |

Displays the rated current






- **Accessory**
  - **Fan cover fixing screws (M3 × 35mm)**
    **These screws are necessary for compliance with the European Directive** (*Refer to Installation Guideline*)

| Type | Number |
|---|---|
| FR-D720-070 to 165<br>FR-D740-036 to 080<br>FR-D720S-070, 100 | 1 |
| FR-D720-120, 160<br>FR-D740-120, 160 | 2 |



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# 1.2 Inverter and peripheral devices



**Three-phase AC power supply**
Use within the permissible power supply specifications of the inverter. To ensure safety, use a moulded case circuit breaker, earth leakage circuit breaker or magnetic contactor to switch power ON/OFF.
*(Refer to page 281)*



**Moulded case circuit breaker (MCCB) or earth leakage circuit breaker (ELB), fuse**
The breaker must be selected carefully since an in-rush current flows in the inverter at power on.
*(Refer to page 4)*



**Magnetic contactor (MC)**
Install the magnetic contactor to ensure safety. Do not use this magnetic contactor to start and stop the inverter. Doing so will cause the inverter life to be shorten.
*(Refer to page 44)*

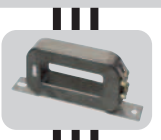
**Reactor (FR-HAL, FR-HEL option)**
Reactors (option) must be used when power harmonics measures are taken, the power factor is to be improved or the inverter is installed near a large power supply system (500kVA or more). The inverter may be damaged if you do not use reactors. Select the reactor according to the model. Remove the jumpers across terminals P/+ and P1 to connect the DC reactor.

**AC reactor (FR-HAL)**

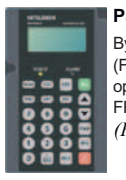


**DC reactor (FR-HEL)**





**Noise filter (FR-BSF01, FR-BLF)**
Install a noise filter to reduce the electromagnetic noise generated from the inverter. Effective in the range from about 1MHz to 10MHz. When more wires are passed through, a more effective result can be obtained. A wire should be wound four turns or more.

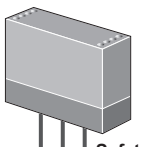


**Parameter unit (FR-PU07)**
By connecting the connection cable (FR-CB2) to the PU connector, operation can be performed from FR-PU07.
*(Refer to page 29)*



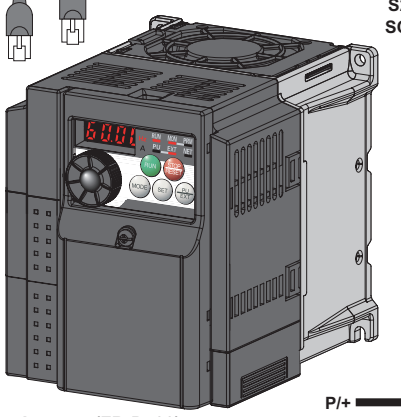
RS-232C - RS-485 converter is required when connecting to PC with RS-232C interface.
*(Refer to page 180)*

**RS-485⇔RS-232C Converter**

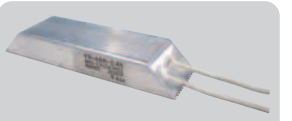


**S1**
**S2**
**SC**

**Safety relay module**
Required for compliance with safety standard.



**Inverter (FR-D700)**

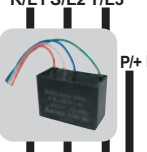


**Brake resistor (FR-ABR, MRS type, MYS type)**
Braking capability can be improved.
(FR-D720-025 or more, FR-D740-012 or more, FR-D720S-025 or more)
*(Refer to page 31)*

**P/+**
**PR**

**P/+ P1**

**Capacitor type filter (FR-BIF)**
Reduces the radio noise.



**R/L1 S/L2 T/L3**

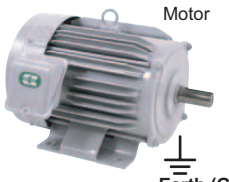
**Earth (Ground)**

**P/+ N/-**

**U V W**

**Noise filter (FR-BSF01, FR-BLF)**
Install a noise filter to reduce the electromagnetic noise generated from the inverter.
Effective in the range from about 1MHz to 10MHz. A wire should be wound four turns at a maximum.





Motor

**Earth (Ground)**

**Devices connected to the output**
Do not install a power factor correction capacitor, surge suppressor or capacitor type 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. For reduction of induction noise from the power line of the inverter, it is recommended to wire the earth (ground) cable by returning it to the earth (ground) terminal of the inverter.



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



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

**Brake unit (FR-BU2)**



**P/+ PR**
**P/+**
**PR**

**Resistor unit (FR-BR) Discharging resistor (GZG, GRZG)**
The regenerative braking capability of the inverter can be exhibited fully. Install this as required.

**NOTE**

- **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 14)*
- **Do not install a power factor correction capacitor, surge suppressor or capacitor type 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, install the FR-BIF optional capacitor type filter (for use in the input side only) or FR-BSF01 or FR-BLF common mode filter to minimize interference.** *(Refer to page 40).*
- **Refer to the instruction manual of each option and peripheral devices for details of peripheral devices.**





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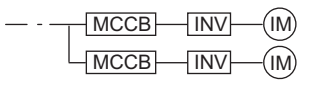
## Inverter and peripheral devices

### 1.2.1 Peripheral devices

Check the inverter type 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:

| Inverter Type | | Motor Output (kW (HP)) | Moulded Case Circuit Breaker (MCCB) *1 or Earth Leakage Circuit Breaker (ELB) *2 | | Magnetic Contactor (MC) *3 | |
|---|---|---|---|---|---|---|
| | | | Reactor connection | | Reactor connection | |
| | | | without | with | without | with |
| Three-Phase 200V | FR-D720-008 | 0.1 (1/8) | 30AF 5A | 30AF 5A | S-N10 | S-N10 |
| | FR-D720-014 | 0.2 (1/4) | 30AF 5A | 30AF 5A | S-N10 | S-N10 |
| | FR-D720-025 | 0.4 (1/2) | 30AF 5A | 30AF 5A | S-N10 | S-N10 |
| | FR-D720-042 | 0.75 (1) | 30AF 10A | 30AF 5A | S-N10 | S-N10 |
| | FR-D720-070 | 1.5 (2) | 30AF 15A | 30AF 10A | S-N10 | S-N10 |
| | FR-D720-100 | 2.2 (3) | 30AF 20A | 30AF 15A | S-N10 | S-N10 |
| | FR-D720-165 | 3.7 (5) | 30AF 30A | 30AF 30A | S-N20, S-N21 | S-N10 |
| | FR-D720-238 | 5.5 (7.5) | 50AF 50A | 50AF 40A | S-N20, S-N21 | S-N20, S-N21 |
| | FR-D720-318 | 7.5 (10) | 100AF 60A | 50AF 50A | S-N25 | S-N20, S-N21 |
| Three-Phase 400V | FR-D740-012 | 0.4 (1/2) | 30AF 5A | 30AF 5A | S-N10 | S-N10 |
| | FR-D740-022 | 0.75 (1) | 30AF 5A | 30AF 5A | S-N10 | S-N10 |
| | FR-D740-036 | 1.5 (2) | 30AF 10A | 30AF 10A | S-N10 | S-N10 |
| | FR-D740-050 | 2.2 (3) | 30AF 15A | 30AF 10A | S-N10 | S-N10 |
| | FR-D740-080 | 3.7 (5) | 30AF 20A | 30AF 15A | S-N10 | S-N10 |
| | FR-D740-120 | 5.5 (7.5) | 30AF 30A | 30AF 20A | S-N20 | S-N11, S-N12 |
| | FR-D740-160 | 7.5 (10) | 30AF 30A | 30AF 30A | S-N20 | S-N20 |
| Single-Phase 200V | FR-D720S-008 | 0.1 (1/8) | 30AF 5A | 30AF 5A | S-N10 | S-N10 |
| | FR-D720S-014 | 0.2 (1/4) | 30AF 5A | 30AF 5A | S-N10 | S-N10 |
| | FR-D720S-025 | 0.4 (1/2) | 30AF 10A | 30AF 5A | S-N10 | S-N10 |
| | FR-D720S-042 | 0.75 (1) | 30AF 15A | 30AF 10A | S-N10 | S-N10 |
| | FR-D720S-070 | 1.5 (2) | 30AF 30A | 30AF 15A | S-N10 | S-N10 |
| | FR-D720S-100 | 2.2 (3) | 30AF 40A | 30AF 30A | S-N20, S-N21 | S-N10 |

*1 •Select an MCCB according to the power supply capacity.
•Install one MCCB per inverter.




*2 For installations in the United States or Canada, use the class T type fuse certified by the UL and cUL.

*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.
When using the MC for emergency stop during motor driving or using on the motor side during commercial-power supply operation, select the MC with class AC-3 rated current for the motor rated current.

**NOTE**

- **When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter type 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.**



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# 1.3 Removal and reinstallation of the cover

## *1.3.1 Front cover*

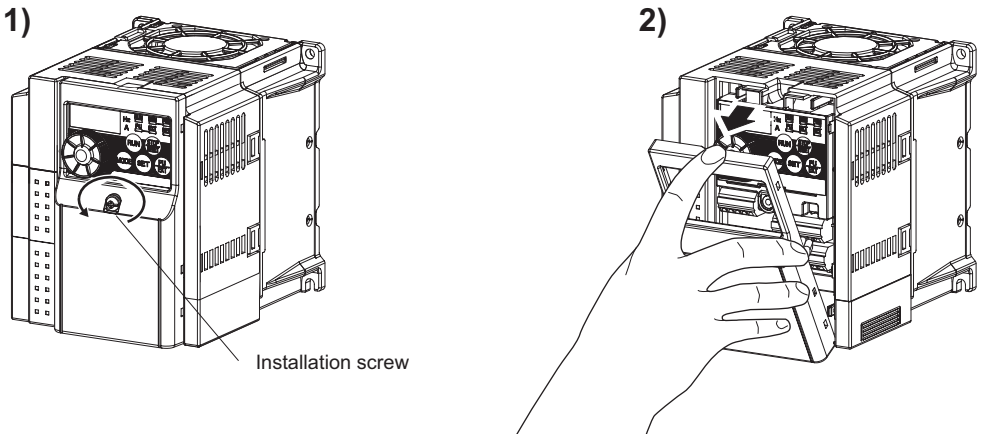
**FR-D720-165 or less**

**FR-D740-080 or less**

**FR-D720S-008 to 100**

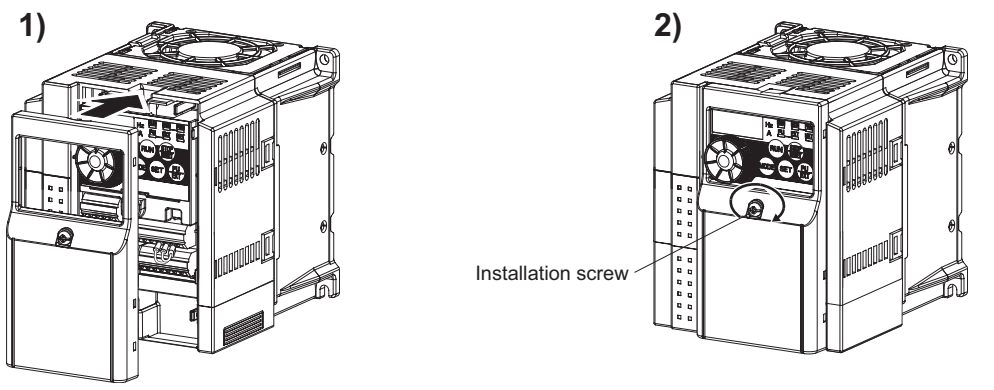
**●Removal (Example of FR-D740-036)**

1) Loosen the installation screws of the front cover. (The screws cannot be removed.)
2) Remove the front cover by pulling it like the direction of arrow.




**●Reinstallation (Example of FR-D740-036)**

1) Place the front cover in front of the inverter, and install it straight.
2) Tighten the installation screws on the front cover.







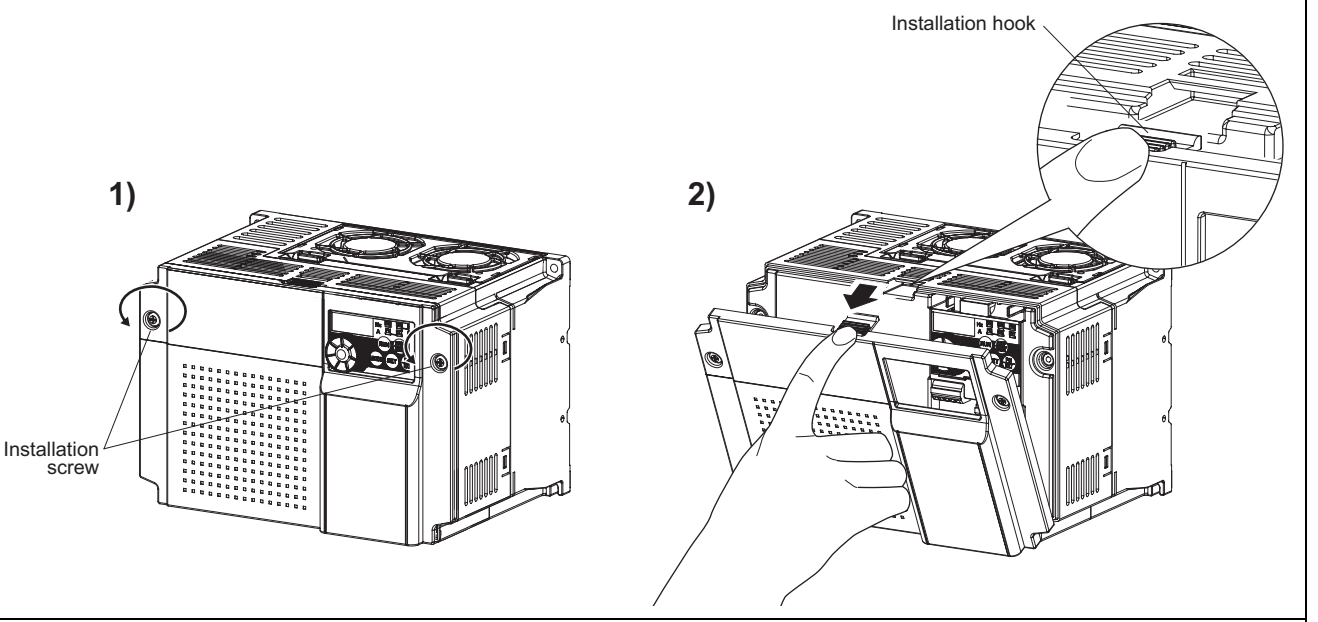

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## Removal and reinstallation of the cover

**FR-D720-238, 318 and FR-D740-120, 160**

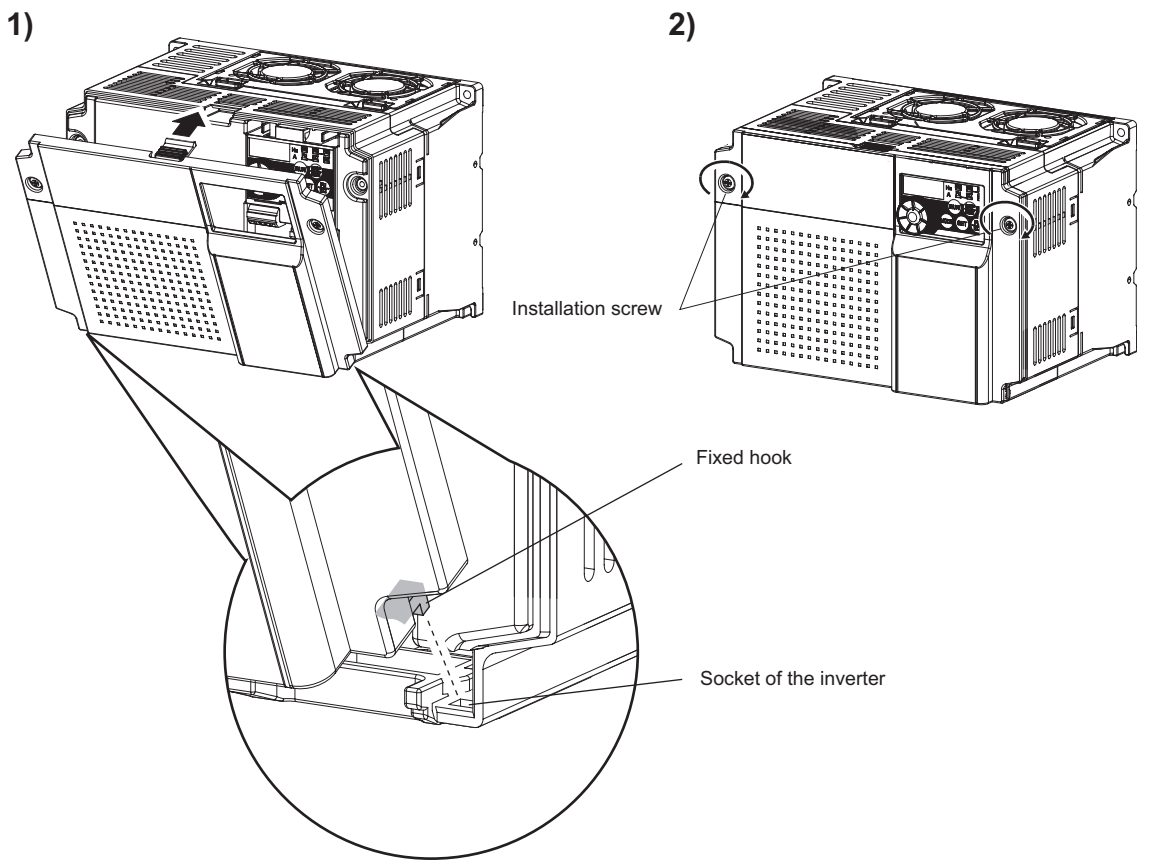
**●Removal (Example of FR-D740-160)**

1) Loosen the installation screws of the front cover. (The screws cannot be removed.)
2) Remove the front cover by pulling it like the direction of arrow with holding the installation hook on the front cover.




**●Reinstallation (Example of FR-D740-160)**

1) Insert the two fixed hooks on the lower side of the front cover into the sockets of the inverter.
2) Tighten the installation screws on the front cover.




**NOTE**

- **Fully make sure that the front cover has been reinstalled securely.**
- **The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Since these plates have the same serial numbers, always reinstall the removed cover onto the original inverter.**



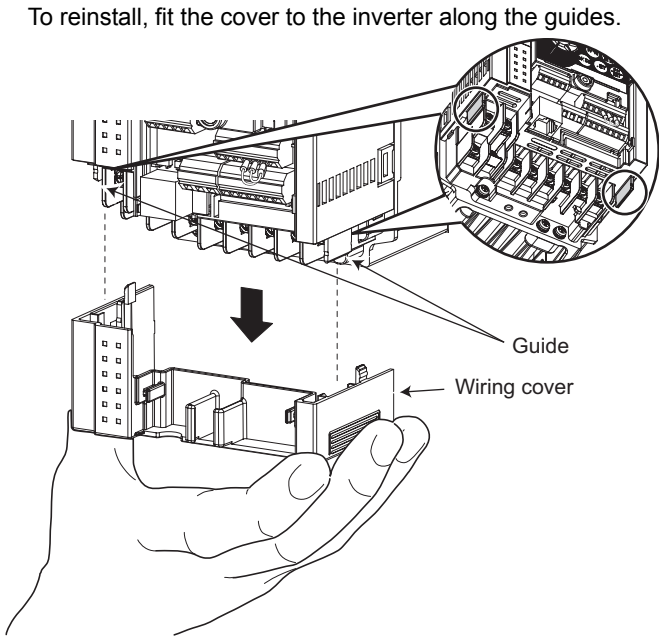
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### *1.3.2 Wiring cover*

**●Removal and reinstallation**

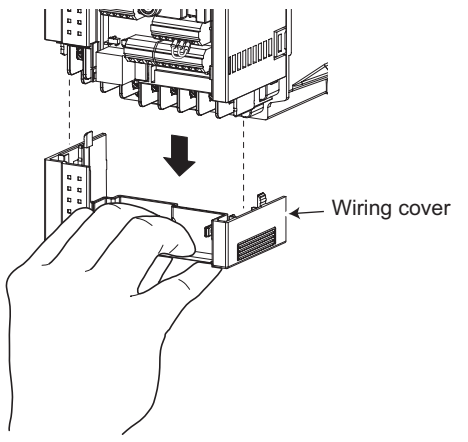
**FR-D720-165 or less and FR-D740-080 or less and FR-D720S-008 to 100**

- Hold the side of the wiring cover, and pull it downward for removal.
  To reinstall, fit the cover to the inverter along the guides.



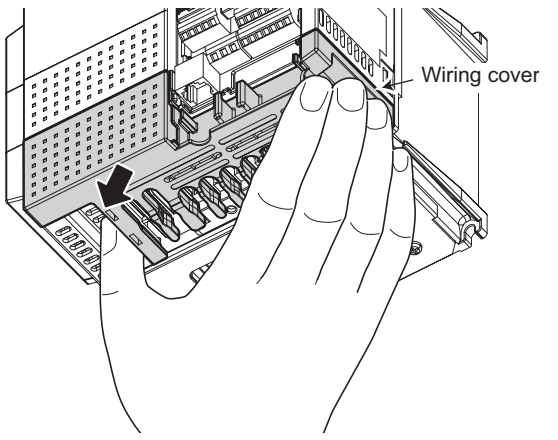

Example of FR-D740-036

- Also pull the wiring cover downward with holding a frontal part of the wiring cover.



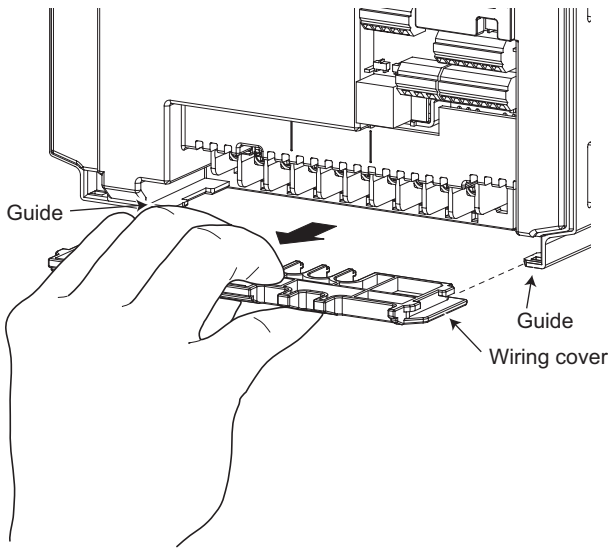

Example of FR-D740-036

- See below diagram for wiring cover of FR-D720-165. Hold the dent of the wiring cover (marked with an arrow) with thumb and the side with other fingers and pull downward for removal.




**FR-D720-238, 318 and FR-D740-120, 160**

- The cover can be removed easily by pulling it toward you.
  To reinstall, fit the cover to the inverter along the guides.




Example of FR-D740-160





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# 1.4 Installation of the inverter and enclosure design

When an inverter panel is to be designed and manufactured, heat generated by contained equipment, etc., the environment of an operating place, and others must be fully considered to determine the panel structure, size and equipment layout. The inverter unit uses many semiconductor devices. To ensure higher reliability and long period of operation, operate the inverter in the ambient environment that completely satisfies the equipment specifications.

## *1.4.1 Inverter installation environment*

As the inverter installation environment should satisfy the standard specifications indicated in the following table, operation in any place that does not meet these conditions not only deteriorates the performance and life of the inverter, but also causes a failure. Refer to the following points and take adequate measures.

**Environmental standard specifications of inverter**

| Item | Description |
|---|---|
| Surrounding air temperature | -10 to +50°C (14°F to 122°F)(non-freezing) |
| Ambient humidity | 90%RH maximum (non-condensing) |
| Atmosphere | Free from corrosive and explosive gases, free from dust and dirt |
| Maximum altitude | 1,000m (3280.80 feet) or less |
| Vibration | 5.9m/s$^2$ or less |

### (1) Temperature

The permissible surrounding air temperature of the inverter is between -10 and +50°C (14°F to 122°F). Always operate the inverter within this temperature range. Operation outside this range will considerably shorten the service lives of the semiconductors, parts, capacitors and others. Take the following measures so that the surrounding air temperature of the inverter falls within the specified range.

1) Measures against high temperature
   - Use a forced ventilation system or similar cooling system. *(Refer to page 10)*
   - Install the panel in an air-conditioned electrical chamber.
   - Block direct sunlight.
   - Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
   - Ventilate the area around the panel well.

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

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

### (2) Humidity

Normally operate the inverter within the 45 to 90% range of the ambient humidity. Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may produce a spatial electrical breakdown. The insulation distance specified in JEM1103 "Control Equipment Insulator" is defined as humidity 45 to 85%.

1) Measures against high humidity
   - Make the panel enclosed, and provide it with a hygroscopic agent.
   - Take dry air into the enclosure from outside.
   - Provide a space heater in the enclosure.

2) Measures against low humidity
   What is important in fitting or inspection of the unit in this status is to discharge your body (static electricity) beforehand and keep your body from contact with the parts and patterns, besides blowing air of proper humidity into the enclosure from outside.

3) Measures against condensation
   Condensation may occur if frequent operation stops change the in-enclosure temperature suddenly or if the outside-air temperature changes suddenly.
   Condensation causes such faults as reduced insulation and corrosion.
   - Take the measures against high humidity in 1).
   - Do not power off the inverter. (Keep the start signal of the inverter off.)



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### (3) Dust, dirt, oil mist

Dust and dirt will cause such faults as poor contact of contact points, reduced insulation or reduced cooling effect due to moisture absorption of accumulated dust and dirt, and in-enclosure temperature rise due to clogged filter. In the atmosphere where conductive powder floats, dust and dirt will cause such faults as malfunction, deteriorated insulation and short circuit in a short time.
Since oil mist will cause similar conditions, it is necessary to take adequate measures.

Countermeasures

- Place in a totally enclosed enclosure.
  Take measures if the in-enclosure temperature rises. *(Refer to page 10)*
- Purge air.
  Pump clean air from outside to make the in-enclosure pressure higher than the outside-air pressure.

### (4) Corrosive gas, salt damage

If the inverter is exposed to corrosive gas or to salt near a beach, the printed board patterns and parts will corrode or the relays and switches will result in poor contact.
In such places, take the measures given in Section 3.

### (5) Explosive, flammable gases

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

### (6) Highland

Use the inverter at the altitude of within 1000m (3280.80 feet). If it is used at a higher place, it is likely that thin air will reduce the cooling effect and low air pressure will deteriorate dielectric strength.
Maximum 1000m (3280.80feet) above sea level for standard operation. After that derate by 3% for every extra 500m (1640.40feet) up to 2500m (8202feet) (91%).

### (7) Vibration, impact

The vibration resistance of the inverter is up to 5.9m/s$^2$ at 10 to 55Hz frequency and 1mm amplitude. Vibration or impact, if less than the specified value, applied for a long time may make the mechanism loose or cause poor contact to the connectors. Especially when impact is imposed repeatedly, caution must be taken as the part pins are likely to break.

Countermeasures

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



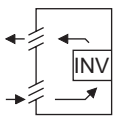
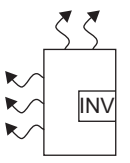
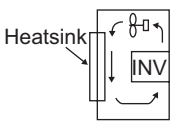
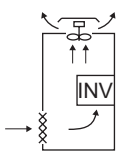
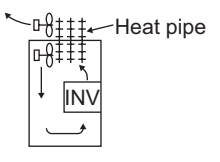


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### 1.4.2 Cooling system types for inverter enclosure

From the enclosure that contains the inverter, the heat of the inverter and other equipment (transformers, lamps, resistors, etc.) and the incoming heat such as direct sunlight must be dissipated to keep the in-enclosure temperature lower than the permissible temperatures of the in-panel equipment including the inverter.
The cooling systems are classified as follows in terms of the cooling calculation method.

1) Cooling by natural heat dissipation from the enclosure surface (totally enclosed type)
2) Cooling by heat sink (aluminum fin, etc.)
3) Cooling by ventilation (forced ventilation type, pipe ventilation type)
4) Cooling by heat exchanger or cooler (heat pipe, cooler, etc.)

| Cooling System | | Enclosure Structure | Comment |
|---|---|---|---|
| Natural cooling | Natural ventilation (enclosed, open type) |  | Low in cost and generally used, but the enclosure size increases as the inverter capacity increases. For relatively small capacities. |
| | Natural ventilation (totally enclosed type) |  | Being a totally enclosed type, the most appropriate for hostile environment having dust, dirt, oil mist, etc. The enclosure size increases depending on the inverter capacity. |
| Forced cooling | Heatsink cooling |  | Having restrictions on the heatsink mounting position and area, and designed for relative small capacities. |
| | Forced ventilation |  | For general indoor installation. Appropriate for enclosure downsizing and cost reduction, and often used. |
| | Heat pipe |  | Totally enclosed type for enclosure downsizing. |



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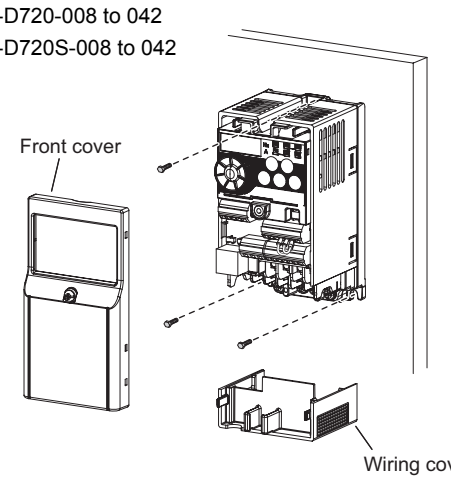
### 1.4.3 Inverter placement

**(1) Installation of the inverter**

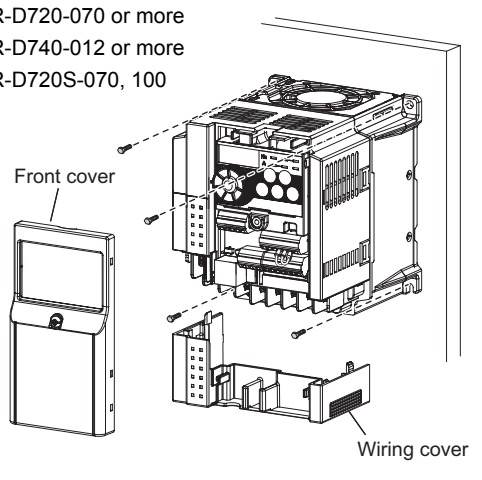
**Enclosure surface mounting**

Remove the front cover and wiring cover to fix the inverter to the surface.

●FR-D720-008 to 042
●FR-D720S-008 to 042

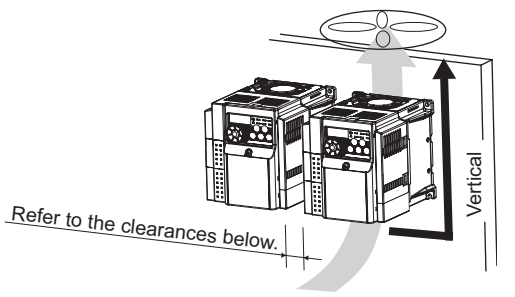



●FR-D720-070 or more
●FR-D740-012 or more
●FR-D720S-070, 100




**NOTE**

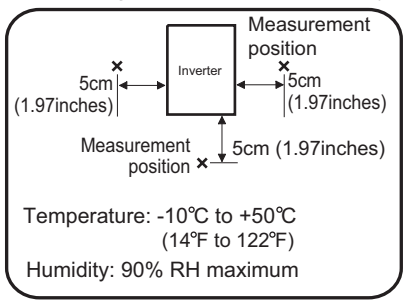
- **When encasing multiple inverters, install them in parallel as a cooling measure.**
- **Install the inverter vertically.**




**(2) Clearances around inverter**

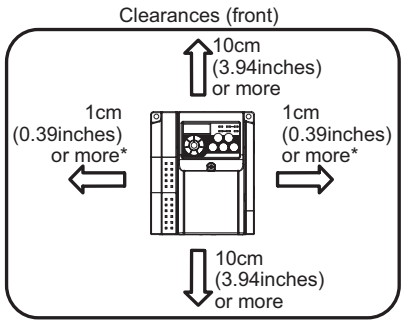
To ensure ease of heat dissipation and maintenance, leave at least the shown clearances around the inverter. At least the following clearances are required under the inverter as a wiring space, and above the inverter as a heat dissipation space.

Surrounding air temperature and humidity



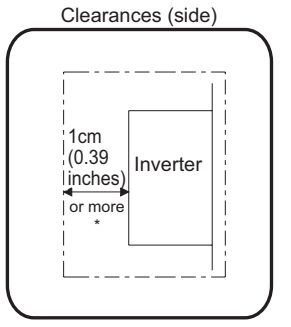

Leave enough clearances and take cooling measures.

Clearances (front)




* When using the inverters at the surrounding air temperature of 40℃ (104℉) or less, the inverters can be installed without any clearance between them (0cm (0inch) clearance).
When surrounding air temperature exceeds 40℃ (104℉), clearances between the inverters should be 1cm (0.39inches) or more (5cm (1.97inches) or more for the FR-D720-238 or more and FR-D740-120 or more).

Clearances (side)




* 5cm (1.97inches) or more for the FR-D720-238 or more and FR-D740-120 or more

**(3) Inverter mounting orientation**

Mount the inverter on a wall as specified. Do not mount it horizontally or any other way.

**(4) Above inverter**

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



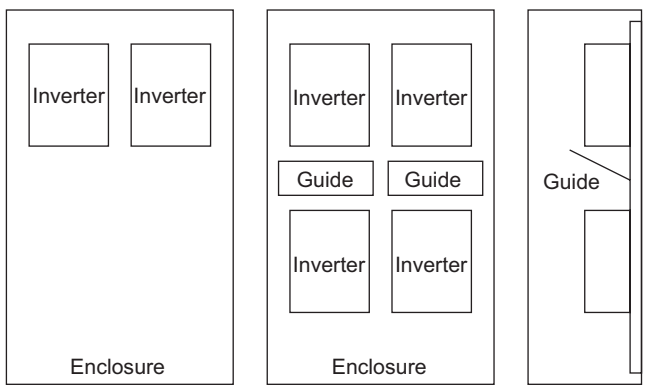


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### (5) Arrangement of multiple inverters

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

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

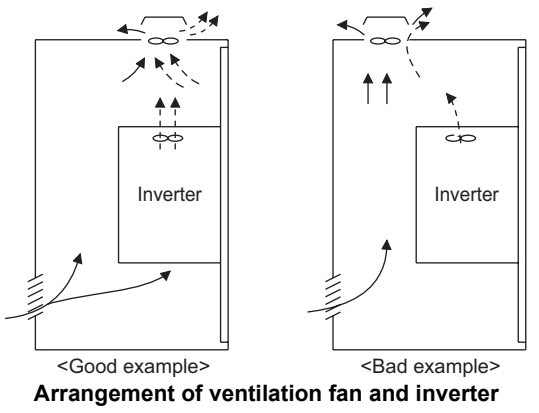



(a) Horizontal arrangement (b) Vertical arrangement

**Arrangement of multiple inverters**

### (6) Arrangement of ventilation fan and inverter

Heat generated in the inverter is blown up from the bottom of the unit as warm air by the cooling fan. When installing a ventilation fan for that heat, determine the place of ventilation fan installation after fully considering an air flow. (Air passes through areas of low resistance. Make an airway and airflow plates to expose the inverter to cool air.)




**Arrangement of ventilation fan and inverter**



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# 2 WIRING

**This chapter describes the basic "WIRING" for use of this product.**
**Always read the instructions before using the equipment**


2.1 Wiring ..... 14
2.2 Main circuit terminal specifications ..... 15
2.3 Control circuit specifications ..... 20
2.4 Connection of stand-alone option unit ..... 31

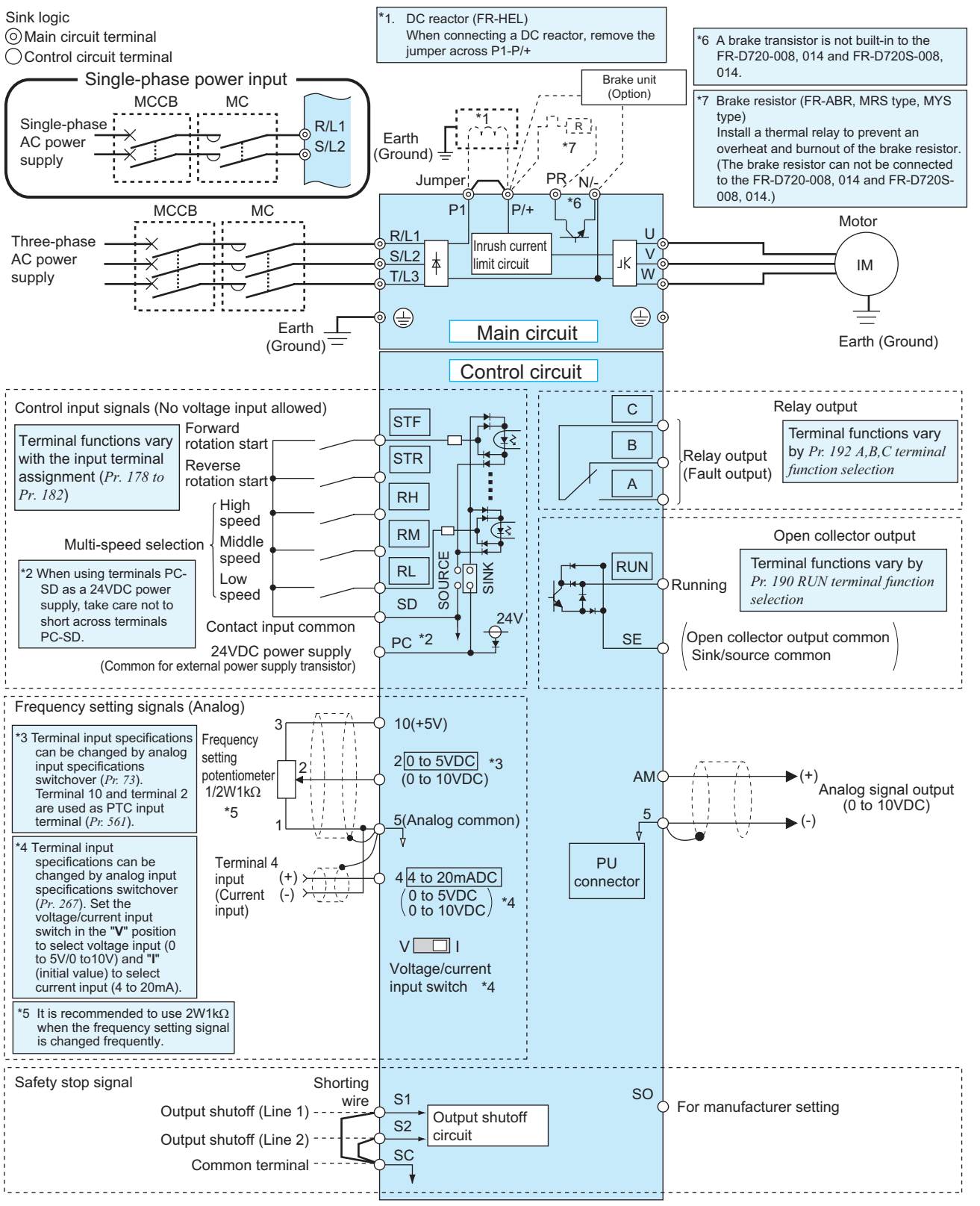





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# 2.1 Wiring

## 2.1.1 Terminal connection diagram




**NOTE**

- **To prevent a malfunction caused by noise, separate the signal cables more than 10cm (3.94inches) 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.**
- **The output of the single-phase power input specification is three-phase 200V.**



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# 2.2 Main circuit terminal specifications

## 2.2.1 Specification of main circuit terminal

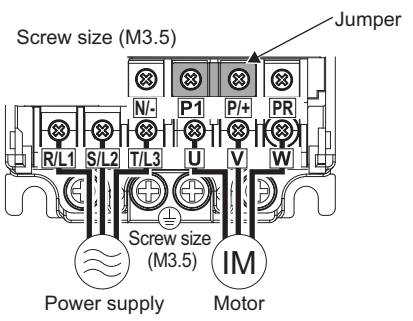
| Terminal Symbol | Terminal Name | Description |
|---|---|---|
| R/L1,<br>S/L2,<br>T/L3 * | AC power input | Connect to the commercial power supply.<br>Keep these terminals open when using the high power factor converter (FR-HC) or power regeneration common converter (FR-CV). |
| U, V, W | Inverter output | Connect a three-phase squirrel-cage motor. |
| P/+, PR | Brake resistor connection | Connect a brake resistor (FR-ABR, MRS type, MYS type) across terminals P/+ and PR. (The brake resistor can not be connected to the FR-D720-008 and 014 and FR-D720S-008 and 014.) |
| P/+, N/- | Brake unit connection | Connect the brake unit (FR-BU2), power regeneration common converter (FR-CV) or high power factor converter (FR-HC). |
| P/+, P1 | DC reactor connection | Remove the jumper across terminals P/+ and P1 and connect a DC reactor. |
| ⏚ | Earth (Ground) | For earthing (grounding) the inverter chassis. Must be earthed (grounded). |

* When using single-phase power input, terminals are R/L1 and S/L2.

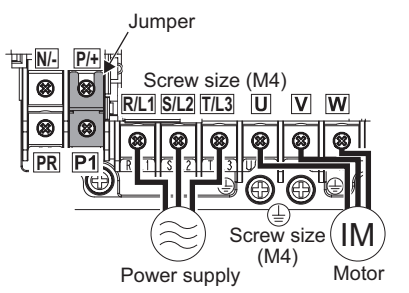
## 2.2.2 Terminal arrangement of the main circuit terminal, power supply and the motor wiring

**●Three-phase 200V class**

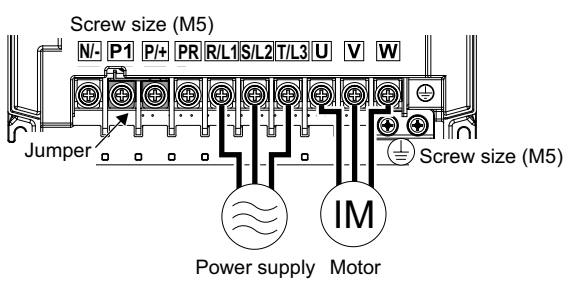
FR-D720-008 to 042



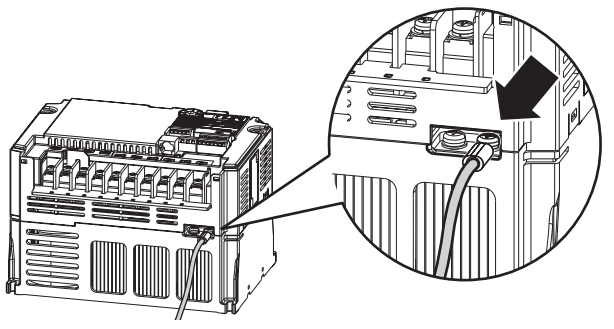

FR-D720-070 to 165




FR-D720-238, 318




* For wiring to earth (ground) terminals of FR-D720-238 and 318, use the earthing cable wiring space (marked with an arrow) to route the wires.



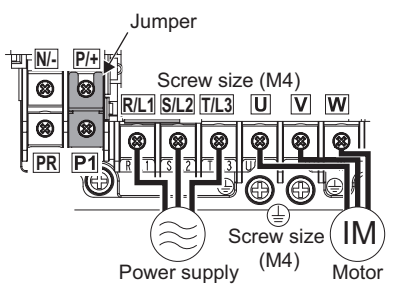
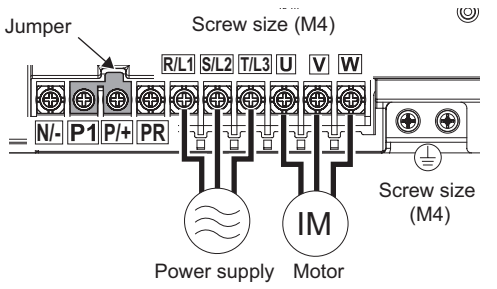




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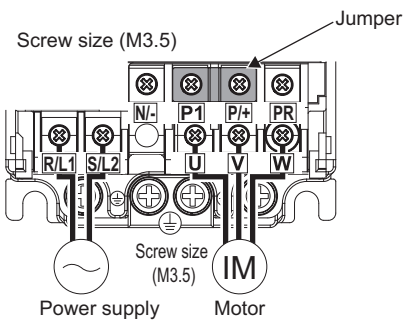
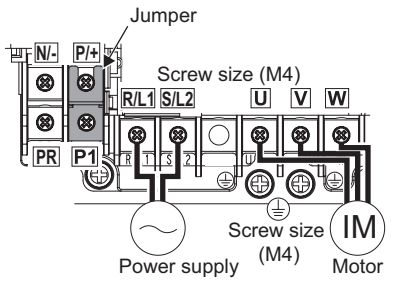
## Main circuit terminal specifications

**●Three-phase 400V class**

| FR-D740-012 to 080 | FR-D740-120, 160 |
|---|---|
|  |  |



**●Single-phase 200V class**

| FR-D720S-008 to 042 | FR-D720S-070, 100 |
|---|---|
|  |  |



**NOTE**

- **Make sure the power cables are connected to the R/L1, S/L2, T/L3. (Phase need not be matched.) Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter.**
- **Connect the motor to U, V, W. Turning on the forward rotation switch (signal) at this time rotates the motor counterclockwise when viewed from the load shaft.**



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### 2.2.3 Cables and wiring length

#### (1) Applied wire size

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 (65.61feet).

**Three-phase 200V class (when input power supply is 220V)**

| Applicable Inverter Model | Terminal Screw Size *4 | Tightening Torque N·m | Crimping Terminal | | Cable Size | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | HIV Cables, etc. (mm²) *1 | | | AWG *2 | | PVC Cables, etc. (mm²) *3 | | |
| | | | R/L1 S/L2 T/L3 | U, V, W | R/L1 S/L2 T/L3 | U, V, W | Earth (ground) cable | R/L1 S/L2 T/L3 | U, V, W | R/L1 S/L2 T/L3 | U, V, W | Earth (ground) cable |
| FR-D720-008 to 042 | M3.5 | 1.2 | 2-3.5 | 2-3.5 | 2 | 2 | 2 | 14 | 14 | 2.5 | 2.5 | 2.5 |
| FR-D720-070, 100 | M4 | 1.5 | 2-4 | 2-4 | 2 | 2 | 2 | 14 | 14 | 2.5 | 2.5 | 2.5 |
| FR-D720-165 | M4 | 1.5 | 5.5-4 | 5.5-4 | 3.5 | 3.5 | 3.5 | 12 | 12 | 4 | 4 | 4 |
| FR-D720-238 | M5 | 2.5 | 5.5-5 | 5.5-5 | 5.5 | 5.5 | 5.5 | 10 | 10 | 6 | 6 | 6 |
| FR-D720-318 | M5 | 2.5 | 14-5 | 8-5 | 14 | 8 | 5.5 | 6 | 8 | 16 | 10 | 6 |

**Three-phase 400V class (when input power supply is 440V)**

| Applicable Inverter Model | Terminal Screw Size *4 | Tightening Torque N·m | Crimping Terminal | | Cable Size | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | HIV Cables, etc. (mm²) *1 | | | AWG *2 | | PVC Cables, etc. (mm²) *3 | | |
| | | | R/L1 S/L2 T/L3 | U, V, W | R/L1 S/L2 T/L3 | U, V, W | Earth (ground) cable | R/L1 S/L2 T/L3 | U, V, W | R/L1 S/L2 T/L3 | U, V, W | Earth (ground) cable |
| FR-D740-012 to 080 | M4 | 1.5 | 2-4 | 2-4 | 2 | 2 | 2 | 14 | 14 | 2.5 | 2.5 | 2.5 |
| FR-D740-120 | M4 | 1.5 | 5.5-4 | 2-4 | 3.5 | 2 | 3.5 | 12 | 14 | 4 | 2.5 | 4 |
| FR-D740-160 | M4 | 1.5 | 5.5-4 | 5.5-4 | 3.5 | 3.5 | 3.5 | 12 | 12 | 4 | 4 | 4 |

**Single-phase 200V class (when input power supply is 220V)**

| Applicable Inverter Model | Terminal Screw Size *4 | Tightening Torque N·m | Crimping Terminal | | Cable Size | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | HIV Cables, etc. (mm²) *1 | | | AWG *2 | | PVC Cables, etc. (mm²) *3 | | |
| | | | R/L1 S/L2 | U, V, W | R/L1 S/L2 | U, V, W | Earth (ground) cable | R/L1 S/L2 | U, V, W | R/L1 S/L2 | U, V, W | Earth (ground) cable |
| FR-D720S-008 to 042 | M3.5 | 1.2 | 2-3.5 | 2-3.5 | 2 | 2 | 2 | 14 | 14 | 2.5 | 2.5 | 2.5 |
| FR-D720S-070 | M4 | 1.5 | 2-4 | 2-4 | 2 | 2 | 2 | 14 | 14 | 2.5 | 2.5 | 2.5 |
| FR-D720S-100 | M4 | 1.5 | 5.5-4 | 2-4 | 3.5 | 2 | 3.5 | 12 | 14 | 4 | 2.5 | 4 |

*1 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 (167°F). Assumes that the surrounding air temperature is 50°C (122°F) or less and the wiring distance is 20m (65.61feet) or less.

*2 The recommended cable size is that of the cable (THHW cable) with continuous maximum permissible temperature of 75°C (167°F). Assumes that the surrounding air temperature is 40°C (104°F) or less and the wiring distance is 20m (65.61feet) or less.
(Selection example for use mainly in the United States.)

*3 The recommended cable size is that of the cable (THHW cable) with continuous maximum permissible temperature of 70°C (158°F). Assumes that the surrounding air temperature is 40°C (104°F) or less and the wiring distance is 20m (65.61feet) or less.
(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, P/+, N/-, P1 and a screw for earthing (grounding).
For single-phase power input, the terminal screw size indicates the size of terminal screw for R/L1, S/L2, U, V, W, PR, P/+, N/-, P1 and a screw for earthing (grounding).

**NOTE**

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

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.





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### (2) Earthing (Grounding) precautions

- Always earth (ground) the motor and inverter.

1) Purpose of earthing (grounding)

Generally, an electrical apparatus has an earth (ground) terminal, which must be connected to the ground before use. An electrical circuit is usually insulated by an insulating material and encased. However, it is impossible to manufacture an insulating material that can shut off a leakage current completely, and actually, a slight current flow into the case. The purpose of earthing (grounding) the case of an electrical apparatus is to prevent operator from getting an electric shock from this leakage current when touching it.

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

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

As described previously, earthing (grounding) is roughly classified into an electrical shock prevention type and a noise-affected malfunction prevention type. Therefore, these two types should be discriminated clearly, and the following work must be done to prevent the leakage current having the inverter's high frequency components from entering the malfunction prevention type earthing (grounding):

(a)Where possible, use independent earthing (grounding) for the inverter. If independent earthing (grounding) (I) is impossible, use joint earthing (grounding) (II) where the inverter is connected with the other equipment at an earthing (grounding) point. Joint earthing (grounding) as in (III) must be avoided as the inverter is connected with the other equipment by a common earth (ground) cable.

Also a leakage current including many high frequency components flows in the earth (ground) cables of the inverter and inverter-driven motor. Therefore, they must use the independent earthing (grounding) method and be separated from the earthing (grounding) of equipment sensitive to the aforementioned noises.

In a tall building, it will be a good policy to use the noise malfunction prevention type earthing (grounding) with steel frames and carry out electric shock prevention type earthing (grounding) in the independent earthing (grounding) method.

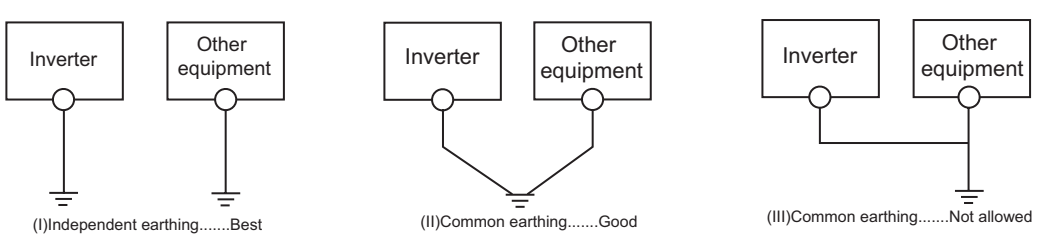
(b)This inverter must be earthed (grounded). Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards).

Use an neutral-point earthed (grounded) power supply for 400V class inverter in compliance with EN standard.

(c)Use the thickest possible earth (ground) cable. The earth (ground) cable should be of not less than the size indicated in the table on the previous *page 17*.

(d)The earthing (grounding) point should be as near as possible to the inverter, and the earth (ground) cable length should be as short as possible.

(e)Run the earth (ground) cable as far away as possible from the I/O wiring of equipment sensitive to noises and run them in parallel in the minimum distance.




**POINT**

To be compliant with the European Directive (Low Voltage Directive), *refer to the Installation Guideline*.



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### (3) Total wiring length

The overall wiring length for connection of a single motor or multiple motors should be within the value in the table below.

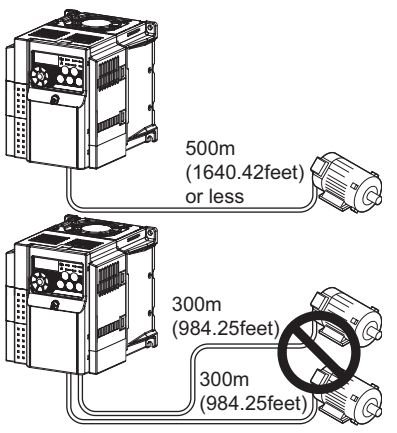
200V class

| *Pr. 72 PWM frequency selection* Setting (carrier frequency) | 008 | 014 | 025 | 042 | 070 or More |
|---|---|---|---|---|---|
| 1 (1kHz) or less | 200m (656.19feet) | 200m (656.19feet) | 300m (984.25feet) | 500m (1640.42feet) | 500m (1640.42feet) |
| 2 to15 (2kHz to 14.5kHz) | 30m (98.42feet) | 100m (328.08feet) | 200m (656.19feet) | 300m (984.25feet) | 500m (1640.42feet) |

400V class

| *Pr. 72 PWM frequency selection* Setting (carrier frequency) | 012 | 022 | 036 | 050 | 080 or More |
|---|---|---|---|---|---|
| 1 (1kHz) or less | 200m (656.19feet) | 200m (656.19feet) | 300m (984.25feet) | 500m (1640.42feet) | 500m (1640.42feet) |
| 2 to15 (2kHz to 14.5kHz) | 30m (98.42feet) | 100m (328.08feet) | 200m (656.19feet) | 300m (984.25feet) | 500m (1640.42feet) |

Total wiring length (FR-D720-070 or more, FR-D720S-070 or more, FR-D740-080 or more)




300m(984.25feet) + 300m(984.25feet)
= 600m(1968.50feet)

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.*(Refer to page 83)*

**NOTE**

- **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, fast response current limit function, or stall prevention function or a malfunction or fault of the equipment connected on the inverter output side. If malfunction of fast-response current limit function occurs, disable this function. If malfunction of stall prevention function occurs, increase the stall level.** ***(Refer to page 79 for Pr. 22 Stall prevention operation level*** **and** ***Pr. 156 Stall prevention operation selection )***
- **Refer to** ***page 148*** **for details of** ***Pr. 72 PWM frequency selection*****. Refer to the manual of the option for details of surge voltage suppression filter (FR-ASF-H/FR-BMF-H).**
- **When using the automatic restart after instantaneous power failure function with wiring length exceeding below, select without frequency search (***Pr. 162*** = "1, 11").** ***(Refer to page 136)***

| Motor capacity (kW(HP)) | 0.1K(1/8) | 0.2K(1/4) | 0.4K(1/2) or more |
|---|---|---|---|
| Wiring length | 20m (65.61feet) | 50m (164.04feet) | 100m (323.08feet) |





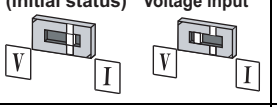
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# 2.3 Control circuit specifications

## 2.3.1 Control circuit terminal

indicates that terminal functions can be selected using *Pr. 178 to Pr. 182, Pr. 190, Pr. 192 (I/O terminal function selection)*. *(Refer to page 113)*.

### (1) Input signal

| 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<br>Voltage when contacts are open<br>21 to 26VDC<br>When contacts are short-circuited<br>4 to 6mADC | *117* |
| | STR | Reverse rotation start | Turn on the STR signal to start reverse rotation and turn it off to stop. | | | |
| | RH, RM, RL | Multi-speed selection | Multi-speed can be selected according to the combination of RH, RM and RL signals. | | | *89* |
| | SD | Contact input common (sink) (initial setting) | Common terminal for contact input terminal (sink logic). | | — | — |
| | | External transistor common (source) | When connecting the transistor output (open collector output), such as a programmable controller, when source logic is selected, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by undesirable currents. | | | |
| | | 24VDC power supply common | Common output terminal for 24VDC 0.1A power supply (PC terminal).<br>Isolated from terminals 5 and SE. | | | |
| | PC | External transistor common (sink) (initial setting) | When connecting the transistor output (open collector output), such as a programmable controller, when sink logic is selected, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by undesirable currents. | | Power supply voltage range<br>22 to 26.5VDC<br>permissible load current<br>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 | 10 | Frequency setting power supply | Used as power supply when connecting potentiometer for frequency setting (speed setting) from outside of the inverter. *(Refer to Pr. 73 Analog input selection.)* | | 5.0V ± 0.2VDC<br>permissible load current<br>10mA | *150* |
| | 2 | Frequency setting (voltage) | Inputting 0 to 5VDC (or 0 to 10V) provides the maximum output frequency at 5V (10V) and makes input and output proportional. Use *Pr. 73* to switch between input 0 to 5VDC input (initial setting) and 0 to 10VDC. | | Input resistance10kΩ ± 1kΩ<br>Permissible maximum voltage 20VDC | *150* |
| | 4 | Frequency setting (current) | Inputting 4 to 20mADC (or 0 to 5V, 0 to 10V) provides the maximum output frequency at 20mA and 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 "V" position to select voltage input (0 to 5V/0 to 10V). | | Current input:<br>Input resistance 233Ω ± 5Ω<br>Maximum permissible current 30mA<br>Voltage input:<br>Input resistance10kΩ ± 1kΩ<br>Permissible maximum voltage 20VDC<br>**Current input (initial status)** **Voltage input**<br> | *150* |
| | 5 | Frequency setting common | Common terminal for frequency setting signal (terminal 2 or 4) and analog output terminal AM. Do not earth (ground). | | — | — |
| PTC thermistor | 10<br>2 | PTC thermistor input | For connecting PTC thermistor output.<br>When PTC thermistor protection is valid (*Pr. 561* ≠ "9999"), terminal 2 is not available for frequency setting. | | Adaptive PTC thermistor specification<br>Heat detection resistance : 500Ω to 30kΩ (Set by *Pr. 561*) | *100* |



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**NOTE**

**Set *Pr. 267* and a voltage/current input switch correctly, then input analog signals in accordance with the settings. Applying a voltage with voltage/current input switch in "I" position (current input is selected) or a current with switch in "V" position (voltage input is selected) could cause component damage of the inverter or analog circuit of output devices.** ***(Refer to page 150 for details.)***

### (2) Output signal

| Type | Terminal Symbol | Terminal Name | Description | Rated Specifications | Reference Page |
|---|---|---|---|---|---|
| Relay | A, B, C | Relay output (fault output) | 1 changeover contact output indicates that the inverter protective function has activated and the output stopped. Fault: discontinuity across B-C (continuity across A-C), Normal: continuity across B-C (discontinuity across A-C) | Contact capacity:230VAC 0.3A (power factor =0.4) 30VDC 0.3A | *119* |
| 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. (Low indicates that the open collector output transistor is on (conducts). High indicates that the transistor is off (does not conduct).) | Permissible load 24VDC (maximum 27VDC) 0.1A (a voltage drop is 3.4V maximum when the signal is on) | *119* |
| | SE | Open collector output common | Common terminal of terminal RUN. | — | — |
| Analog | AM | Analog signal output | 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. / Output item: Output frequency (initial setting) | Output signal 0 to 10VDC Permissible load current 1mA (load impedance 10kΩ or more) Resolution 8 bit | *128* |

### (3) Communication

| Type | Terminal Symbol | Terminal Name | Description | Reference Page |
|---|---|---|---|---|
| RS-485 | — | PU connector | With the PU connector, communication can be made through RS-485.<br>• Conforming standard: EIA-485 (RS-485)<br>• Transmission format: Multidrop link<br>• Communication speed: 4800 to 38400bps<br>• Overall length: 500m (1640.42feet) | *180* |

### (4) Safety stop signal

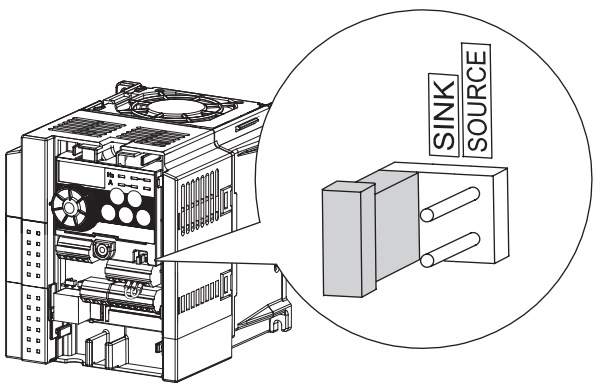
| Terminal Symbol | Terminal Name | Description | Reference Page |
|---|---|---|---|
| S1 | Inverter output shutoff (Line 1) | Inverter output is shutoff depending on shorting/opening between S1 and SC, S2 and SC. At initial state, terminal S1 and S2 are shorted to terminal SC with a shorting wire. When using the safety stop function, remove this shorting wire, and connect to a safety relay module. | — |
| S2 | Inverter output shutoff (Line 2) | | |
| SO | For manufacturer setting | | |
| SC | Output shutoff terminal common | Common terminal for terminals S1, S2. Connected to terminal SD inside of the inverter. | |





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### 2.3.2 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 above the control terminal must be moved to the other position.

- Change the jumper connector in the sink logic (SINK) position to source logic (SOURCE) position using tweezers, a pair of long-nose pliers etc. Change the jumper connector position before switching power on.

**NOTE**

- **Fully make sure that the front cover has been reinstalled securely.**
- **The capacity plate is placed on the front cover and the rating plate is on the inverter. Since these plates have the same serial numbers, always reinstall the removed cover onto the original inverter.**
- **The sink-source logic change-over jumper connector must be fitted in only one of those positions. If it is fitted in both positions at the same time, the inverter may be damaged.**

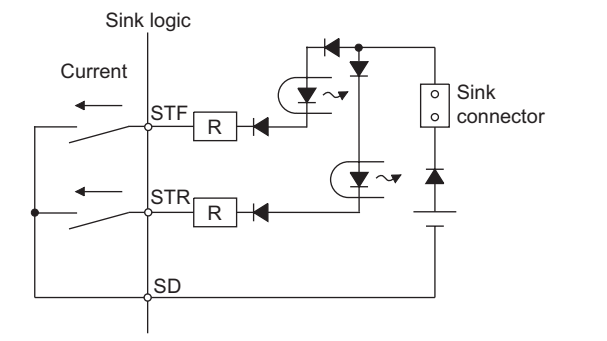


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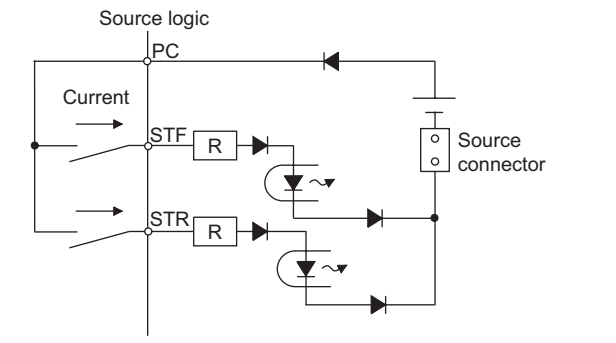
(1) Sink logic type and source logic type

- 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

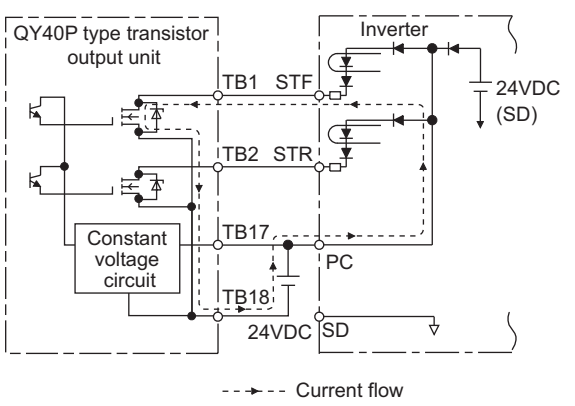



●Current flow concerning the input/output signal when source logic is selected

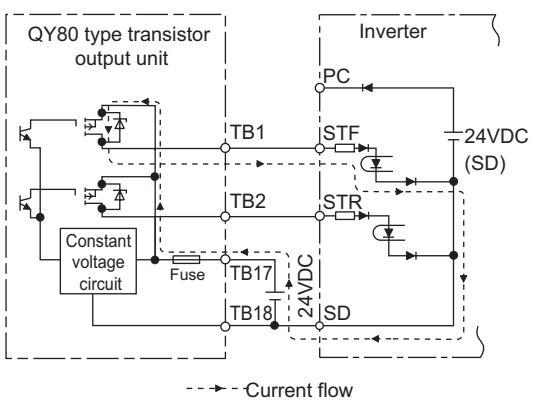



●When using an external power supply for transistor output

- Sink logic type
  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
  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.)





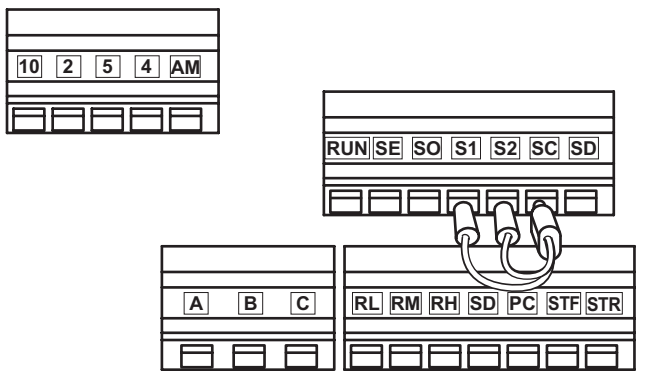



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### 2.3.3 Wiring of control circuit

**(1) Standard control circuit terminal layout**

Recommend wire size:
0.3mm$^2$ to 0.75mm$^2$

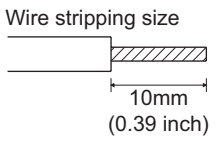



**(2) Wiring method**

●Wiring

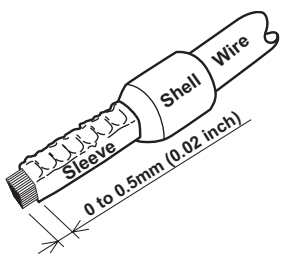
Use a bar terminal and a wire with a sheath stripped off for the control circuit wiring. For a single wire, strip off the sheath of the wire and apply directly.
Insert the bar terminal or the single wire into a socket of the terminal.

1) Strip off the sheath about the size below. If the length of the sheath peeled is too long, a short circuit may occur among neighboring wires. If the length is too short, wires might come off.

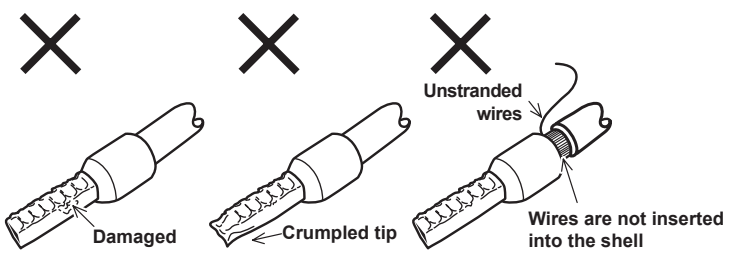



**Wire the stripped wire after twisting it to prevent it from becoming loose. In addition, do not solder it.**

2) Crimp the bar terminal.
Insert wires to a bar terminal, and check that the wires come out for about 0 to 0.5 mm from a sleeve.




Check the condition of the bar terminal after crimping. Do not use a bar terminal of which the crimping is inappropriate, or the face is damaged.




Introduced products on bar terminals :(as of Mar., 2008)

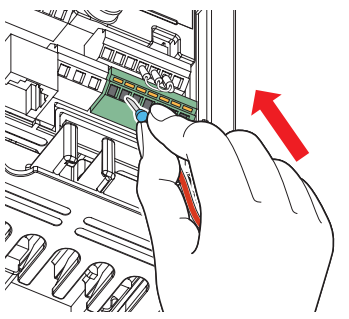
| Wire Size (mm$^2$) | Bar Terminal Model | | Maker |
|---|---|---|---|
| | with insulation sleeve | without insulation sleeve | |
| 0.3, 0.5 | AI 0,5-10WH | — | Phoenix Contact Co.,Ltd. |
| 0.75 | AI 0,75-10GY | A 0,75-10 | |
| 1 | AI 1-10RD | A1-10 | |
| 1.25, 1.5 | AI 1,5-10BK | A1,5-10 | |
| 0.75 (for two wires) | AI-TWIN 2 x 0,75-10GY | — | |

Bar terminal crimping tool: CRIMPFOX ZA3 (Phoenix Contact Co., Ltd.)

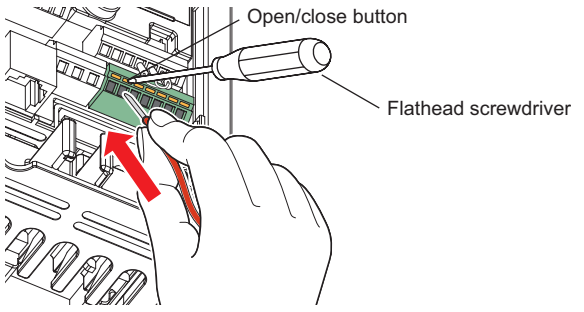


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3) Insert the wire into a socket.



When using a stranded wire without a bar terminal, push an open/close button all the way down with a flathead screw driver, and insert the wire.

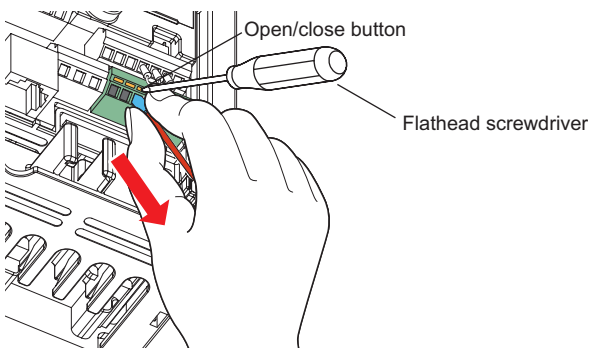



**Note**

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

●Wire removal

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




**Note**

- **Use a small flathead screwdriver (Tip thickness: 0.4mm (0.02 inch)/tip width: 2.5mm (0.10 inch)).**
  **If a flathead screwdriver with a narrow tip is used, terminal block may be damaged.**
- **Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause to damage of inverter or injury.**





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### (3) Control circuit common terminals (SD, 5, SE)

Terminals SD, SE and 5 are common terminals for I/O signals.(All common terminals are isolated from each other.) Do not earth them. 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, RH, RM, RL). The open collector circuit is isolated from the internal control circuit by photocoupler

Terminal 5 is a common terminal for the frequency setting signals (terminals 2 or 4) and analog signal output (AM). It should be protected from external noise using a shielded or twisted cable.

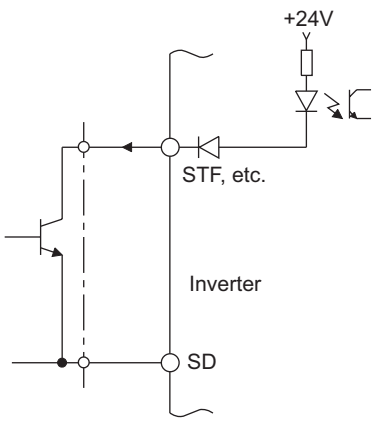
Terminal SE is a common terminal for the open collector output terminal (RUN). The contact input circuit is isolated from the internal control circuit by photocoupler.



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### (4) Signal inputs by contactless switches

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




**External signal input using transistor**

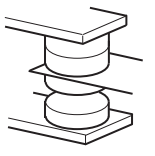




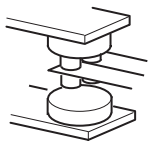
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### 2.3.4 Wiring instructions

1) Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).
2) Use two or more parallel micro-signal contacts or twin contacts to prevent contact faults when using contact inputs since the control circuit input signals are micro-currents.



Micro signal contacts



Twin contacts

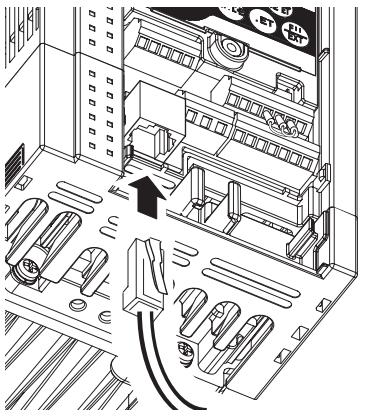
3) Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
4) Always apply a voltage to the fault output terminals (A, B, C) via a relay coil, lamp, etc.
5) It is recommended to use the cables of 0.3mm$^2$ to 0.75mm$^2$ gauge for connection to the control circuit terminals.
   If the cable gauge 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 a fall off of the front cover.
6) The maximum wiring length should be 30m (98.43feet).
7) Do not short terminal PC and SD. Inverter may be damaged.



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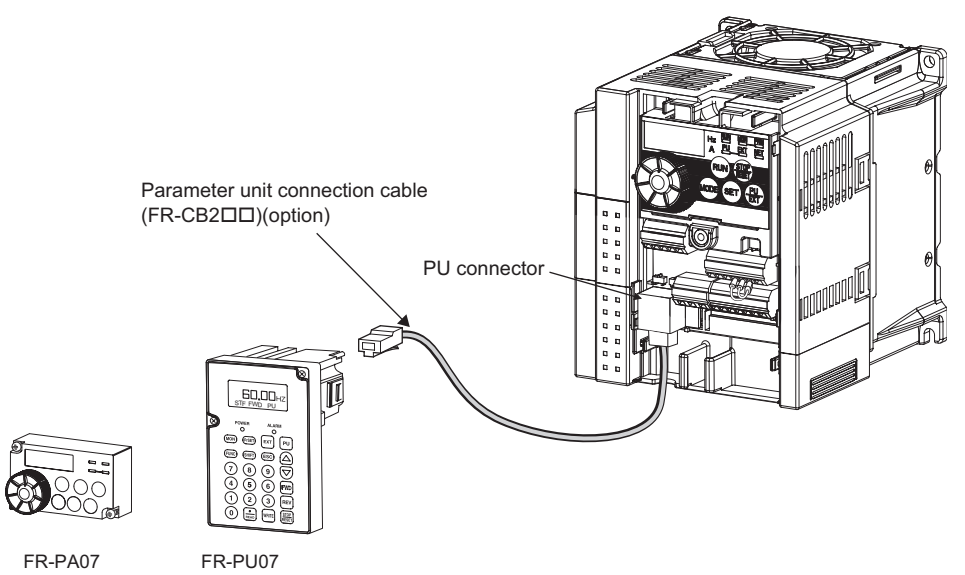
### 2.3.5 Connection to the PU connector

Using the PU connector, you can perform communication operation from the parameter unit (FR-PU07), enclosure surface operation panel (FR-PA07), or a personal computer etc.
Remove the inverter front cover when connecting.



**●When connecting the parameter unit, enclosure surface operation panel using a connection cable**

Use the optional FR-CB2☐☐ or connector and cable available on the market.
Insert the cable plugs securely into the PU connector of the inverter and the connection connector of the FR-PU07, FR-PA07 along the guide until the tabs snap into place.
Install the inverter front cover after connecting.




**REMARKS**

- Overall wiring length when the parameter unit is connected: max 20m (65.6feet)
- Refer to the following when fabricating the cable on the user side.
  Examples of product available on the market (as of February, 2008)

| | Product | Type | Maker |
|---|---|---|---|
| 1) | 10BASE-T cable | SGLPEV-T 0.5mm × 4P | Mitsubishi Cable Industries, Ltd. |





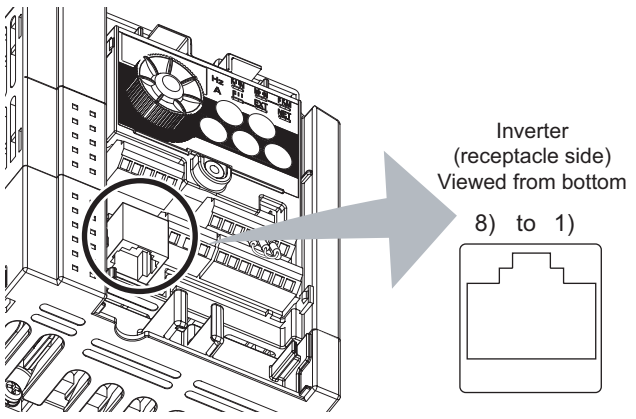
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## Control circuit specifications

### ●RS-485 communication

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.
The protocol can be selected from Mitsubishi inverter and Modbus RTU.

- **PU connector pin-outs**




| Pin Number | Name | Description |
|---|---|---|
| 1) | SG | Earth (ground) (connected to terminal 5) |
| 2) | — | Parameter unit power supply |
| 3) | RDA | Inverter receive+ |
| 4) | SDB | Inverter send- |
| 5) | SDA | Inverter send+ |
| 6) | RDB | Inverter receive- |
| 7) | SG | Earth (ground) (connected to terminal 5) |
| 8) | — | Parameter unit power supply |

**NOTE**

- **Pins No. 2 and 8 provide power to the parameter unit. Do not use these pins for RS-485 communication.**
- **When making RS-485 communication between the FR-D700 series, FR-E500 series and FR-S500 series, incorrect connection of pins No.2 and 8 (parameter unit power supply) of the above PU connector may result in the inverter malfunction or failure.**
- **Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. The product could be damaged due to differences in electrical specifications.**

For further details, *refer to page 180*.

•Conforming standard: EIA-485 (RS-485)
•Transmission form: Multidrop link
•Communication speed: Maximum 38400 bps
•Overall extension: 500m (1640feet)



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## 2.4 Connection of stand-alone option unit

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.

### 2.4.1 Connection of a dedicated external brake resistor (MRS type, MYS type, FR-ABR) (FR-D720-025 or more, FR-D740-012 or more, FR-D720S-025 or more)

Install a dedicated brake resistor (MRS type, MYS type, FR-ABR) outside when the motor driven by the inverter is made to run by the load, quick deceleration is required, etc. Connect a dedicated brake resistor (MRS type, MYS type, FR-ABR) to terminal P/+ and PR. (For the locations of terminal P/+ and PR, refer to the terminal block layout *(page 15)*.)
Set parameters below.

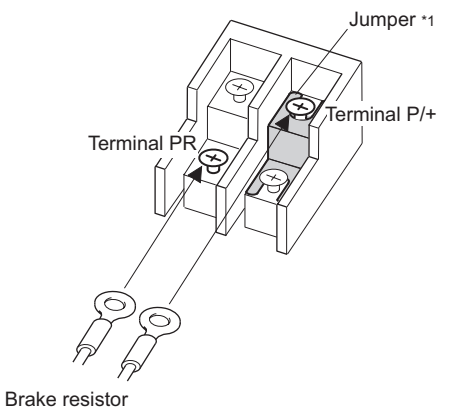
| Connected Brake Resistor | *Pr. 30 Regenerative function selection* Setting | *Pr. 70 Special regenerative brake duty* Setting | |
|---|---|---|---|
| MRS type, MYS type | 0 (initial value) | — | |
| MYS type (used at 100% torque/6%ED) | 1 | 6% | *Refer to page 110* |
| FR-ABR | 1 | 10% | |

**NOTE**

**The brake resistor connected should only be the dedicated brake resistor.**

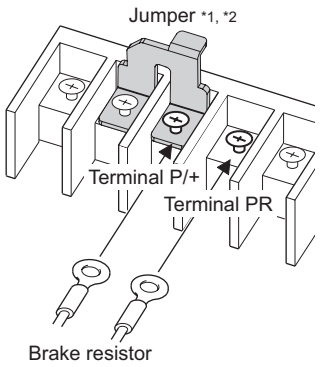
**FR-D720-070 to 165**
**FR-D740-012 to 080**
**FR-D720S-070, 100**

Connect the brake resistor across terminals P/+ and PR.



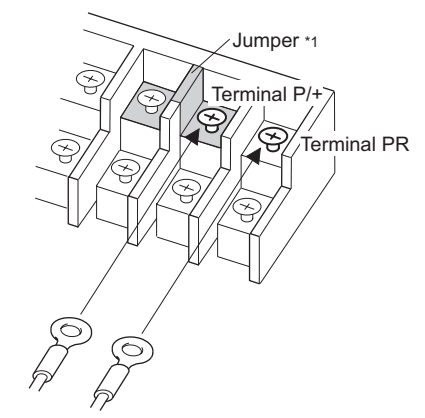

**FR-D720-238, 318**
**FR-D740-120, 160**

Connect the brake resistor across terminals P/+ and PR.




**FR-D720-025, 042**
**FR-D720S-025, 042**

Connect the brake resistor across terminals P/+ and PR.




*1 Do not remove a jumper across terminal P/+ and P1 except when connecting a DC reactor.
*2 The shape of jumper differs according to capacities.



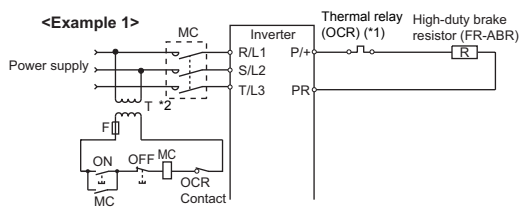


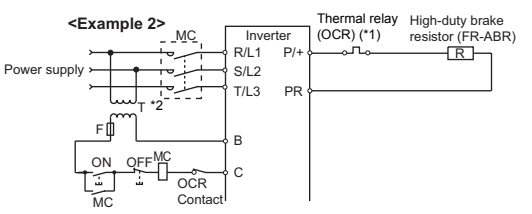
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## Connection of stand-alone option unit

### (1) When using the brake resistor (MRS type, MYS type) and high-duty brake resistor (FR-ABR)

- It is recommended to configure a sequence, which shuts off power in the input side of the inverter by the external thermal relay as shown below, to prevent overheat and burnout of the brake resistor (MRS type, MYS type) and high duty brake resistor (FR-ABR) in case the regenerative brake transistor is damaged. (The brake resistor can not be connected to the FR-D720-008 or 014 and FR-D720S-008 or 014.)

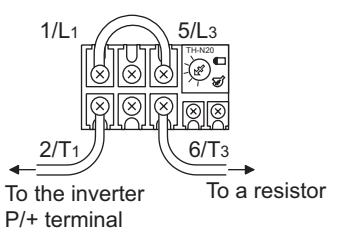



*1 Refer to the table below for the type number of each capacity of thermal relay and the diagram below for the connection.
*2 When the power supply is 400V class, install a step-down transformer.

| Power Supply Voltage | Brake Resistor | Thermal Relay Type (Mitsubishi product) | Contact Rating |
|---|---|---|---|
| 200V | MRS120W200 | TH-N20CXHZ-0.7A | 110VAC 5A, 220VAC 2A(AC11 class) 110VDC 0.5A, 220VDC 0.25A(DC11class) |
| | MRS120W100 | TH-N20CXHZ-1.3A | |
| | MRS120W60 | TH-N20CXHZ-2.1A | |
| | MRS120W40 | TH-N20CXHZ-3.6A | |
| | MYS220W50 (two units in parallel) | TH-N20CXHZ-5A | |

| Power Supply Voltage | High-duty Brake Resistor | Thermal Relay Type (Mitsubishi product) | Contact Rating |
|---|---|---|---|
| 200V | FR-ABR-0.4K | TH-N20CXHZ-0.7A | 110VAC 5A, 220VAC 2A(AC11 class) 110VDC 0.5A, 220VDC 0.25A(DC11 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 | |
| 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 | |




**NOTE**

- **Brake resistor can not be used with the brake unit, high power factor converter, power supply regeneration converter, etc.**
- **Do not use the brake resistor with a lead wire extended.**
- **Do not connect a resistor directly to the DC terminals P/+ and N/-. This could cause a fire.**

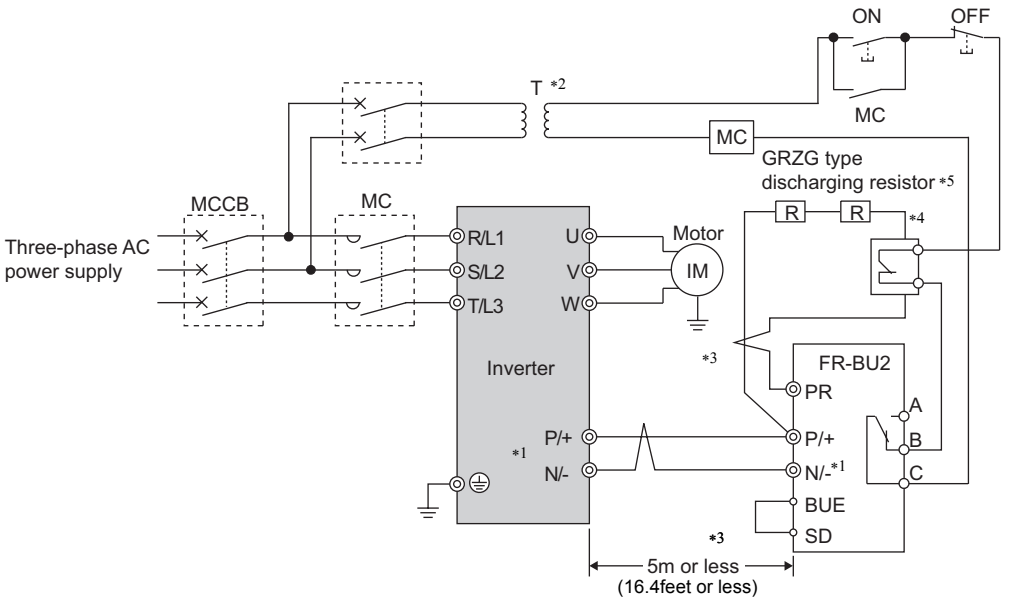


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### 2.4.2 Connection of the brake unit (FR-BU2)

Connect the brake unit (FR-BU2(-H)) as shown below to improve the braking capability at deceleration. If the transistors in the brake unit should become faulty, the resistor can be unusually hot. To prevent unusual overheat and fire, 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.

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




*1 Connect the inverter terminals (P/+ and 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 step-down transformer.
*3 The wiring distance between the inverter, brake unit (FR-BU2) and discharging resistor should be within 5m(16.4feet) each. Even when the wiring is twisted, the cable length must not exceed 10m(32.8feet).
*4 It is recommended to install an external thermal relay to prevent overheat of discharging resistor.
*5 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 1.1A |
| 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 |

**NOTE**

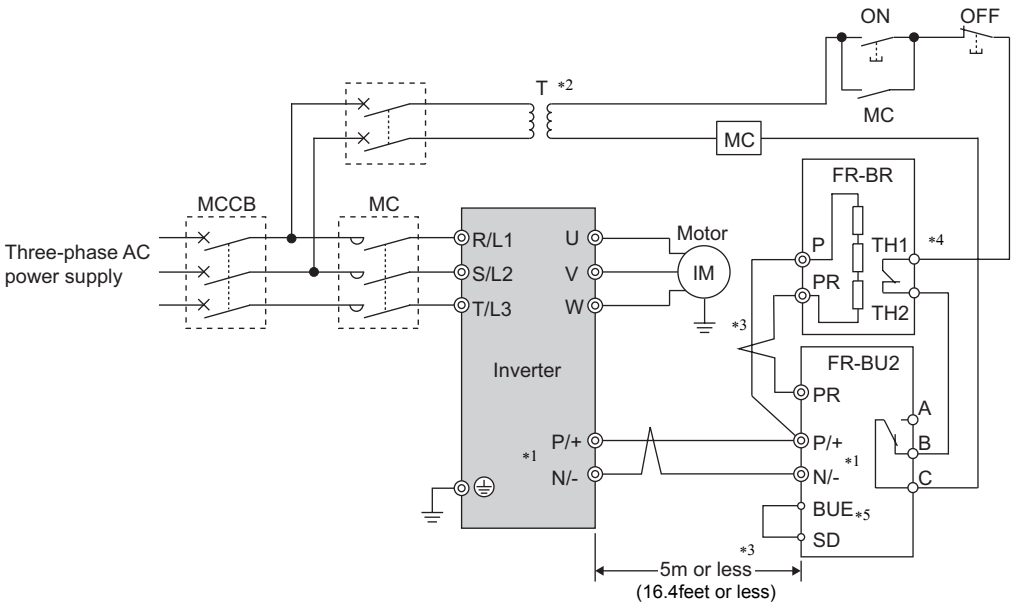
- **Set "1" in *Pr. 0 Brake mode selection* of the FR-BU2 to use GRZG type discharging resistor.**
- **Do not remove a jumper across terminal P/+ and P1 except when connecting a DC reactor.**





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### (2) Connection example with the FR-BR(-H) type resistor



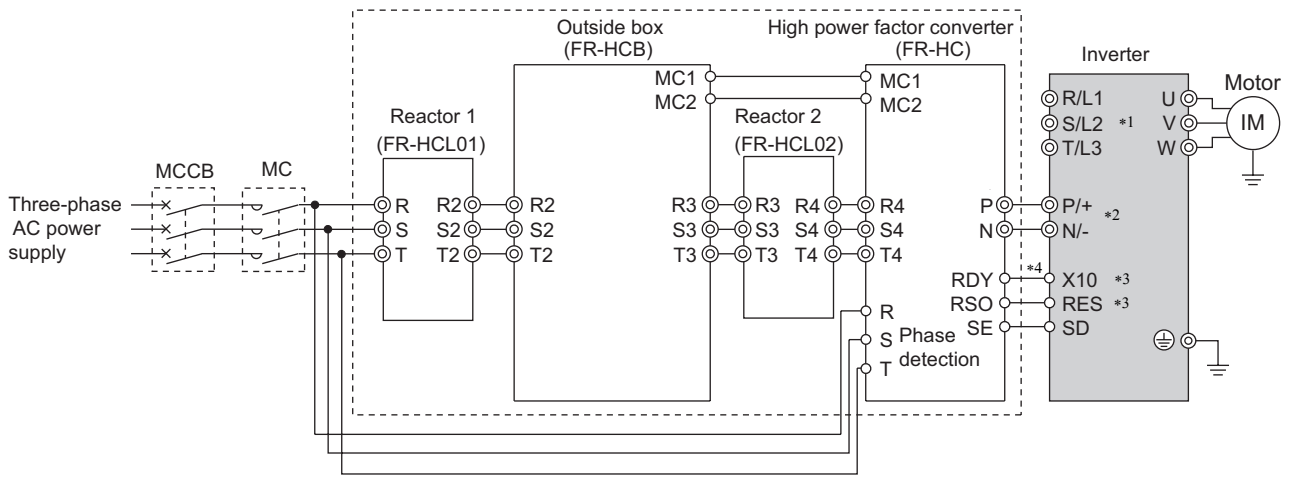

*1 Connect the inverter terminals (P/+ and N/-) and brake unit (FR-BU2) terminals so that their terminal names match with each other.
(Incorrect connection will damage the inverter and brake unit.)
*2 When the power supply is 400V class, install a step-down transformer.
*3 The wiring distance between the inverter, brake unit (FR-BU2) and resistor unit (FR-BR) should be within 5m(16.4feet) each. Even when the wiring is twisted, the cable length must not exceed 10m(32.8feet).
*4 Normal: across TH1-TH2...close, Alarm: across TH1-TH2...open
*5 A jumper is connected across BUE and SD in the initial status.

**NOTE**

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

## 2.4.3 Connection of the high power factor converter (FR-HC)

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




*1 Always keep the power input terminals R/L1, S/L2, T/L3 open. Incorrect connection will damage the inverter.
*2 Do not insert an MCCB between the terminals P/+ and N/- (between P and P/+, between N and N/-). Opposite polarity of terminals N/- and P/+ will damage the inverter.
*3 Use *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the terminals used for the X10, RES signal. *(Refer to page 113)*
*4 Be sure to connect terminal RDY of the FR-HC to the X10 signal or MRS signal assigned terminal of the inverter, and connect terminal SE of the FR-HC to terminal SD of the inverter. Without proper connecting, FR-HC will be damaged.

**NOTE**

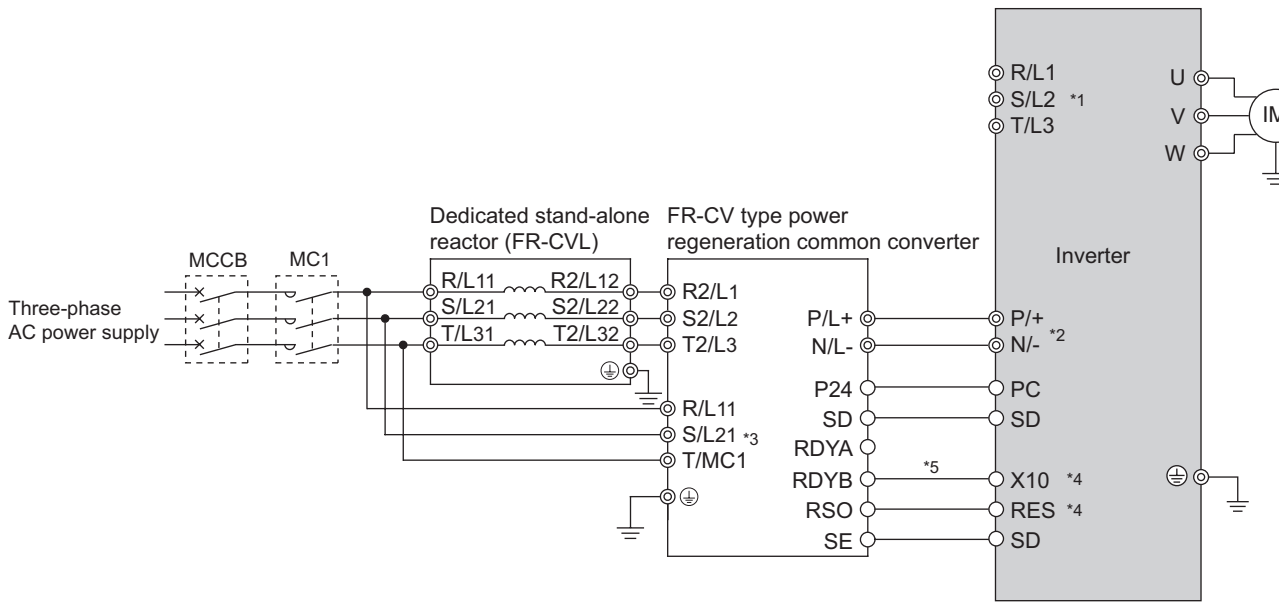
- **The voltage phases of terminals R/L1, S/L2, T/L3 and terminals R4, S4, T4 must be matched.**
- **Use sink logic (factory setting) when the FR-HC is connected. The FR-HC cannot be connected when source logic is selected.**
- **Do not remove a jumper across terminal P/+ and P1.**



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

When connecting the power regeneration common converter (FR-CV), connect the inverter terminals (P/+ and N/-) and power regeneration common converter (FR-CV) terminals as shown below so that their symbols match with each other.



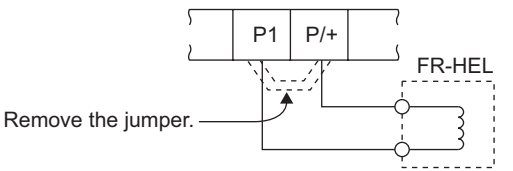

*1 Always keep the power input terminals R/L1, S/L2, T/L3 open. Incorrect connection will damage the inverter.
*2 Do not insert an MCCB between the terminals P/+ and N/- (between P/L+ and P/+, between N/L- and N/-). Opposite polarity of terminals N/- and P/+ will damage the inverter.
*3 Always connect the power supply and terminals R/L11, S/L21, T/MC1.
Operating the inverter without connecting them will damage the power regeneration common converter.
*4 Use *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the terminals used for the X10, RES signal. *(Refer to page 113)*
*5 Be sure to connect terminal RDYB of the FR-CV to the X10 signal or MRS signal assigned terminal of the inverter, and connect terminal SE of the FR-CV to terminal SD of the inverter. Without proper connecting, FR-CV will be damaged.

**NOTE**

- **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 remove a jumper across terminal P/+ and P1.**

### 2.4.5 Connection of a DC reactor (FR-HEL)

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




**NOTE**

- **The wiring distance should be within 5m (16.4feet).**
- **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).** *(Refer to page 17)*





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MEMO



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# 3 PRECAUTIONS FOR USE OF THE INVERTER

**This chapter explains the "PRECAUTIONS FOR USE OF THE INVERTER" for use of this product.**
**Always read the instructions before using the equipment**


3.1 EMC and leakage currents ..... 38
3.2 Installation of power factor improving reactor ..... 43
3.3 Power-off and magnetic contactor (MC) ..... 44
3.4 Inverter-driven 400V class motor ..... 45
3.5 Precautions for use of the inverter ..... 46
3.6 Failsafe of the system which uses the inverter ..... 48






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# 3.1 EMC and leakage currents

## 3.1.1 Leakage currents and countermeasures

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

### (1) To-earth (ground) leakage currents

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

●Suppression technique

- If the carrier frequency setting is high, decrease the *Pr. 72 PWM frequency selection* setting.
  Note that motor noise increases. Selecting *Pr. 240 Soft-PWM operation selection* makes the sound inoffensive.
- By using earth leakage circuit breakers designed for harmonic and surge suppression in the inverter's own line and other line, operation can be performed with the carrier frequency kept high (with low noise).

●To-earth (ground) leakage currents

- Take caution as long wiring will increase the leakage current. Decreasing the carrier frequency of the inverter reduces the leakage current.
- Increasig the motor capacity increases the leakage current. The leakage current of the 400V class is larger than that of the 200V class.

### (2) Line-to-line leakage currents

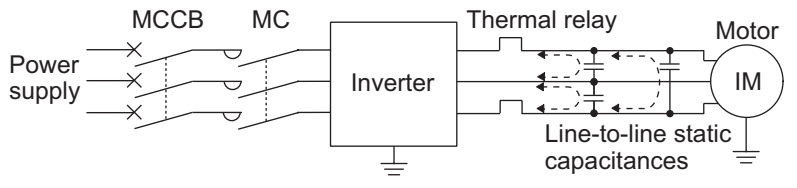
Harmonics of leakage currents flowing in static capacitances between the inverter output cables may operate the external thermal relay unnecessarily. When the wiring length is long (50m (164.04feet) or more) for the 400V class small-capacity model (FR-D740-160 or less), the external thermal relay is likely to operate unnecessarily because the ratio of the leakage current to the rated motor current increases.

●Line-to-line leakage current data example

| Motor Capacity (kW (HP)) | Rated Motor Current (A) | Leakage Current (mA) * | |
|---|---|---|---|
| | | Wiring length 50m (164.04feet) | Wiring length 100m (328.08feet) |
| 0.4 (1/2) | 1.1 | 620 | 1000 |
| 0.75 (1) | 1.9 | 680 | 1060 |
| 1.5 (2) | 3.5 | 740 | 1120 |
| 2.2 (3) | 4.1 | 800 | 1180 |
| 3.7 (5) | 6.4 | 880 | 1260 |
| 5.5 (7.5) | 9.7 | 980 | 1360 |

*The leakage currents of the 200V class are about a half.

•Motor: SF-JR 4P
•Carrier frequency: 14.5kHz
•Used wire: 2mm$^2$, 4 cores Cabtyre cable




**Line-to-line leakage currents path**

●Measures

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

●Installation and selection of moulded case circuit breaker

Install a moulded case circuit breaker (MCCB) on the power receiving side to protect the wiring of the inverter input side. Select the MCCB according to the inverter input side power factor (which depends on the power supply voltage, output frequency and load). Especially for a completely electromagnetic MCCB, one of a slightly large capacity must be selected since its operation characteristic varies with harmonic currents. (Check it in the data of the corresponding breaker.) As an earth leakage current breaker, use the Mitsubishi earth leakage current breaker designed for harmonics and surge suppression.



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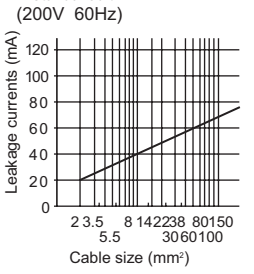
### (3) Selection of rated sensitivity current of earth (ground) leakage current breaker

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

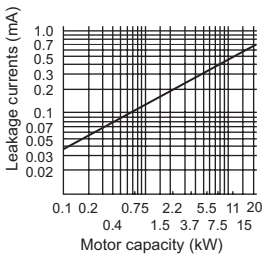
- Breaker designed for harmonic and surge suppression
  Rated sensitivity current:
  $I\Delta n \geq 10 \times (Ig1+Ign+Igi+Ig2+Igm)$
- Standard breaker
  Rated sensitivity current:
  $I\Delta n \geq 10 \times \{Ig1+Ign+Igi+3 \times (Ig2+Igm)\}$

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

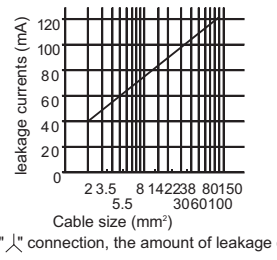
Example of leakage current of cable path per 1km during the commercial power supply operation when the CV cable is routed in metal conduit (200V 60Hz)



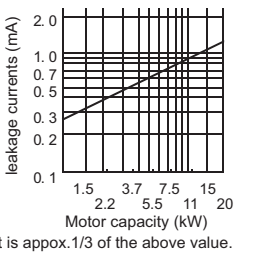

Example of leakage current of three-phase induction motor during the commercial power supply operation (200V 60Hz)




Example of leakage current per 1km during the commercial power supply operation when the CV cable is routed in metal conduit (Three-phase three-wire delta connection 400V60Hz)



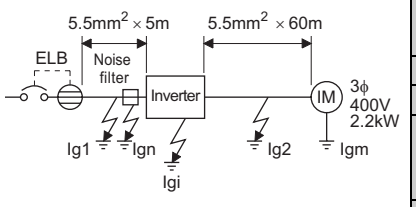

Example of leakage current of three-phase induction motor during the commercial power supply operation (Totally-enclosed fan-cooled type motor 400V60Hz)




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

<Example>

●Selection example (in the case of the left figure (400V class 人 connection))




| | Breaker Designed for Harmonic and Surge Suppression | Standard Breaker |
|---|---|---|
| Leakage current Ig1 (mA) | $\frac{1}{3} \times 66 \times \frac{5m}{1000m} = 0.11$ | |
| Leakage current Ign (mA) | 0 (without noise filter) | |
| Leakage current Igi (mA) | 1 | |
| Leakage current Ig2 (mA) | $\frac{1}{3} \times 66 \times \frac{60m}{1000m} = 1.32$ | |
| Motor leakage current Igm (mA) | 0.36 | |
| Total leakage current (mA) | 2.79 | 6.15 |
| Rated sensitivity current (mA) (≥ Ig × 10) | 30 | 100 |

**NOTE**

- **Install the earth leakage breaker (ELB) on the input side of the inverter.**
- **In the 人 connection earthed-neutral system, the sensitivity current is blunt against an earth (ground) fault in the inverter output side. Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)**
- **When the breaker is installed on the output side of the inverter, it may be unnecessarily operated by harmonics even if the effective value is less than the rating.**
  **In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.**
- **General products indicate the following models. ..... BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, NV-2F earth leakage relay (except NV-ZHA), NV with AA neutral wire open-phase protection**
  **The other models are designed for harmonic and surge suppression ....NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, NV-H**





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### 3.1.2 EMC measures

Some electromagnetic noises enter the inverter to malfunction it and others are radiated by the inverter to malfunction peripheral devices. Though the inverter is designed to have high immunity performance, it handles low-level signals, so it requires the following basic techniques. Also, since the inverter chops outputs at high carrier frequency, that could generate electromagnetic noises. If these electromagnetic noises cause peripheral devices to malfunction, EMI measures should be taken to suppress noises. These techniques differ slightly depending on EMI paths.

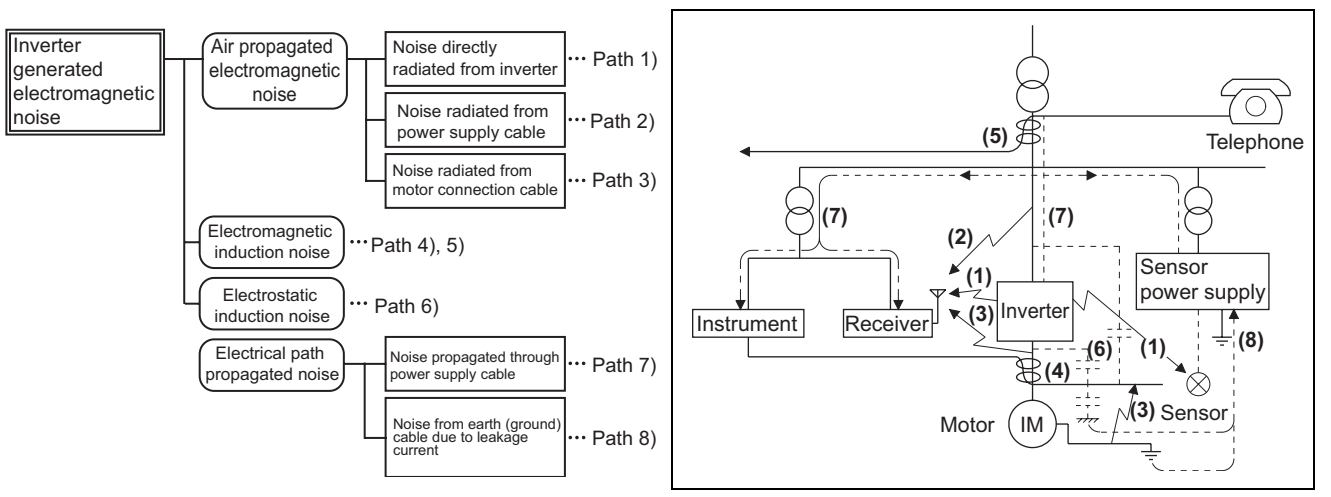
(1) Basic techniques
- Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
- Use twisted shield cables for the detector connecting and control signal cables and connect the sheathes of the shield cables to terminal SD.
- Earth (Ground) the inverter, motor, etc. at one point.

(2) Techniques to reduce electromagnetic noises that enter and malfunction the inverter (Immunity measures)

When devices that generate many electromagnetic noises (which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter and the inverter may be malfunctioned by electromagnetic noises, the following measures must be taken:
- Provide surge suppressors for devices that generate many electromagnetic noises to suppress electromagnetic noises.
- Fit data line filters *(page 41)* to signal cables.
- Earth (Ground) the shields of the detector connection and control signal cables with cable clamp metal.

(3) Techniques to reduce electromagnetic noises that are radiated by the inverter to malfunction peripheral devices (EMI measures)

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





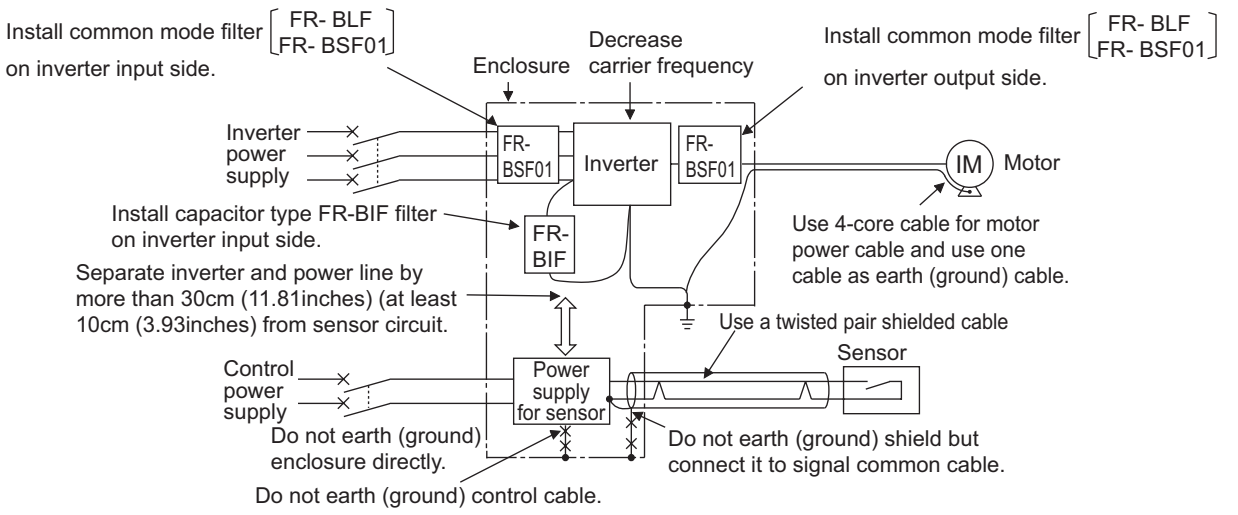

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| Propagation Path | Measures |
|---|---|
| (1)(2)(3) | When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or when their signal cables are run near the inverter, the devices may be malfunctioned by air-propagated electromagnetic noises. The following measures must be taken:<br>• Install easily affected devices as far away as possible from the inverter.<br>• Run easily affected signal cables as far away as possible from the inverter and its I/O cables.<br>• Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.<br>• Insert common mode filters into I/O and capacitors between the input lines to suppress cable-radiated noises.<br>• Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects. |
| (4)(5)(6) | When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables to malfunction the devices and the following measures must be taken:<br>• Install easily affected devices as far away as possible from the inverter.<br>• Run easily affected signal cables as far away as possible from the I/O cables of the inverter.<br>• Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.<br>• Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects. |
| (7) | When the power supplies of the peripheral devices are connected to the power supply of the inverter in the same line, inverter-generated noises may flow back through the power supply cables to malfunction the devices and the following measures must be taken:<br>• Install the common mode filter (FR-BLF, FR-BSF01) to the power cables (output cable) of the inverter. |
| (8) | When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage currents may flow through the earth (ground) cable of the inverter to malfunction the device. In such a case, disconnection of the earth (ground) cable of the device may cause the device to operate properly. |

### ●Data line filter

As immunity measures it may effective, provide a data line filter for the detector cable etc.

### ●EMC measures




**NOTE**

- **For compliance with the EU EMC directive, refer to the *Installation Guideline*.**





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### 3.1.3 Power supply harmonics

The inverter may generate power supply harmonics from its converter circuit to affect the power generator, power capacitor etc. Power supply harmonics are different from noise and leakage currents in source, frequency band and transmission path. Take the following countermeasure suppression techniques.

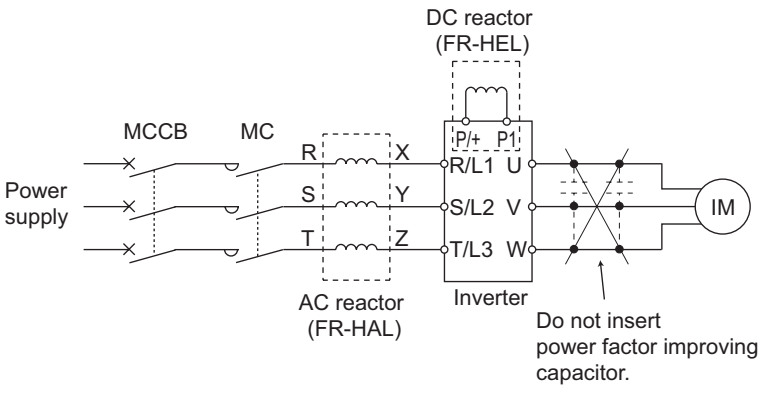
●The differences between harmonics and RF noises are indicated below:

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

**●Suppression technique**

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

For the output frequency and output current, we understand that they should be calculated in the conditions under the rated load at the maximum operating frequency.




**NOTE**

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

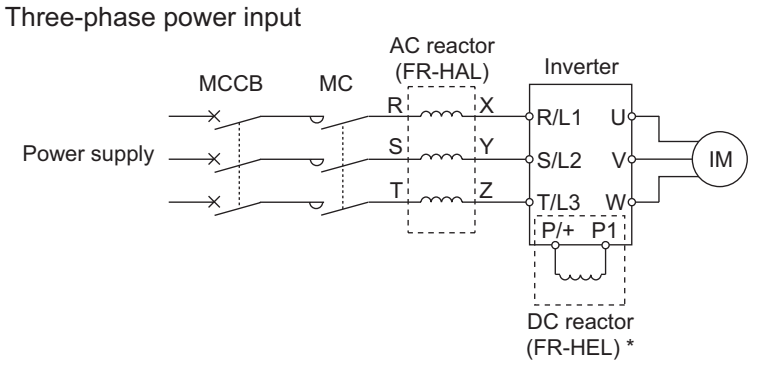


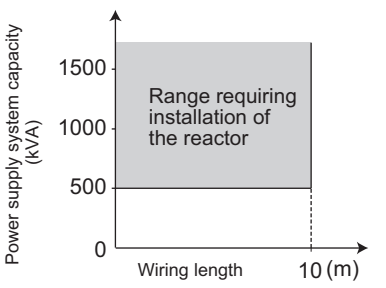
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## 3.2 Installation of power factor improving reactor

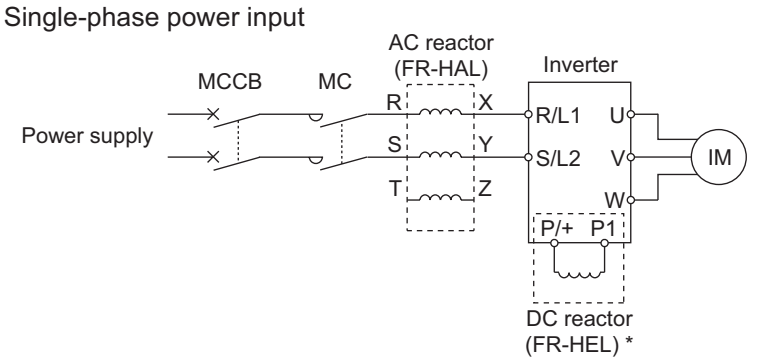
When the inverter is connected near a large-capacity power transformer (500kVA or more) or when a power capacitor is to be switched over, an excessive peak current may flow in the power input circuit, damaging the converter circuit. To prevent this, always install an optional reactor (FR-HAL, FR-HEL).

● Three-phase power input




● Single-phase power input




∗ When connecting the FR-HEL, remove the jumper across terminals P/+ and P1.
The wiring length between the FR-HEL and inverter should be 5m (16.4feet) maximum and minimized.

**REMARKS**

- Use the same wire size as that of the power supply wire (R/L1, S/L2, T/L3). *(Refer to page 17)*





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## 3.3 Power-off and magnetic contactor (MC)

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

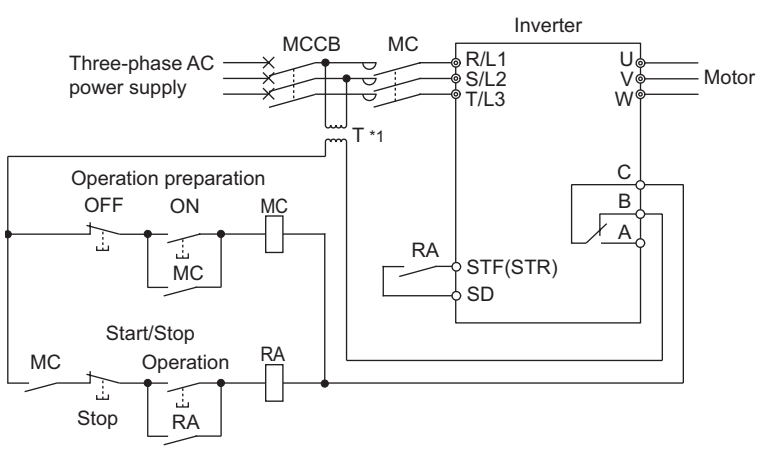
On the inverter input side, it is recommended to provide an MC for the following purposes.
(Refer to *page 4* for selection.)

1) To release the inverter from the power supply when the fault occurs or when the drive is not functioning (e.g. emergency stop operation). When cycle operation or heavy-duty operation is performed with an optional brake resistor connected, overheat and burnout of the discharging resistor can be prevented if a regenerative brake transistor is damaged due to insufficient heat capacity of the discharging resistor and excess regenerative brake duty.
2) To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure
3) The control power supply for inverter is always running and consumes a little power. When stopping the inverter for an extended period of time, powering off the inverter will save power slightly.
4) To separate the inverter from the power supply to ensure safe maintenance and inspection work.

The inverter's input side MC is used for the above purpose, select class JEM1038-AC3 MC for the inverter input side current when making an emergency stop during normal operation.

**REMARKS**

Since repeated inrush currents at power on will shorten the life of the converter circuit (switching life is about 1,000,000 times.), frequent starts and stops of the 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 across terminals STF or STR-SD) to make a start or stop.

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

### (2) 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 an MC is provided for switching to the commercial power supply, for example, switch it on/off after the inverter and motor have stopped.



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## 3.4 Inverter-driven 400V class motor

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

### ●Measures

It is recommended to take either of the following measures:

**(1) Rectifying the motor insulation and limiting the PWM carrier frequency according to the wiring length**

For the 400V class motor, use an insulation-enhanced motor.
Specifically,

1) Specify the "400V class inverter-driven insulation-enhanced motor".
2) For the dedicated motor such as the constant-torque motor and low-vibration motor, use the "inverter-driven, dedicated motor".
3) Set *Pr. 72 PWM frequency selection* as indicated below according to the wiring length

| | Wiring Length | | |
|---|---|---|---|
| | **50m (164.04feet) or less** | **50m to 100m (164.04feet to 328.09feet)** | **exceeding 100m (328.09feet)** |
| *Pr. 72 PWM frequency selection* | 15 (14.5kHz) or less | 8 (8kHz) or less | 2 (2kHz) or less |

**(2) Suppressing the surge voltage on the inverter side**

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

**NOTE**

- **For details of *Pr. 72 PWM frequency selection*, *refer to page 148*.**
- **For explanation of surge voltage suppression filter (FR-ASF-H/FR-BMF-H), refer to the manual of each option**





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## 3.5 Precautions for use of the inverter

The FR-D700 series is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product.
Before starting operation, always recheck the following 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 size to make a voltage drop 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 17* for the recommended wire sizes.

(5) The overall wiring length should be 500m (1640.42feet) maximum.
Especially for long distance wiring, the fast-response current limit function may decrease or the equipment connected to the secondary side may malfunction or become faulty under the influence of a charging current due to the stray capacity of the wiring. Therefore, note the overall wiring length. (*Refer to page 19)*

(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, install the FR-BIF optional capacitor type filter (for use in the input side only) or FR-BSF01 or FR-BLF common mode filter to minimize interference.

(7) Do not install a power factor correction capacitor, surge suppressor or capacitor type 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. (When using capacitor type filter (FR-BIF) for single-phase power supply specification, make sure of secure insulation of T/L3-phase, and connect to the input side of the inverter.)

(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 not more than 30VDC using a tester, etc. The capacitor is charged with high voltage for some time after power off and it is dangerous.

(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 caused by peripheral circuit inadequacy or an earth (ground) fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter modules.
- 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 hostile atmosphere, securely check the motor insulation resistance etc.

(10) Do not use the inverter input side magnetic contactor to start/stop the inverter.
Always use the start signal (turn on/off STF and STR signals) to start/stop the inverter. (*Refer to page 44)*

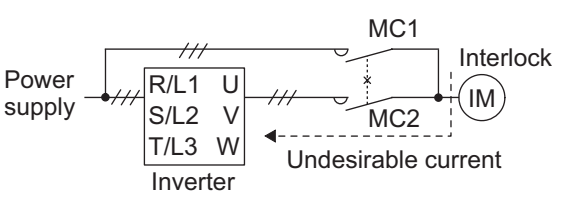
(11) Across P/+ and PR terminals, connect only an external regenerative brake discharging resistor.
Do not connect a mechanical brake.
The brake resistor can not be connected to the FR-D720-008 and 014 and FR-D720S-008 and 014. Never short between terminals P/+ and PR.



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(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 terminals 10-5.

(13) Provide electrical and mechanical interlocks for MC1 and MC2 which are used for bypass operation. When the wiring is incorrect and if there is a bypass operation circuit as shown right, the inverter will be damaged due to arcs generated at the time of switch-over or chattering caused by a sequence error.




(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) Instructions for overload operation
When performing operation of frequent start/stop of the inverter, rise/fall in the temperature of the transistor element of the inverter will repeat due to a repeated flow of large current, shortening the life from thermal fatigue. Since thermal fatigue is related to the amount of current, the life can be increased by reducing current at locked condition, starting current, etc. Decreasing current may increase the life. However, decreasing current will result in insufficient torque and the inverter may not start. Therefore, choose the inverter which has enough allowance for current (up to 2 rank larger in capacity).

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

(17) When the motor speed is unstable, due to change in the frequency setting signal caused by electromagnetic noises from the inverter, take the following measures while applying the motor speed by the analog signal.
- 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).





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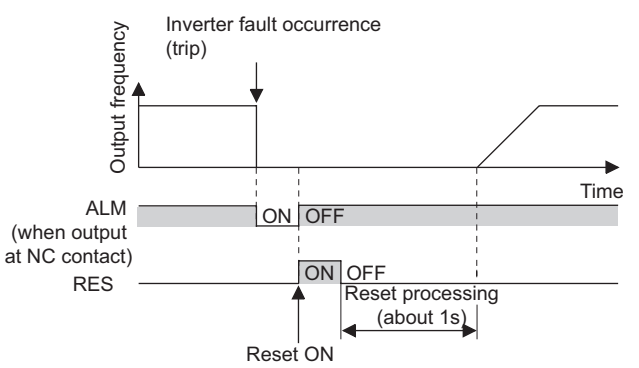
## 3.6 Failsafe of the system which uses the inverter

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.

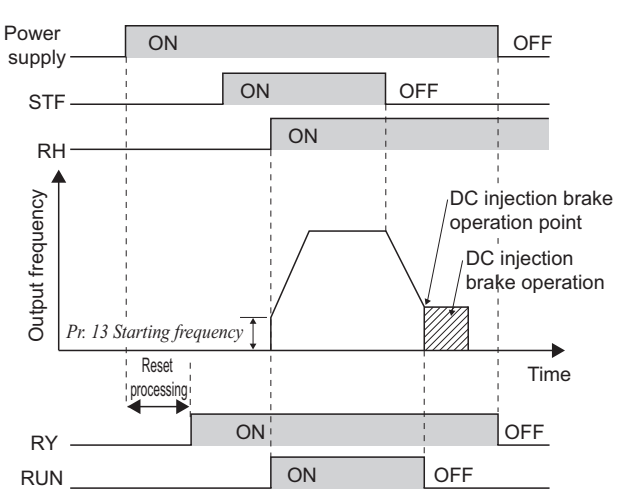
| No | Interlock Method | Check Method | Used Signals | Refer to Page |
|---|---|---|---|---|
| 1) | Inverter protective function operation | Operation check of an alarm contact<br>Circuit error detection by negative logic | Fault output signal (ALM signal) | *122* |
| 2) | Inverter operating status | Operation ready signal check | Operation ready signal (RY signal) | *121* |
| 3) | Inverter running status | Logic check of the start signal and running signal | Start signal (STF signal, STR signal)<br>Running signal (RUN signal) | *117, 121* |
| 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) | *117, 124* |

1) Check by the inverter fault output signal
When the fault occurs and the inverter trips, the fault output signal (ALM signal) is output (ALM signal is assigned to terminal ABC in the initial setting).
Check that the inverter functions properly.
In addition, negative logic can be set (on when the inverter is normal, off when the fault occurs).




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

3) Checking the inverter operating status by the start signal input to the inverter and inverter running signal.
The inverter running signal (RUN signal) is output when the inverter is running (RUN signal is assigned to terminal RUN in the initial setting).
Check if RUN signal is output when inputting the start signal to the inverter (forward signal is STF signal and reverse signal is STR signal). For logic check, note that RUN signal is output for the period from the inverter decelerates until output to the motor is stopped, configure a sequence considering the inverter deceleration time.






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4) Checking the motor operating status by the start signal input to the inverter and inverter output current detection signal.
The output current detection signal (Y12 signal) is output when the inverter operates and currents flows in the motor. Check if Y12 signal is output when inputting the start signal to the inverter (forward signal is STF signal and reverse signal is STR signal). Note that the current level at which Y12 signal is output is set to 150% of the inverter rated current in the initial setting, it is necessary to adjust the level to around 20% using no load current of the motor as reference with *Pr.150 Output current detection level*.
For logic check, as same as the inverter running signal (RUN signal), the inverter outputs for the period from the inverter decelerates until output to the motor is stopped, configure a sequence considering the inverter deceleration time.

| Output Signal | *Pr. 190, Pr. 192* Setting | |
|---|---|---|
| | Positive logic | Negative logic |
| ALM | 99 | 199 |
| RY | 11 | 111 |
| RUN | 0 | 100 |
| Y12 | 12 | 112 |

- When using various signals, assign functions to *Pr.190, Pr.192 (output terminal function selection)* referring to the table on the left.

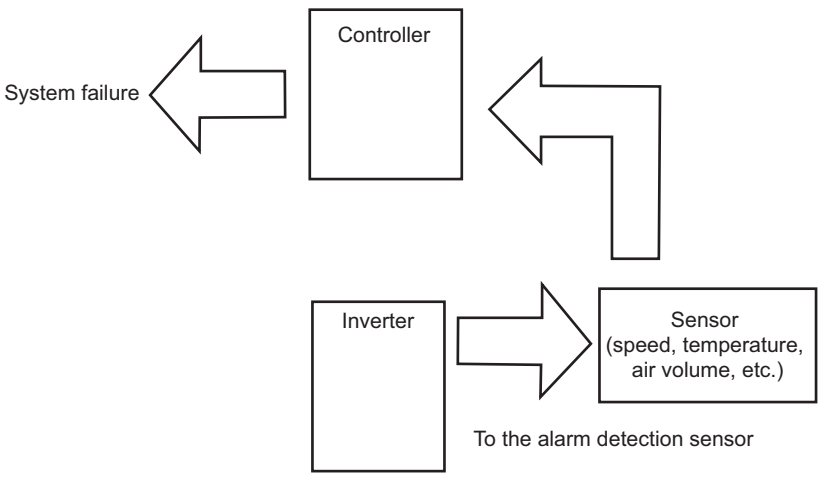
**NOTE**

- **Changing the terminal assignment using *Pr. 190, Pr. 192 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

(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.








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MEMO



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# 4 PARAMETERS

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

The abbreviations in the explanations below are as follows:
V/F .....V/F control
GP MFVC .....General-purpose magnetic-flux vector control
(Parameters without any indication are valid for both control)



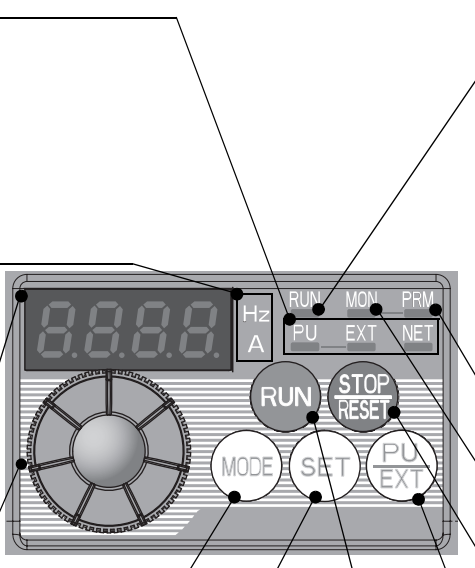


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# 4.1 Operation panel

## 4.1.1 Names and functions of the operation panel

**The operation panel cannot be removed from the inverter.**




**Operation mode indication**
PU: Lit to indicate PU operation mode.
EXT: Lit to indicate external operation mode.
NET: Lit to indicate network operation mode.
PU, EXT: Lit to indicate external/PU combined operation mode 1, 2.

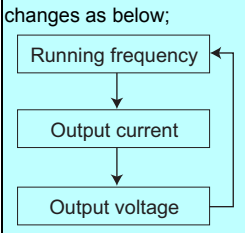
**Unit indication**
Hz: Lit to indicate frequency.
(Flickers when the set frequency monitor is displayed.)
A: Lit to indicate current.
(Both "Hz" and "A" turn off when other than the above is displayed.)

**Monitor (4-digit LED)**
Shows the frequency, parameter number, etc.

**Setting dial**
(Setting dial: Mitsubishi inverter dial)
Used to change the frequency setting and parameter values.
Press to display the following.
- Displays the set frequency in the monitor mode
- Present set value is displayed during calibration
- Displays the order in the faults history mode

**Mode switchover**
Used to change each setting mode.
Pressing (PU/EXT) simultaneously changes the operation mode. *(Refer to page 54)*
Pressing for a while (2s) can lock operation. *(Refer to page 238)*

**Determination of each setting**
If pressed during operation, monitor changes as below;




**Operating status display**
Lit or flicker during inverter operation. *
* On: Indicates that forward rotation operation is being performed.
Slow flickering (1.4s cycle):
Reverse rotation operation
Fast flickering (0.2s cycle):
When (RUN) was pressed or the start command was given, but the operation can not be made.
•When the frequency command is less than the starting frequency.
•When the MRS signal is input.

**Parameter setting mode indication**
Lit to indicate parameter setting mode.

**Monitor indication**
Lit to indicate monitoring mode.

**Stop operation**
Used to stop Run command.
Fault can be reset when protective function is activated (fault).

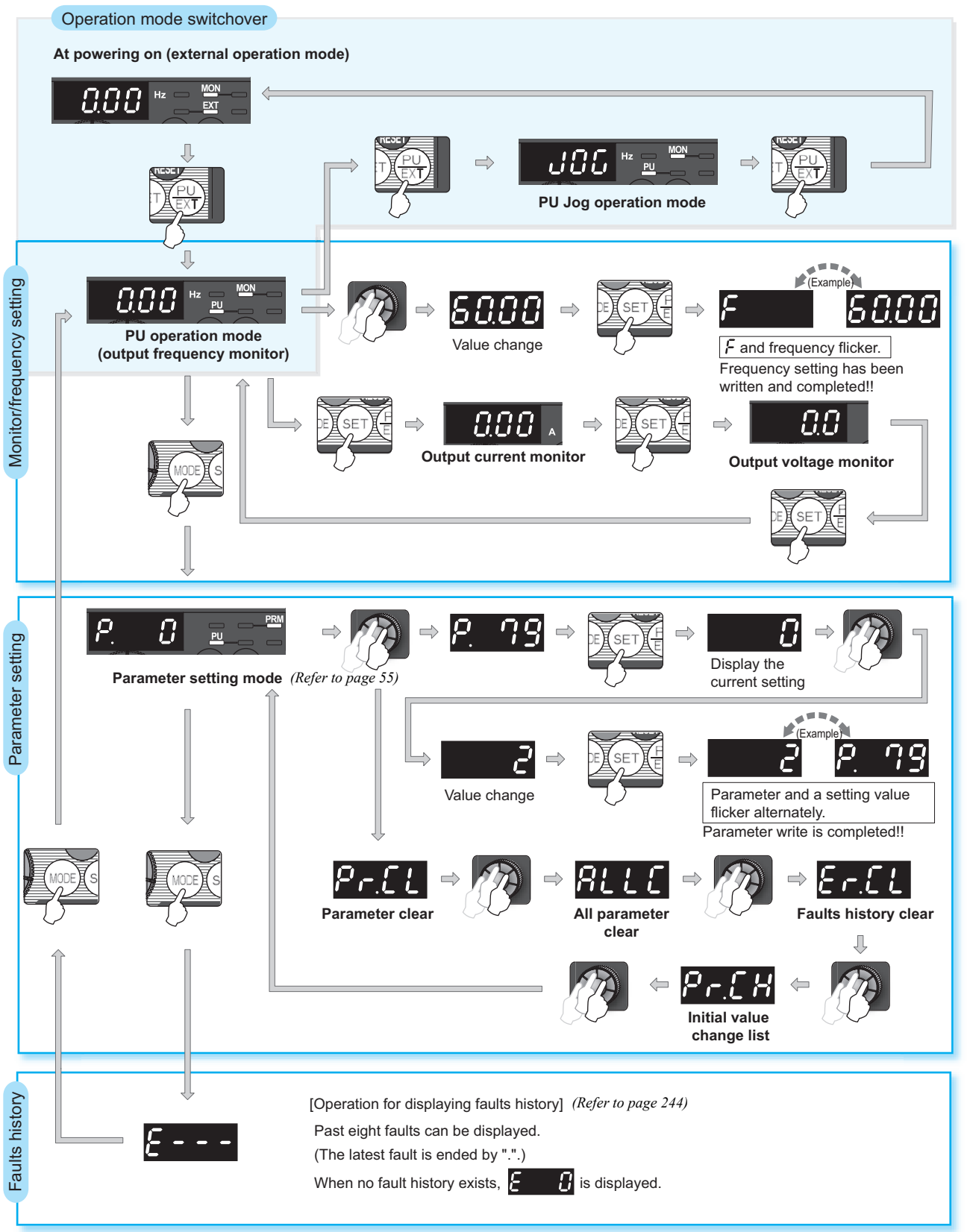
**Operation mode switchover**
Used to switch between the PU and external operation mode.
When using the external operation mode (operation using a separately connected frequency setting potentiometer and start signal), press this key to light up the EXT indication.
(Press (MODE) simultaneously (0.5s) *(Refer to page 54)*, or change *Pr. 79* setting to change to combined mode .)
PU: PU operation mode
EXT: External operation mode
Cancels PU stop also.

**Start command**
The rotation direction can be selected by setting *Pr. 40*.



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### 4.1.2 Basic operation (factory setting)








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### 4.1.3 Easy operation mode setting (easy setting mode)

Setting of *Pr. 79 Operation mode selection* according to combination of the start command and speed command can be easily made.

Changing example — Start command: external (STF/STR), frequency command: operate with

| Operation | Display |
|---|---|
| 1. Screen at powering on<br>The monitor display appears. |  |
| 2. Press PU/EXT and MODE for 0.5s. |  |
| 3. Turn until 79-3 appears.<br>(refer to the table below for other settings) |  |

| Operation Panel Indication | Operation Method | |
|---|---|---|
| | Start command | Frequency command |
| Flickering 79-1 PRM PU Flickering | RUN | |
| Flickering 79-2 PRM EXT Flickering | External (STF, STR) | Analog voltage input |
| Flickering 79-3 PRM PU EXT Flickering | External (STF, STR) | |
| Flickering 79-4 PRM PU EXT Flickering | RUN | Analog voltage input |

4. Press SET to set.



**Flicker ··· Parameter setting complete!!**

**The monitor display appears after 3s.**



**REMARKS**

? Er1 is displayed ... Why?

☞ Parameter write is disabled with "1" set in *Pr. 77*.

? Er2 is displayed ... Why?

☞ Setting can not be made during operation. Turn the start switch (RUN, STF or STR) off.

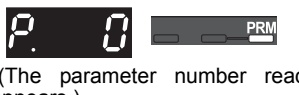
- Press MODE before pressing SET to return to the monitor display without setting. In this case, the mode changes to external operation mode when performed in the PU operation mode (PU JOG operation mode) and to PU operation mode when performed in the external operation mode.
- Reset can be made with STOP/RESET.
- 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".



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### 4.1.4 Change the parameter setting value

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

| Operation | Display |
|---|---|
| 1. Screen at powering on<br>The monitor display appears. |  |
| 2. Press (PU/EXT) to choose the PU operation mode. | (PU/EXT) ⇨  PU indication is lit. |
| 3. Press (MODE) to choose the parameter setting mode. | (MODE) ⇨  PRM indication is lit. (The parameter number read previously appears.) |
| 4. Turn (dial) until P. 1 *(Pr. 1)* appears. | ⇨  |
| 5. Press (SET) to read the present set value.<br>" 120.0 "(120.0Hz (initial value)) appears. | (SET) ⇨  |
| 6. Turn (dial) to change the set value to<br>"60.00" (60.00Hz). | ⇨  |
| 7. Press (SET) to set. | (SET) ⇨  **Flicker...Parameter setting complete!!** |

- Turn (dial) to read another parameter.
- Press (SET) to show the setting again.
- Press (SET) twice to show the next parameter.
- Press (MODE) twice to return to frequency monitor.

**REMARKS**

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

☞ Er 1 appears ..... Write disable error
Er 2 appears ..... Write error during operation
Er 3 appears ..... Calibration error
Er 4 appears ..... Mode designation error

(For details, refer to *page 250*.)

- The number of digits displayed on the operation panel is four. Only the upper four digits of values can be displayed and set. If the values to be displayed have five digits or more including decimal places, the fifth or later numerals can not be displayed nor set.
  (Example) For *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.

### 4.1.5 Setting dial push

Push the setting dial (  ) to display the set frequency* currently set.

* Appears when PU operation mode or external/PU combined operation mode 1 is selected (*Pr. 79* ="3").





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## 4.2 Parameter list

### 4.2.1 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. For details of parameters, refer to the instruction manual.

**REMARKS**

- ◎ indicates simple mode parameters.
- The parameters surrounded by a black border in the table allow its setting to be changed during operation even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

| Function | Parameter | Name | Setting Range | Minimum Setting Increments | Initial Value | Refer to Page | Customer Setting |
|---|---|---|---|---|---|---|---|
| Basic functions | ◎ 0 | Torque boost | 0 to 30% | 0.1% | 6/4/3% *1 | *73* | |
| | ◎ 1 | Maximum frequency | 0 to 120Hz | 0.01Hz | 120Hz | *83* | |
| | ◎ 2 | Minimum frequency | 0 to 120Hz | 0.01Hz | 0Hz | *83* | |
| | ◎ 3 | Base frequency | 0 to 400Hz | 0.01Hz | 60Hz | *85* | |
| | ◎ 4 | Multi-speed setting (high speed) | 0 to 400Hz | 0.01Hz | 60Hz | *89* | |
| | ◎ 5 | Multi-speed setting (middle speed) | 0 to 400Hz | 0.01Hz | 30Hz | *89* | |
| | ◎ 6 | Multi-speed setting (low speed) | 0 to 400Hz | 0.01Hz | 10Hz | *89* | |
| | ◎ 7 | Acceleration time | 0 to 3600s | 0.1s | 5/10s *2 | *96* | |
| | ◎ 8 | Deceleration time | 0 to 3600s | 0.1s | 5/10s *2 | *96* | |
| | ◎ 9 | Electronic thermal O/L relay | 0 to 500A | 0.01A | Rated inverter current | *100* | |
| DC injection brake | 10 | DC injection brake operation frequency | 0 to 120Hz | 0.01Hz | 3Hz | *109* | |
| | 11 | DC injection brake operation time | 0 to 10s | 0.1s | 0.5s | *109* | |
| | 12 | DC injection brake operation voltage | 0 to 30% | 0.1% | 6/4% *3 | *109* | |
| — | 13 | Starting frequency | 0 to 60Hz | 0.01Hz | 0.5Hz | *98* | |
| — | 14 | Load pattern selection | 0 to 3 | 1 | 0 | *87* | |
| JOG operation | 15 | Jog frequency | 0 to 400Hz | 0.01Hz | 5Hz | *91* | |
| | 16 | Jog acceleration/deceleration time | 0 to 3600s | 0.1s | 0.5s | *91* | |
| — | 17 | MRS input selection | 0, 2, 4 | 1 | 0 | *115* | |
| — | 18 | High speed maximum frequency | 120 to 400Hz | 0.01Hz | 120Hz | *83* | |
| — | 19 | Base frequency voltage | 0 to 1000V, 8888, 9999 | 0.1V | 9999 | *85* | |
| Acceleration/ deceleration time | 20 | Acceleration/deceleration reference frequency | 1 to 400Hz | 0.01Hz | 60Hz | *96* | |
| Stall prevention | 22 | Stall prevention operation level | 0 to 200% | 0.1% | 150% | *79* | |
| | 23 | Stall prevention operation level compensation factor at double speed | 0 to 200%, 9999 | 0.1% | 9999 | *79* | |
| Multi-speed setting | 24 | Multi-speed setting (speed 4) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *89* | |
| | 25 | Multi-speed setting (speed 5) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *89* | |
| | 26 | Multi-speed setting (speed 6) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *89* | |
| | 27 | Multi-speed setting (speed 7) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *89* | |
| — | 29 | Acceleration/deceleration pattern selection | 0, 1, 2 | 1 | 0 | *99* | |



- These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication. (*Refer to page 183* for RS-485 communication)
- "○" indicates valid and "×" indicates invalid of "control mode-based correspondence table", "parameter copy", "parameter clear", and "all parameter clear".

| Parameter | Remarks | Instruction Code | | | Control Mode-based Correspondence Table | | Parameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Read | Write | Extended | V/F | GP MFVC | Copy | Clear | All clear |
| ◎ 0 | | *00* | *80* | *0* | ○ | × | ○ | ○ | ○ |
| ◎ 1 | | *01* | *81* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 2 | | *02* | *82* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 3 | | *03* | *83* | *0* | ○ | × | ○ | ○ | ○ |
| ◎ 4 | | *04* | *84* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 5 | | *05* | *85* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 6 | | *06* | *86* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 7 | | *07* | *87* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 8 | | *08* | *88* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 9 | | *09* | *89* | *0* | ○ | ○ | ○ | ○ | ○ |
| 10 | | *0A* | *8A* | *0* | ○ | ○ | ○ | ○ | ○ |
| 11 | | *0B* | *8B* | *0* | ○ | ○ | ○ | ○ | ○ |
| 12 | | *0C* | *8C* | *0* | ○ | ○ | ○ | ○ | ○ |
| 13 | | *0D* | *8D* | *0* | ○ | ○ | ○ | ○ | ○ |
| 14 | | *0E* | *8E* | *0* | ○ | × | ○ | ○ | ○ |
| 15 | | *0F* | *8F* | *0* | ○ | ○ | ○ | ○ | ○ |
| 16 | | *10* | *90* | *0* | ○ | ○ | ○ | ○ | ○ |
| 17 | | *11* | *91* | *0* | ○ | ○ | ○ | ○ | ○ |
| 18 | | *12* | *92* | *0* | ○ | ○ | ○ | ○ | ○ |
| 19 | | *13* | *93* | *0* | ○ | × | ○ | ○ | ○ |
| 20 | | *14* | *94* | *0* | ○ | ○ | ○ | ○ | ○ |
| 22 | | *16* | *96* | *0* | ○ | ○ | ○ | ○ | ○ |
| 23 | | *17* | *97* | *0* | ○ | ○ | ○ | ○ | ○ |
| 24 | | *18* | *98* | *0* | ○ | ○ | ○ | ○ | ○ |
| 25 | | *19* | *99* | *0* | ○ | ○ | ○ | ○ | ○ |
| 26 | | *1A* | *9A* | *0* | ○ | ○ | ○ | ○ | ○ |
| 27 | | *1B* | *9B* | *0* | ○ | ○ | ○ | ○ | ○ |
| 29 | | *1D* | *9D* | *0* | ○ | ○ | ○ | ○ | ○ |





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| Function | Parameter | Name | Setting Range | Minimum Setting Increments | Initial Value | Refer to Page | Customer Setting |
|---|---|---|---|---|---|---|---|
| — | 30 | Regenerative function selection | 0, 1, 2 | 1 | 0 | *110, 136* | |
| Frequency jump | 31 | Frequency jump 1A | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *84* | |
| | 32 | Frequency jump 1B | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *84* | |
| | 33 | Frequency jump 2A | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *84* | |
| | 34 | Frequency jump 2B | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *84* | |
| | 35 | Frequency jump 3A | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *84* | |
| | 36 | Frequency jump 3B | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *84* | |
| — | 37 | Speed display | 0, 0.01 to 9998 | 0.001 | 0 | *127* | |
| — | 40 | RUN key rotation direction selection | 0, 1 | 1 | 0 | *237* | |
| Frequency detection | 41 | Up-to-frequency sensitivity | 0 to 100% | 0.1% | 10% | *123* | |
| | 42 | Output frequency detection | 0 to 400Hz | 0.01Hz | 6Hz | *123* | |
| | 43 | Output frequency detection for reverse rotation | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *123* | |
| Second functions | 44 | Second acceleration/deceleration time | 0 to 3600s | 0.1s | 5/10s *2 | *96, 220* | |
| | 45 | Second deceleration time | 0 to 3600s, 9999 | 0.1s | 9999 | *96, 220* | |
| | 46 | Second torque boost | 0 to 30%, 9999 | 0.1% | 9999 | *73* | |
| | 47 | Second V/F (base frequency) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *85* | |
| | 48 | Second stall prevention operation current | 0 to 200%, 9999 | 0.1% | 9999 | *79* | |
| | 51 | Second electronic thermal O/L relay | 0 to 500A, 9999 | 0.01A | 9999 | *100* | |
| Monitor functions | 52 | DU/PU main display data selection | 0, 5, 8 to 12, 14, 20, 23 to 25, 52 to 55, 61, 62, 64, 100 | 1 | 0 | *128* | |
| | 55 | Frequency monitoring reference | 0 to 400Hz | 0.01Hz | 60Hz | *133* | |
| | 56 | Current monitoring reference | 0 to 500A | 0.01A | Rated inverter current | *133* | |
| Automatic restart functions | 57 | Restart coasting time | 0, 0.1 to 5s, 9999 | 0.1s | 9999 | *136* | |
| | 58 | Restart cushion time | 0 to 60s | 0.1s | 1s | *136* | |
| — | 59 | Remote function selection | 0, 1, 2, 3 | 1 | 0 | *93* | |
| — | 60 | Energy saving control selection | 0, 9 | 1 | 0 | *147* | |
| — | 65 | Retry selection | 0 to 5 | 1 | 0 | *144* | |
| — | 66 | Stall prevention operation reduction starting frequency | 0 to 400Hz | 0.01Hz | 60Hz | *79* | |
| Retry | 67 | Number of retries at fault occurrence | 0 to 10, 101 to 110 | 1 | 0 | *144* | |
| | 68 | Retry waiting time | 0.1 to 600s | 0.1s | 1s | *144* | |
| | 69 | Retry count display erase | 0 | 1 | 0 | *144* | |
| — | 70 | Special regenerative brake duty | 0 to 30% | 0.1% | 0% | *110* | |
| — | 71 | Applied motor | 0, 1, 3, 13, 23, 40, 43, 50, 53 | 1 | 0 | *75, 103, 105,* | |
| — | 72 | PWM frequency selection | 0 to 15 | 1 | 1 | *148* | |
| — | 73 | Analog input selection | 0, 1, 10, 11 | 1 | 1 | *150* | |
| — | 74 | Input filter time constant | 0 to 8 | 1 | 1 | *152* | |
| — | 75 | Reset selection/disconnected PU detection/PU stop selection | 0 to 3, 14 to 17 | 1 | 14 | *158* | |
| — | 77 | Parameter write selection | 0, 1, 2 | 1 | 0 | *161* | |
| — | 78 | Reverse rotation prevention selection | 0, 1, 2 | 1 | 0 | *162* | |
| — | ◎ 79 | Operation mode selection | 0, 1, 2, 3, 4, 6, 7 | 1 | 0 | *165, 175* | |



| Parameter | Remarks | Instruction Code | | | Control Mode-based Correspondence Table | | Parameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Read | Write | Extended | V/F | GP MFVC | Copy | Clear | All clear |
| 30 | | *1E* | *9E* | *0* | ○ | ○ | ○ | ○ | ○ |
| 31 | | *1F* | *9F* | *0* | ○ | ○ | ○ | ○ | ○ |
| 32 | | *20* | *A0* | *0* | ○ | ○ | ○ | ○ | ○ |
| 33 | | *21* | *A1* | *0* | ○ | ○ | ○ | ○ | ○ |
| 34 | | *22* | *A2* | *0* | ○ | ○ | ○ | ○ | ○ |
| 35 | | *23* | *A3* | *0* | ○ | ○ | ○ | ○ | ○ |
| 36 | | *24* | *A4* | *0* | ○ | ○ | ○ | ○ | ○ |
| 37 | | *25* | *A5* | *0* | ○ | ○ | ○ | ○ | ○ |
| 40 | | *28* | *A8* | *0* | ○ | ○ | ○ | ○ | ○ |
| 41 | | *29* | *A9* | *0* | ○ | ○ | ○ | ○ | ○ |
| 42 | | *2A* | *AA* | *0* | ○ | ○ | ○ | ○ | ○ |
| 43 | | *2B* | *AB* | *0* | ○ | ○ | ○ | ○ | ○ |
| 44 | | *2C* | *AC* | *0* | ○ | ○ | ○ | ○ | ○ |
| 45 | | *2D* | *AD* | *0* | ○ | ○ | ○ | ○ | ○ |
| 46 | | *2E* | *AE* | *0* | ○ | × | ○ | ○ | ○ |
| 47 | | *2F* | *AF* | *0* | ○ | × | ○ | ○ | ○ |
| 48 | | *30* | *B0* | *0* | ○ | ○ | ○ | ○ | ○ |
| 51 | | *33* | *B3* | *0* | ○ | ○ | ○ | ○ | ○ |
| 52 | | *34* | *B4* | *0* | ○ | ○ | ○ | ○ | ○ |
| 55 | | *37* | *B7* | *0* | ○ | ○ | ○ | ○ | ○ |
| 56 | | *38* | *B8* | *0* | ○ | ○ | ○ | ○ | ○ |
| 57 | | *39* | *B9* | *0* | ○ | ○ | ○ | ○ | ○ |
| 58 | | *3A* | *BA* | *0* | ○ | ○ | ○ | ○ | ○ |
| 59 | | *3B* | *BB* | *0* | ○ | ○ | ○ | ○ | ○ |
| 60 | | *3C* | *BC* | *0* | ○ | × | ○ | ○ | ○ |
| 65 | | *41* | *C1* | *0* | ○ | ○ | ○ | ○ | ○ |
| 66 | | *42* | *C2* | *0* | ○ | ○ | ○ | ○ | ○ |
| 67 | | *43* | *C3* | *0* | ○ | ○ | ○ | ○ | ○ |
| 68 | | *44* | *C4* | *0* | ○ | ○ | ○ | ○ | ○ |
| 69 | | *45* | *C5* | *0* | ○ | ○ | ○ | ○ | ○ |
| 70 | | *46* | *C6* | *0* | ○ | ○ | ○ | ○ | ○ |
| 71 | | *47* | *C7* | *0* | ○ | ○ | ○ | ○ | ○ |
| 72 | | *48* | *C8* | *0* | ○ | ○ | ○ | ○ | ○ |
| 73 | | *49* | *C9* | *0* | ○ | ○ | ○ | × | ○ |
| 74 | | *4A* | *CA* | *0* | ○ | ○ | ○ | ○ | ○ |
| 75 | | *4B* | *CB* | *0* | ○ | ○ | ○ | × | × |
| 77 | | *4D* | *CD* *4 | *0* | ○ | ○ | ○ | ○ | ○ |
| 78 | | *4E* | *CE* | *0* | ○ | ○ | ○ | ○ | ○ |
| ◎ 79 | | *4F* | *CF* *4 | *0* | ○ | ○ | ○ | ○ | ○ |





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| Function | Parameter | Name | Setting Range | Minimum Setting Increments | Initial Value | Refer to Page | Customer Setting |
|---|---|---|---|---|---|---|---|
| Motor constants | 80 | Motor capacity | 0.1 to 7.5kW, 9999 | 0.01kW | 9999 | *75, 105* | |
| | 82 | Motor excitation current | 0 to 500A, 9999 | 0.01A | 9999 | *105* | |
| | 83 | Rated motor voltage | 0 to 1000V | 0.1V | 200V/400V *5 | *105* | |
| | 84 | Rated motor frequency | 10 to 120Hz | 0.01Hz | 60Hz | *105* | |
| | 90 | Motor constant (R1) | 0 to 50Ω , 9999 | 0.001Ω | 9999 | *105* | |
| | 96 | Auto tuning setting/status | 0, 11, 21 | 1 | 0 | *105, 136* | |
| PU connector communication | 117 | PU communication station number | 0 to 31 (0 to 247) | 1 | 0 | *183, 200* | |
| | 118 | PU communication speed | 48, 96, 192, 384 | 1 | 192 | *183, 200* | |
| | 119 | PU communication stop bit length | 0, 1, 10, 11 | 1 | 1 | *183* | |
| | 120 | PU communication parity check | 0, 1, 2 | 1 | 2 | *183, 200* | |
| | 121 | Number of PU communication retries | 0 to 10, 9999 | 1 | 1 | *184* | |
| | 122 | PU communication check time interval | 0, 0.1 to 999.8s, 9999 | 0.1s | 0 | *184, 200* | |
| | 123 | PU communication waiting time setting | 0 to 150ms, 9999 | 1 | 9999 | *183* | |
| | 124 | PU communication CR/LF selection | 0, 1, 2 | 1 | 1 | *183* | |
| — | ◎ 125 | Terminal 2 frequency setting gain frequency | 0 to 400Hz | 0.01Hz | 60Hz | *153* | |
| — | ◎126 | Terminal 4 frequency setting gain frequency | 0 to 400Hz | 0.01Hz | 60Hz | *153* | |
| PID operation | 127 | PID control automatic switchover frequency | 0 to 400Hz, 9999 | 0.01Hz | 9999 | *212* | |
| | 128 | PID action selection | 0, 20, 21, 40 to 43 | 1 | 0 | *212, 220* | |
| | 129 | PID proportional band | 0.1 to 1000%, 9999 | 0.1% | 100% | *212, 220* | |
| | 130 | PID integral time | 0.1 to 3600s, 9999 | 0.1s | 1s | *212, 220* | |
| | 131 | PID upper limit | 0 to 100%, 9999 | 0.1% | 9999 | *212, 220* | |
| | 132 | PID lower limit | 0 to 100%, 9999 | 0.1% | 9999 | *212, 220* | |
| | 133 | PID action set point | 0 to 100%, 9999 | 0.01% | 9999 | *212, 220* | |
| | 134 | PID differential time | 0.01 to 10s, 9999 | 0.01s | 9999 | *212, 220* | |
| PU | 145 | PU display language selection | 0 to 7 | 1 | 1 | *237* | |
| — | 146 | Parameter for manufacturer setting. Do not set. | | | | | |
| Current detection | 150 | Output current detection level | 0 to 200% | 0.1% | 150% | *124* | |
| | 151 | Output current detection signal delay time | 0 to 10s | 0.1s | 0s | *124* | |
| | 152 | Zero current detection level | 0 to 200% | 0.1% | 5% | *124* | |
| | 153 | Zero current detection time | 0 to 1s | 0.01s | 0.5s | *124* | |
| — | 156 | Stall prevention operation selection | 0 to 31, 100, 101 | 1 | 0 | *79* | |
| — | 157 | OL signal output timer | 0 to 25s, 9999 | 0.1s | 0s | *79* | |
| — | 158 | AM terminal function selection | 1 to 3, 5, 8 to 12, 14, 21, 24, 52, 53, 61, 62 | 1 | 1 | *128* | |
| — | ◎ 160 | Extended function display selection | 0, 9999 | 1 | 0 | *162* | |
| — | 161 | Frequency setting/key lock operation selection | 0, 1, 10, 11 | 1 | 0 | *238* | |
| Automatic restart functions | 162 | Automatic restart after instantaneous power failure selection | 0, 1, 10, 11 | 1 | 1 | *136* | |
| | 165 | Stall prevention operation level for restart | 0 to 200% | 0.1% | 150% | *136* | |



| Parameter | Remarks | Instruction Code | | | Control Mode-based Correspondence Table | | Parameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Read | Write | Extended | V/F | GP MFVC | Copy | Clear | All clear |
| 80 | | *50* | *D0* | *0* | × | ○ | ○ | ○ | ○ |
| 82 | | *52* | *D2* | *0* | × | ○ | ○ | × | ○ |
| 83 | | *53* | *D3* | *0* | × | ○ | ○ | ○ | ○ |
| 84 | | *54* | *D4* | *0* | × | ○ | ○ | ○ | ○ |
| 90 | | *5A* | *DA* | *0* | ○ | ○ | ○ | × | ○ |
| 96 | | *60* | *E0* | *0* | ○ | ○ | ○ | × | ○ |
| 117 | | *11* | *91* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 118 | | *12* | *92* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 119 | | *13* | *93* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 120 | | *14* | *94* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 121 | | *15* | *95* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 122 | | *16* | *96* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 123 | | *17* | *97* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 124 | | *18* | *98* | *1* | ○ | ○ | ○ | ○ *7 | ○ *7 |
| ◎ 125 | | *19* | *99* | *1* | ○ | ○ | ○ | × | ○ |
| ◎ 126 | | *1A* | *9A* | *1* | ○ | ○ | ○ | × | ○ |
| 127 | | *1B* | *9B* | *1* | ○ | ○ | ○ | ○ | ○ |
| 128 | | *1C* | *9C* | *1* | ○ | ○ | ○ | ○ | ○ |
| 129 | | *1D* | *9D* | *1* | ○ | ○ | ○ | ○ | ○ |
| 130 | | *1E* | *9E* | *1* | ○ | ○ | ○ | ○ | ○ |
| 131 | | *1F* | *9F* | *1* | ○ | ○ | ○ | ○ | ○ |
| 132 | | *20* | *A0* | *1* | ○ | ○ | ○ | ○ | ○ |
| 133 | | *21* | *A1* | *1* | ○ | ○ | ○ | ○ | ○ |
| 134 | | *22* | *A2* | *1* | ○ | ○ | ○ | ○ | ○ |
| 145 | | *2D* | *AD* | *1* | ○ | ○ | ○ | × | × |
| 146 | Parameter for manufacturer setting. Do not set. | | | | | | | | |
| 150 | | *32* | *B2* | *1* | ○ | ○ | ○ | ○ | ○ |
| 151 | | *33* | *B3* | *1* | ○ | ○ | ○ | ○ | ○ |
| 152 | | *34* | *B4* | *1* | ○ | ○ | ○ | ○ | ○ |
| 153 | | *35* | *B5* | *1* | ○ | ○ | ○ | ○ | ○ |
| 156 | | *38* | *B8* | *1* | ○ | ○ | ○ | ○ | ○ |
| 157 | | *39* | *B9* | *1* | ○ | ○ | ○ | ○ | ○ |
| 158 | | *3A* | *BA* | *1* | ○ | ○ | ○ | ○ | ○ |
| ◎ 160 | | *00* | *80* | *2* | ○ | ○ | ○ | ○ | ○ |
| 161 | | *01* | *81* | *2* | ○ | ○ | ○ | × | ○ |
| 162 | | *02* | *82* | *2* | ○ | ○ | ○ | ○ | ○ |
| 165 | | *05* | *85* | *2* | ○ | ○ | ○ | ○ | ○ |





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| Function | Parameter | Name | Setting Range | Minimum Setting Increments | Initial Value | Refer to Page | Customer Setting |
|---|---|---|---|---|---|---|---|
| Current detection | 166 | Output current detection signal retention time | 0 to 10s, 9999 | 0.1s | 0.1s | 124 | |
| | 167 | Output current detection operation selection | 0, 1 | 1 | 0 | 124 | |
| — | 168 | Parameter for manufacturer setting. Do not set. | | | | | |
| — | 169 | | | | | | |
| Cumulative monitor clear | 170 | Watt-hour meter clear | 0, 10, 9999 | 1 | 9999 | 128 | |
| | 171 | Operation hour meter clear | 0, 9999 | 1 | 9999 | 128 | |
| Input terminal function assignment | 178 | STF terminal function selection | 0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 60, 62, 65 to 67, 9999 | 1 | 60 | 113 | |
| | 179 | STR terminal function selection | 0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 61, 62, 65 to 67, 9999 | 1 | 61 | 113 | |
| | 180 | RL terminal function selection | 0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 62, 65 to 67, 9999 | 1 | 0 | 113 | |
| | 181 | RM terminal function selection | | 1 | 1 | 113 | |
| | 182 | RH terminal function selection | | 1 | 2 | 113 | |
| Output terminal function assignment | 190 | RUN terminal function selection | 0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46, 47, 64, 70, 80, 90, 91, 93, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146, 147, 164, 170, 180, 190, 191, 193, 195, 196, 198, 199, 9999 | 1 | 0 | 119 | |
| | 192 | A,B,C terminal function selection | 0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46, 47, 64, 70, 80, 90, 91, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146, 147, 164, 170, 180, 190, 191, 195, 196, 198, 199, 9999 | 1 | 99 | 119 | |
| Multi-speed setting | 232 | Multi-speed setting (speed 8) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| | 233 | Multi-speed setting (speed 9) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| | 234 | Multi-speed setting (speed 10) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| | 235 | Multi-speed setting (speed 11) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| | 236 | Multi-speed setting (speed 12) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| | 237 | Multi-speed setting (speed 13) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| | 238 | Multi-speed setting (speed 14) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| | 239 | Multi-speed setting (speed 15) | 0 to 400Hz, 9999 | 0.01Hz | 9999 | 89 | |
| — | 240 | Soft-PWM operation selection | 0, 1 | 1 | 1 | 148 | |
| — | 241 | Analog input display unit switchover | 0, 1 | 1 | 0 | 153 | |
| — | 244 | Cooling fan operation selection | 0, 1 | 1 | 1 | 228 | |
| Slip compensation | 245 | Rated slip | 0 to 50%, 9999 | 0.01% | 9999 | 78 | |
| | 246 | Slip compensation time constant | 0.01 to 10s | 0.01s | 0.5s | 78 | |
| | 247 | Constant-power range slip compensation selection | 0, 9999 | 1 | 9999 | 78 | |
| — | 249 | Earth (ground) fault detection at start | 0, 1 | 1 | 0 | 146 | |
| — | 250 | Stop selection | 0 to 100s, 1000 to 1100s, 8888, 9999 | 0.1s | 9999 | 112, 117 | |
| — | 251 | Output phase loss protection selection | 0, 1 | 1 | 1 | 146 | |



| Parameter | Remarks | Instruction Code | | | Control Mode-based Correspondence Table | | Parameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Read | Write | Extended | V/F | GP MFVC | Copy | Clear | All clear |
| 166 | | 06 | 86 | 2 | ○ | ○ | ○ | ○ | ○ |
| 167 | | 07 | 87 | 2 | ○ | ○ | ○ | ○ | ○ |
| 168 | Parameter for manufacturer setting. Do not set. | | | | | | | | |
| 169 | | | | | | | | | |
| 170 | | 0A | 8A | 2 | ○ | ○ | ○ | × | ○ |
| 171 | | 0B | 8B | 2 | ○ | ○ | × | × | × |
| 178 | | 12 | 92 | 2 | ○ | ○ | ○ | × | ○ |
| 179 | | 13 | 93 | 2 | ○ | ○ | ○ | × | ○ |
| 180 | | 14 | 94 | 2 | ○ | ○ | ○ | × | ○ |
| 181 | | 15 | 95 | 2 | ○ | ○ | ○ | × | ○ |
| 182 | | 16 | 96 | 2 | ○ | ○ | ○ | × | ○ |
| 190 | | 1E | 9E | 2 | ○ | ○ | ○ | × | ○ |
| 192 | | 20 | A0 | 2 | ○ | ○ | ○ | × | ○ |
| 232 | | 28 | A8 | 2 | ○ | ○ | ○ | ○ | ○ |
| 233 | | 29 | A9 | 2 | ○ | ○ | ○ | ○ | ○ |
| 234 | | 2A | AA | 2 | ○ | ○ | ○ | ○ | ○ |
| 235 | | 2B | AB | 2 | ○ | ○ | ○ | ○ | ○ |
| 236 | | 2C | AC | 2 | ○ | ○ | ○ | ○ | ○ |
| 237 | | 2D | AD | 2 | ○ | ○ | ○ | ○ | ○ |
| 238 | | 2E | AE | 2 | ○ | ○ | ○ | ○ | ○ |
| 239 | | 2F | AF | 2 | ○ | ○ | ○ | ○ | ○ |
| 240 | | 30 | B0 | 2 | ○ | ○ | ○ | ○ | ○ |
| 241 | | 31 | B1 | 2 | ○ | ○ | ○ | ○ | ○ |
| 244 | | 34 | B4 | 2 | ○ | ○ | ○ | ○ | ○ |
| 245 | | 35 | B5 | 2 | ○ | ○ | ○ | ○ | ○ |
| 246 | | 36 | B6 | 2 | ○ | ○ | ○ | ○ | ○ |
| 247 | | 37 | B7 | 2 | ○ | ○ | ○ | ○ | ○ |
| 249 | | 39 | B9 | 2 | ○ | ○ | ○ | ○ | ○ |
| 250 | | 3A | BA | 2 | ○ | ○ | ○ | ○ | ○ |
| 251 | | 3B | BB | 2 | ○ | ○ | ○ | ○ | ○ |





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| Function | Parameter | Name | Setting Range | Minimum Setting Increments | Initial Value | Refer to Page | Customer Setting |
|---|---|---|---|---|---|---|---|
| Life diagnosis | 255 | Life alarm status display | (0 to 15) | 1 | 0 | 229 | |
| | 256 | Inrush current limit circuit life display | (0 to 100%) | 1% | 100% | 229 | |
| | 257 | Control circuit capacitor life display | (0 to 100%) | 1% | 100% | 229 | |
| | 258 | Main circuit capacitor life display | (0 to 100%) | 1% | 100% | 229 | |
| | 259 | Main circuit capacitor life measuring | 0, 1 (2, 3, 8, 9) | 1 | 0 | 229 | |
| — | 260 | PWM frequency automatic switchover | 0, 1 | 1 | 0 | 148 | |
| Power failure stop | 261 | Power failure stop selection | 0, 1, 2 | 1 | 0 | 142 | |
| — | 267 | Terminal 4 input selection | 0, 1, 2 | 1 | 0 | 150 | |
| — | 268 | Monitor decimal digits selection | 0, 1, 9999 | 1 | 9999 | 128 | |
| — | 269 | Parameter for manufacturer setting. Do not set. | | | | | |
| — | 295 | Magnitude of frequency change setting | 0, 0.01, 0.10, 1.00, 10.00 | 0.01 | 0 | 240 | |
| Password function | 296 | Password lock level | 1 to 6, 101 to 106, 9999 | 1 | 9999 | 163 | |
| | 297 | Password lock/unlock | 1000 to 9999 (0 to 5, 9999) | 1 | 9999 | 163 | |
| — | 298 | Frequency search gain | 0 to 32767, 9999 | 1 | 9999 | 136 | |
| — | 299 | Rotation direction detection selection at restarting | 0, 1, 9999 | 1 | 0 | 136 | |
| RS-485 communication | 338 | Communication operation command source | 0, 1 | 1 | 0 | 176 | |
| | 339 | Communication speed command source | 0, 1, 2 | 1 | 0 | 176 | |
| | 340 | Communication startup mode selection | 0, 1, 10 | 1 | 0 | 175 | |
| | 342 | Communication EEPROM write selection | 0, 1 | 1 | 0 | 187 | |
| | 343 | Communication error count | — | 1 | 0 | 200 | |
| Second motor constant | 450 | Second applied motor | 0, 1, 9999 | 1 | 9999 | 103 | |
| Remote Output | 495 | Remote output selection | 0, 1, 10, 11 | 1 | 0 | 126 | |
| | 496 | Remote output data 1 | 0 to 4095 | 1 | 0 | 126 | |
| — | 502 | Stop mode selection at communication error | 0, 1, 2 | 1 | 0 | 184, 200 | |
| Maintenance | 503 | Maintenance timer | 0 (1 to 9998) | 1 | 0 | 233 | |
| | 504 | Maintenance timer alarm output set time | 0 to 9998, 9999 | 1 | 9999 | 233 | |
| Communication | 549 | Protocol selection | 0, 1 | 1 | 0 | 200 | |
| | 551 | PU mode operation command source selection | 2, 4, 9999 | 1 | 9999 | 176 | |
| Current average time monitor | 555 | Current average time | 0.1 to 1s | 0.1s | 1s | 234 | |
| | 556 | Data output mask time | 0 to 20s | 0.1s | 0s | 234 | |
| | 557 | Current average value monitor signal output reference current | 0 to 500A | 0.01A | Rated inverter current | 234 | |
| — | 561 | PTC thermistor protection level | 0.5 to 30kΩ , 9999 | 0.01Ω | 9999 | 100 | |
| — | 563 | Energization time carrying-over times | (0 to 65535) | 1 | 0 | 128 | |



| Parameter | Remarks | Instruction Code Read | Write | Extended | Control Mode-based Correspondence Table V/F | GP MFVC | Parameter Copy | Clear | All clear |
|---|---|---|---|---|---|---|---|---|---|
| 255 | | 3F | BF | 2 | ○ | ○ | × | × | × |
| 256 | | 40 | C0 | 2 | ○ | ○ | × | × | × |
| 257 | | 41 | C1 | 2 | ○ | ○ | × | × | × |
| 258 | | 42 | C2 | 2 | ○ | ○ | × | × | × |
| 259 | | 43 | C3 | 2 | ○ | ○ | ○ | ○ | ○ |
| 260 | | 44 | C4 | 2 | ○ | ○ | ○ | ○ | ○ |
| 261 | | 45 | C5 | 2 | ○ | ○ | ○ | ○ | ○ |
| 267 | | 4B | CB | 2 | ○ | ○ | ○ | × | ○ |
| 268 | | 4C | CC | 2 | ○ | ○ | ○ | ○ | ○ |
| 269 | Parameter for manufacturer setting. Do not set. | | | | | | | | |
| 295 | | 67 | E7 | 2 | ○ | ○ | ○ | ○ | ○ |
| 296 | | 68 | E8 | 2 | ○ | ○ | ○ | × | ○ |
| 297 | | 69 | E9 | 2 | ○ | ○ | ○ | × | ○ |
| 298 | | 6A | EA | 2 | ○ | ○ | ○ | × | ○ |
| 299 | | 6B | EB | 2 | ○ | ○ | ○ | ○ | ○ |
| 338 | | 26 | A6 | 3 | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 339 | | 27 | A7 | 3 | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 340 | | 28 | A8 | 3 | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 342 | | 2A | AA | 3 | ○ | ○ | ○ | ○ | ○ |
| 343 | | 2B | AB | 3 | ○ | ○ | × | × | × |
| 450 | | 32 | B2 | 4 | ○ | ○ | ○ | ○ | ○ |
| 495 | | 5F | DF | 4 | ○ | ○ | ○ | ○ | ○ |
| 496 | | 60 | E0 | 4 | ○ | ○ | × | × | × |
| 502 | | 02 | 82 | 5 | ○ | ○ | ○ | ○ | ○ |
| 503 | | 03 | 83 | 5 | ○ | ○ | × | × | × |
| 504 | | 04 | 84 | 5 | ○ | ○ | ○ | × | ○ |
| 549 | | 31 | B1 | 5 | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 551 | | 33 | B3 | 5 | ○ | ○ | ○ | ○ *7 | ○ *7 |
| 555 | | 37 | B7 | 5 | ○ | ○ | ○ | ○ | ○ |
| 556 | | 38 | B8 | 5 | ○ | ○ | ○ | ○ | ○ |
| 557 | | 39 | B9 | 5 | ○ | ○ | ○ | ○ | ○ |
| 561 | | 3D | BD | 5 | ○ | ○ | ○ | × | ○ |
| 563 | | 3F | BF | 5 | ○ | ○ | × | × | × |





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| Function | Parameter | Name | Setting Range | Minimum Setting Increments | Initial Value | Refer to Page | Customer Setting |
|---|---|---|---|---|---|---|---|
| — | 564 | Operating time carrying-over times | (0 to 65535) | 1 | 0 | *128* | |
| — | 571 | Holding time at a start | 0 to 10s, 9999 | 0.1s | 9999 | *98* | |
| PID operation | 575 | Output interruption detection time | 0 to 3600s, 9999 | 0.1s | 1s | *212* | |
| | 576 | Output interruption detection level | 0 to 400Hz | 0.01Hz | 0Hz | *212* | |
| | 577 | Output interruption cancel level | 900 to 1100% | 0.1% | 1000% | *212* | |
| — | 611 | Acceleration time at a restart | 0 to 3600s, 9999 | 0.1s | 9999 | *136* | |
| — | 653 | Speed smoothing control | 0 to 200% | 0.1% | 0 | *149* | |
| — | 665 | Regeneration avoidance frequency gain | 0 to 200% | 0.1% | 100 | *226* | |
| Protective functions | 872 *8 | Input phase loss protection selection | 0, 1 | 1 | 0 | *146* | |
| Regeneration avoidance function | 882 | Regeneration avoidance operation selection | 0, 1, 2 | 1 | 0 | *226* | |
| | 883 | Regeneration avoidance operation level | 300 to 800V | 0.1V | 400VDC/ 780VDC *5 | *226* | |
| | 885 | Regeneration avoidance compensation frequency limit value | 0 to 10Hz, 9999 | 0.01Hz | 6Hz | *226* | |
| | 886 | Regeneration avoidance voltage gain | 0 to 200% | 0.1% | 100% | *226* | |
| Free parameter | 888 | Free parameter 1 | 0 to 9999 | 1 | 9999 | *236* | |
| | 889 | Free parameter 2 | 0 to 9999 | 1 | 9999 | *236* | |
| — | 891 | Cumulative power monitor digit shifted times | 0 to 4, 9999 | 1 | 9999 | *128* | |
| Calibration parameters | C1 (901) *6 | AM terminal calibration | — | — | — | *134* | |
| | C2 (902) *6 | Terminal 2 frequency setting bias frequency | 0 to 400Hz | 0.01Hz | 0Hz | *153* | |
| | C3 (902) *6 | Terminal 2 frequency setting bias | 0 to 300% | 0.1% | 0% | *153* | |
| | 125 (903) *6 | Terminal 2 frequency setting gain frequency | 0 to 400Hz | 0.01Hz | 60Hz | *153* | |
| | C4 (903) *6 | Terminal 2 frequency setting gain | 0 to 300% | 0.1% | 100% | *153* | |
| | C5 (904) *6 | Terminal 4 frequency setting bias frequency | 0 to 400Hz | 0.01Hz | 0Hz | *153* | |
| | C6 (904) *6 | Terminal 4 frequency setting bias | 0 to 300% | 0.1% | 20% | *153* | |
| | 126 (905) *6 | Terminal 4 frequency setting gain frequency | 0 to 400Hz | 0.01Hz | 60Hz | *153* | |
| | C7 (905) *6 | Terminal 4 frequency setting gain | 0 to 300% | 0.1% | 100% | *153* | |
| — | C22 to C25 (922 to 923) | Parameter for manufacturer setting. Do not set. | | | | | |
| PU | 990 | PU buzzer control | 0, 1 | 1 | 1 | *241* | |
| | 991 | PU contrast adjustment | 0 to 63 | 1 | 58 | *241* | |



| Parameter | Remarks | Instruction Code | | | Control Mode-based Correspondence Table | | Parameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Read | Write | Extended | V/F | GP MFVC | Copy | Clear | All clear |
| 564 | | *40* | *C0* | *5* | ○ | ○ | × | × | × |
| 571 | | *47* | *C7* | *5* | ○ | ○ | ○ | ○ | ○ |
| 575 | | *4B* | *CB* | *5* | ○ | ○ | ○ | ○ | ○ |
| 576 | | *4C* | *CC* | *5* | ○ | ○ | ○ | ○ | ○ |
| 577 | | *4D* | *CD* | *5* | ○ | ○ | ○ | ○ | ○ |
| 611 | | *0B* | *8B* | *6* | ○ | ○ | ○ | ○ | ○ |
| 653 | | *35* | *B5* | *6* | ○ | ○ | ○ | ○ | ○ |
| 665 | | *41* | *C1* | *6* | ○ | ○ | ○ | ○ | ○ |
| 872 | | *48* | *C8* | *8* | ○ | ○ | ○ | ○ | ○ |
| 882 | | *52* | *D2* | *8* | ○ | ○ | ○ | ○ | ○ |
| 883 | | *53* | *D3* | *8* | ○ | ○ | ○ | ○ | ○ |
| 885 | | *55* | *D5* | *8* | ○ | ○ | ○ | ○ | ○ |
| 886 | | *56* | *D6* | *8* | ○ | ○ | ○ | ○ | ○ |
| 888 | | *58* | *D8* | *8* | ○ | ○ | ○ | × | × |
| 889 | | *59* | *D9* | *8* | ○ | ○ | ○ | × | × |
| 891 | | *5B* | *D8* | *8* | ○ | ○ | ○ | ○ | ○ |
| C1 (901) | | *5D* | *DD* | *1* | ○ | ○ | ○ | × | ○ |
| C2 (902) | | *5E* | *DE* | *1* | ○ | ○ | ○ | × | ○ |
| C3 (902) | | *5E* | *DE* | *1* | ○ | ○ | ○ | × | ○ |
| 125 (903) | | *5F* | *DF* | *1* | ○ | ○ | ○ | × | ○ |
| C4 (903) | | *5F* | *DF* | *1* | ○ | ○ | ○ | × | ○ |
| C5 (904) | | *60* | *E0* | *1* | ○ | ○ | ○ | × | ○ |
| C6 (904) | | *60* | *E0* | *1* | ○ | ○ | ○ | × | ○ |
| 126 (905) | | *61* | *E1* | *1* | ○ | ○ | ○ | × | ○ |
| C7 (905) | | *61* | *E1* | *1* | ○ | ○ | ○ | × | ○ |
| C22 to C25 (922 to 923) | Parameter for manufacturer setting. Do not set. | | | | | | | | |
| 990 | | *5A* | *DA* | *9* | ○ | ○ | ○ | ○ | ○ |
| 991 | | *5B* | *DB* | *9* | ○ | ○ | ○ | × | ○ |





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| Function | Parameter | Name | Setting Range | Minimum Setting Increments | Initial Value | Refer to Page | Customer Setting |
|---|---|---|---|---|---|---|---|
| Clear parameters Initial value change list | Pr.CL | Parameter clear | 0, 1 | 1 | 0 | *242* | |
| | ALLC | All parameter clear | 0, 1 | 1 | 0 | *242* | |
| | Er.CL | Faults history clear | 0, 1 | 1 | 0 | *244* | |
| | Pr.CH | Initial value change list | — | — | — | *243* | |

*1 Differ according to capacities.
6%: FR-D720-042 or less, FR-D740-022 or less, FR-D720S-042 or less
4%: FR-D720-070 to 165, FR-D740-036 to 080, FR-D720S-070 and 100
3%: FR-D720-238 and 318, FR-D740-120 and 160

*2 Differ according to capacities.
5s: FR-D720-165 or less, FR-D740-080 or less, FR-D720S-008 to 100
10s: FR-D720-238 and 318, FR-D740-120 and 160

*3 Differ according to capacities.
6%: FR-D720-008 and 014, FR-D720S-008 and 014
4%: FR-D720-025 or more, FR-D740-012 or more, FR-D720S-025 or more

*4 Write is disabled in the communication mode (network operation mode) from the PU connector.

*5 The initial value differs according to the voltage class. (200V class, 400V class)

*6 The parameter number in parentheses is the one for use with the operation panel (PA02) for the FR-E500 series or parameter unit (FR-PU04/FR-PU07).

*7 These parameters are communication parameters that are not cleared when parameter clear (all clear) is executed from RS-485 communication. (*Refer to page 180* for RS-485 communication)

*8 Available only for the three-phase power input specification model.



| Parameter | Remarks | Instruction Code | | | Control Mode-based Correspondence Table | | Parameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Read | Write | Extended | V/F | GP MFVC | Copy | Clear | All clear |
| Pr.CL | | — | — | — | — | — | — | — | — |
| ALLC | | — | — | — | — | — | — | — | — |
| Er.CL | | — | — | — | — | — | — | — | — |
| Pr.CH | | — | — | — | — | — | — | — | — |





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# 4.3 Adjust the output torque (current) of the motor

| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Set starting torque manually | Manual torque boost | Pr. 0, Pr. 46 | 73 |
| Automatically control output current according to load | General-purpose magnetic flux vector control | Pr. 71, Pr. 80 | 75 |
| Compensate for motor slip to secure low-speed torque | Slip compensation | Pr. 245 to Pr. 247 | 78 |
| Limit output current to prevent inverter trip | Stall prevention operation | Pr. 22, Pr. 23, Pr. 66, Pr. 156, Pr. 157 | 79 |

## 4.3.1 Manual torque boost (Pr. 0, Pr. 46) V/F

Motor torque reduction in the low-speed range can be improved by compensating a voltage drop in the low-frequency range.

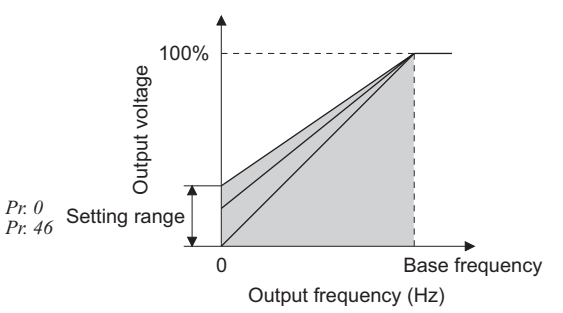
- Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
- Two kinds of start torque boosts can be changed by switching between terminals.

| Parameter Number | Name | Initial Value | | Setting Range | Description |
|---|---|---|---|---|---|
| 0 | Torque boost | FR-D720-042 or less<br>FR-D740-022 or less<br>FR-D720S-008 to 042 | 6% | 0 to 30% | Set the output voltage at 0Hz as %. |
| | | FR-D720-070 to 165<br>FR-D740-036 to 080<br>FR-D720S-070 and 100 | 4% | | |
| | | FR-D720-238 and 318<br>FR-D740-120 and 160 | 3% | | |
| 46 * | Second torque boost | 9999 | | 0 to 30% | Set the torque boost when the RT signal is on. |
| | | | | 9999 | Without second torque boost |

* The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

### (1) Starting torque adjustment

- On the assumption that *Pr. 19 Base frequency voltage* is 100%, set the output voltage at 0Hz in % to *Pr. 0 (Pr. 46)*.
- Adjust the parameter little by little (about 0.5%), and check the motor status each time. If the setting is too large, the motor will overheat. The guideline is about 10% at the greatest.




### (2) Set two kinds of torque boosts (RT signal, *Pr. 46*)

- When you want to change torque boost according to applications, switch multiple motors with one inverter, etc., use *Second torque boost*.
- *Pr. 46 Second torque boost* is valid when the RT signal is on.
- For the terminal used for RT signal input, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

**REMARKS**

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 116)*





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## Adjust the output torque (current) of the motor

### NOTE

- The amount of current flows in the motor may become large according to the conditions such as the motor characteristics, load, acceleration/deceleration time, wiring length, etc., resulting in an overcurrent trip (OL (overcurrent alarm) then E.OC1 (overcurrent trip during acceleration), overload trip (E.THM (motor overload trip), or 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 248*.)
- The *Pr. 0, Pr. 46* settings are valid only when V/F control is selected.
- When using the inverter dedicated motor (constant torque motor) with the FR-D720-238 and 318, FR-D740-120 and 160, set torque boost value to 2%.
  When *Pr. 0* = "3%"(initial value), if *Pr. 71* value is changed to the setting for use with a constant-torque motor, the *Pr. 0* setting changes to 2%.
- Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.

### Parameters referred to

*Pr. 3 Base frequency, Pr. 19 Base frequency voltage* ☞ *Refer to page 85*
*Pr. 71 Applied motor* ☞ *Refer to page 103*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*



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### 4.3.2 Large starting torque and low speed torque are necessary (General-purpose magnetic flux vector control (Pr. 71, Pr. 80)) GP MFVC

General-purpose magnetic flux vector control is available.

Large starting torque and low speed torque are available with General-purpose magnetic flux vector control.

● What is General-purpose 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. With setting slip compensation *(Pr. 245 to Pr. 247),* output frequency compensation (slip compensation) is made so that the actual motor speed goes closer to a speed command value. Effective when load fluctuates drastically, etc.

General-purpose magnetic flux vector control is the same function as the FR-E500 series.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **71** | **Applied motor** | 0 | 0,1, 3, 13, 23, 40, 43 50, 53 | By selecting a standard motor or constant torque motor, thermal characteristic and motor constants of each motor are set. |
| **80** | **Motor capacity** | 9999 | 0.1 to 7.5kW | Applied motor capacity. (General-purpose magnetic flux vector control) |
| | | | 9999 | V/F control |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

**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 should be 0.1kW or more)
- Motor to be used is any of Mitsubishi standard motor, high efficiency motor (SF-JR, SF-HR 0.2kW or more) or Mitsubishi constant torque motor (SF-JRCA four-pole, SF-HRCA 0.4kW to 7.5kW). 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.
- The wiring length from inverter to motor should be within 30m (98.42feet). (Perform offline auto tuning in the state where wiring work is performed when the wiring length exceeds 30m (98.42feet).)
  Permissible wiring length between inverter and motor differs according to the inverter capacity and setting value of *Pr. 72 PWM frequency selection* (carrier frequency). *Refer to page 19* for the permissible wiring length.

#### (1) Control mode

- V/F control (initial setting) and General-purpose magnetic flux vector control are available with this inverter.
- V/F control is for controlling frequency and voltage so that the ratio of frequency (F) to voltage (V) is constant when changing frequency.
- General-purpose magnetic flux vector control divides the inverter output current into an excitation current and a torque current by vector calculation, and makes voltage compensation to flow a motor current which meets the load torque. (General-purpose magnetic flux vector control is the same function as the FR-E500 series.)





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### (2) Selection method of General-purpose magnetic flux vector control

**Perform secure wiring.**
*(Refer to page 14)*

↓

**Display the extended function parameters.**
*(Pr. 160) (Refer to page 162)*

Set "0" in *Pr. 160* to display the extended function parameters.

↓

**Set the motor.** *(Pr. 71)*

| Motor | | *Pr. 71* Setting ∗1 | Remarks |
|---|---|---|---|
| Mitsubishi standard motor | SF-JR | 0 (initial value) | |
| | SF-HR | 40 | |
| Mitsubishi high efficiency motor | Others | 3 | Offline auto tuning is necessary. ∗2 |
| Mitsubishi constant-torque motor | SF-JRCA 4P | 1 | |
| | SF-HRCA | 50 | |
| | Others (SF-JRC, etc.) | 13 | Offline auto tuning is necessary. ∗2 |
| Other standard motor | — | 3 | Offline auto tuning is necessary. ∗2 |
| Other constant-torque motor | — | 13 | Offline auto tuning is necessary. ∗2 |

∗1 *Refer to page 103* for other settings of *Pr. 71*.
∗2 *Refer to page 105* for offline auto tuning.

↓

**Set the motor capacity.**
*(Pr. 80) (Refer to page 74)*

Set motor capacity (kW) in *Pr. 80 Motor capacity*.
(V/F control is performed when the setting is "9999" (initial value).

↓

**Set the operation command.** *(Refer to page 165)*

Select the start command and speed command.
(1)Start command
1)Operation panel: Setting by pressing RUN of the operation panel
2)External command: Setting by forward rotation or reverse rotation command (terminal STF or STR)
(2)Speed command
1)Operation panel: Setting by turning of the operation panel
2)External analog command (terminal 2 or 4):
Give a speed command using the analog signal input to terminal 2 (or terminal 4).
3)Multi-speed command:
The external signals (RH, RM, RL) may also be used to give speed command.

↓

**Test run**

**As required**
- Perform offline auto tuning. *(Pr. 96) (Refer to page 105)*
- Set motor excitation current. *(Pr. 82) (Refer to page 105)*
- Set slip compensation. *(Pr. 245, Pr. 246, Pr. 247) (Refer to page 78)*

**NOTE**

- **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.)**
- **When a surge voltage suppression filter (FR-ASF-H/FR-BMF-H) is connected between the inverter and motor, output torque may decrease.**



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### (3) Control method switching by external terminals (X18 signal)

- Use the V/F switchover signal (X18) to change the control method (V/F control and General-purpose magnetic flux vector control) with external terminal.
- Turn the X18 signal on to change the currently selected control method (General-purpose magnetic flux vector control) to V/F control.

For the terminal used for X18 signal input, set "18" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

**REMARKS**

When V/F control is selected by V/F switchover (X18 signal), second function is also selected at the same time. Control between V/F control and General-purpose magnetic flux vector control can not be switched while the inverter is running. In case control is switched between V/F control and General-purpose magnetic flux vector control, only second function is selected.

**NOTE**

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

**Parameters referred to**

*Pr.3 Base frequency, Pr.19 Base frequency voltage* ☞ *Refer to page 85*
*Pr.71 Applied motor* ☞ *Refer to page 103*
*Pr.77 Parameter write selection* ☞ *Refer to page 161*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*





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### 4.3.3 Slip compensation (Pr. 245 to Pr. 247)

Inverter output current may be used to assume motor slip to keep the motor speed constant.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **245** | **Rated slip** | 9999 | 0.01 to 50% | Rated motor slip |
| | | | 0, 9999 | No slip compensation |
| **246** | **Slip compensation time constant** | 0.5s | 0.01 to 10s | Slip compensation response time. When the value is made smaller, response will be faster. However, as load inertia is greater, a regenerative overvoltage fault (E.OV□) is more liable to occur. |
| **247** | **Constant-power range slip compensation selection** | 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. |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

- Slip compensation is validated when the motor rated slip calculated by the following formula is set in *Pr. 245*. Slip compensation is not made when *Pr. 245* = "0" or "9999".

$$\text{Rated slip} = \frac{\text{Synchronous speed at base frequency - rated speed}}{\text{Synchronous speed at base frequency}} \times 100[\%]$$

**REMARKS**

- When performing slip compensation, the output frequency may become greater than the set frequency. Set the *Pr. 1 Maximum frequency* value a little higher than the set frequency.

**Parameters referred to**

*Pr. 1 Maximum frequency* ☞ *Refer to page 83*
*Pr. 3 Base frequency* ☞ *Refer to page 85*



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### *4.3.4 Stall prevention operation (Pr. 22, Pr. 23, Pr. 48, Pr. 66, Pr. 156, Pr. 157)*

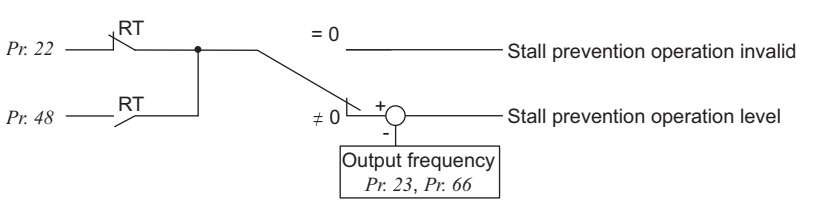
This function monitors the output current and automatically changes the output frequency to prevent the inverter from coming to trip due to overcurrent, overvoltage, etc.
It can also limit stall prevention and fast-response current limit operation during acceleration/deceleration, driving or regeneration.

- ●Stall prevention
  If the output current exceeds the stall prevention operation level, the output frequency of the inverter is automatically changed to reduce the output current.
- ●Fast-response current limit
  If the current exceeds the limit value, the output of the inverter is shut off to prevent an overcurrent.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **22** | **Stall prevention operation level** | 150% | 0 | Stall prevention operation invalid |
| | | | 0.1 to 200% | Set the current value to start the stall prevention operation. |
| **23** | **Stall prevention operation level compensation factor at double speed** | 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** | 9999 | 0 | Stall prevention operation invalid |
| | | | 0.1 to 200% | Second stall prevention operation level |
| | | | 9999 | Same level as *Pr. 22*. |
| **66** | **Stall prevention operation reduction starting frequency** | 60Hz | 0 to 400Hz | Set the frequency at which the stall operation level is started to reduce. |
| **156** | **Stall prevention operation selection** | 0 | 0 to 31, 100, 101 | Select whether stall prevention operation and fast-response current limit operation will be performed or not. |
| **157** | **OL signal output timer** | 0s | 0 to 25s | Output start time of the OL signal output when stall prevention is activated. |
| | | | 9999 | Without the OL signal output |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

#### (1) Block diagram

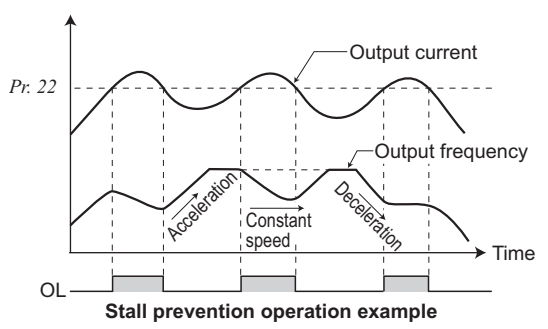







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### (2) Setting of stall prevention operation level *(Pr. 22)*



**Stall prevention operation example**

- Set in *Pr. 22* the percentage of the output current to the rated inverter current at which stall prevention operation will be performed. Normally set this parameter to 150% (initial value).
- Stall prevention operation stops acceleration (makes deceleration) during acceleration, makes deceleration during constant speed, and stops deceleration (makes acceleration) during deceleration.
- When stall prevention operation is performed, the OL signal is output.

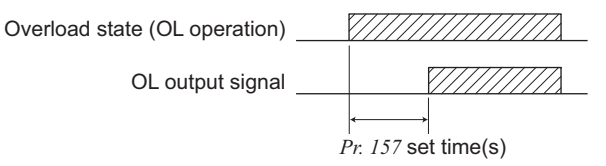
**NOTE**

- **If an overload status lasts long, an inverter trip (e.g. electronic thermal O/L relay (E.THM)) may occur.**

### (3) Stall prevention operation signal output and output timing adjustment (OL signal, *Pr. 157*)

- When the output current exceeds the stall prevention operation level and stall prevention is activated, the stall prevention operation signal (OL signal) turns on for longer than 100ms. When the output current falls to or below the stall prevention operation level, the output signal turns off.
- Use *Pr. 157 OL signal output timer* to set whether the OL signal is output immediately or after a preset period of time.
- This operation is also performed when the regeneration avoidance function or oL (overvoltage stall) is executed.
- For the OL signal, set "3 (positive logic) or 103 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)* and assign functions to the output terminal.

| *Pr. 157* Setting | Description |
|---|---|
| 0 (initial value) | Output immediately. |
| 0.1 to 25 | Output after the set time (s) has elapsed. |
| 9999 | Not output. |



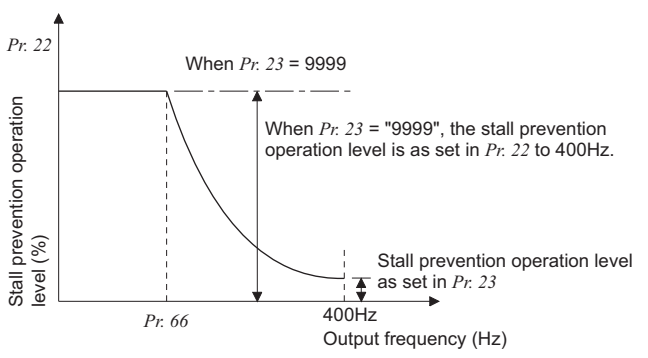

**NOTE**

- **If the frequency has fallen to 1Hz by stall prevention operation and remains for 3s, a fault (E.OLT) appears to trip the inverter output.**
- **Changing the terminal assignment using *Pr. 190, Pr. 192 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

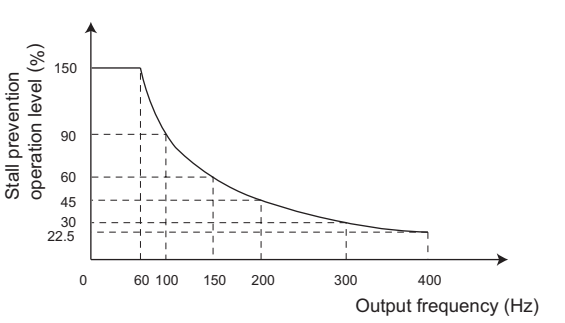


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### (4) Setting of stall prevention operation in high frequency range *(Pr. 22, Pr. 23, Pr. 66)*




Setting example (*Pr. 22* = 150%, *Pr. 23* = 100%, *Pr. 66* = 60Hz)




•During high-speed operation above the rated motor frequency, acceleration may not be made because the motor current does not increase. If operation is performed in a high frequency range, the current at motor lockup becomes smaller than the rated output current of the inverter, and the protective function (OL) is not executed even if the motor is at a stop.
To improve the operating characteristics of the motor in this case, the stall prevention level can be reduced in the high frequency range. This function is effective for performing operation up to the high-speed range on a centrifugal separator, etc. Normally, set 60Hz in *Pr. 66* and 100% in *Pr. 23*.

•Formula for stall prevention operation level

$$\text{Stall prevention operation level in high frequency range (\%)} = A + B \times \left[\frac{Pr.\ 22 - A}{Pr.\ 22 - B}\right] \times \left[\frac{Pr.\ 23 - 100}{100}\right]$$

$$\text{However,}\quad A = \frac{Pr.\ 66\ (\text{Hz}) \times Pr.\ 22\ (\%)}{\text{Output frequency (Hz)}},\quad B = \frac{Pr.\ 66\ (\text{Hz}) \times Pr.\ 22\ (\%)}{400\text{Hz}}$$

•By setting "9999" (initial value) in *Pr. 23 Stall prevention operation level compensation factor at double speed*, the stall prevention operation level is constant at the *Pr. 22* setting up to 400Hz.

### (5) Set two types of stall prevention operation levels *(Pr. 48)*

•Turning RT signal on makes *Pr. 48 Second stall prevention operation current* valid.

•For the terminal used for RT signal input, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

**NOTE**

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**
- **The RT signal acts the second function selection signal and makes the other second functions valid.**
  ***(Refer to page 116)***





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### (6) Limit the stall prevention operation and fast-response current limit operation according to the operating status *(Pr. 156)*

•Refer to the following table and select whether stall prevention operation and fast-response current limit operation will be performed or not and the operation to be performed at OL signal output.

| *Pr. 156* Setting | Fast-Response Current Limit ○: Activated ●: Not activated | Stall Prevention Operation Selection ○: Activated ●: Not activated | | | OL Signal Output ○:Operation continued ●: Operation not continued *1 |
|---|---|---|---|---|---|
| | | Acceleration | Constant speed | Deceleration | |
| 0 (initial value) | ○ | ○ | ○ | ○ | ○ |
| 1 | ● | ○ | ○ | ○ | ○ |
| 2 | ○ | ● | ○ | ○ | ○ |
| 3 | ● | ● | ○ | ○ | ○ |
| 4 | ○ | ○ | ● | ○ | ○ |
| 5 | ● | ○ | ● | ○ | ○ |
| 6 | ○ | ● | ● | ○ | ○ |
| 7 | ● | ● | ● | ○ | ○ |
| 8 | ○ | ○ | ○ | ● | ○ |
| 9 | ● | ○ | ○ | ● | ○ |
| 10 | ○ | ● | ○ | ● | ○ |
| 11 | ● | ● | ○ | ● | ○ |
| 12 | ○ | ○ | ● | ● | ○ |
| 13 | ● | ○ | ● | ● | ○ |
| 14 | ○ | ● | ● | ● | — *2 |
| 15 | ● | ● | ● | ● | — *2 |
| 16 | ○ | ○ | ○ | ○ | ● |
| 17 | ● | ○ | ○ | ○ | ● |
| 18 | ○ | ● | ○ | ○ | ● |
| 19 | ● | ● | ○ | ○ | ● |
| 20 | ○ | ○ | ● | ○ | ● |
| 21 | ● | ○ | ● | ○ | ● |
| 22 | ○ | ● | ● | ○ | ● |
| 23 | ● | ● | ● | ○ | ● |
| 24 | ○ | ○ | ○ | ● | ● |
| 25 | ● | ○ | ○ | ● | ● |
| 26 | ○ | ● | ○ | ● | ● |
| 27 | ● | ● | ○ | ● | ● |
| 28 | ○ | ○ | ● | ● | ● |
| 29 | ● | ○ | ● | ● | ● |
| 30 | ○ | ● | ● | ● | — *2 |
| 31 | ● | ● | ● | ● | — *2 |
| 100 *3 Power driving | ○ | ○ | ○ | ○ | ○ |
| 100 *3 Regeneration | ● | ● | ● | ● | — *2 |
| 101 *3 Power driving | ● | ○ | ○ | ○ | ○ |
| 101 *3 Regeneration | ● | ● | ● | ● | — *2 |

*1 When "Operation not continued for OL signal output" is selected, the E.OLT fault (stopped by stall prevention) is displayed and operation is stopped.

*2 Since stall prevention is not activated, OL signal and E.OLT are not output.

*3 The settings "100" and "101" allow operations to be performed in the driving and regeneration modes, respectively. The setting "101" disables the fast-response current limit in the driving mode.

**NOTE**

- **When the load is heavy or the acceleration/deceleration time is short, stall prevention is activated and acceleration/deceleration may not be made according to the preset acceleration/deceleration time. Set *Pr. 156* and stall prevention operation level to the optimum values.**
- **In vertical lift applications, make setting so that the fast-response current limit is not activated. Torque may not be produced, causing a load drop due to gravity.**

**CAUTION**

**Do not set a small value as the stall prevention operation current.
Otherwise, torque generated will reduce.**

**Test operation must be performed.
Stall prevention operation during acceleration may increase the acceleration time.
Stall prevention operation performed during constant speed may cause sudden speed changes.
Stall prevention operation during deceleration may increase the deceleration time, increasing the deceleration distance.**

**Parameters referred to**

- *Pr. 3 Base frequency* *Refer to page 85*
- *Pr. 178 to Pr. 182 (input terminal function selection)* *Refer to page 113*
- *Pr. 190, Pr. 192 (output terminal function selection)* *Refer to page 119*



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## 4.4 Limit the output frequency

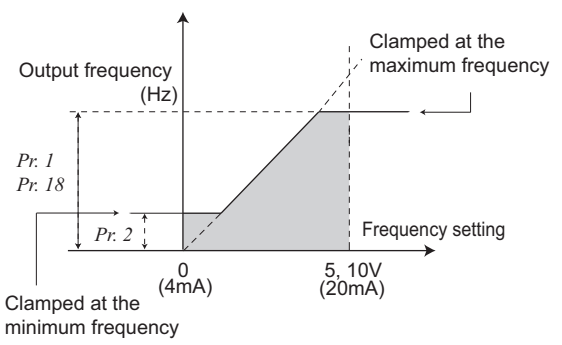
| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Set upper limit and lower limit of output frequency | Maximum/minimum frequency | Pr. 1, Pr. 2, Pr. 18 | 83 |
| Perform operation by avoiding mechanical resonance points | Frequency jump | Pr. 31 to Pr. 36 | 84 |

### 4.4.1 Maximum/minimum frequency (Pr. 1, Pr. 2, Pr. 18)

Motor speed can be limited.
Clamp the upper and lower limits of the output frequency.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 1 | Maximum frequency | 120Hz | 0 to 120Hz | Upper limit of the output frequency. |
| 2 | Minimum frequency | 0Hz | 0 to 120Hz | Lower limit of the output frequency. |
| 18 * | High speed maximum frequency | 120Hz | 120 to 400Hz | Set when performing the operation at 120Hz or more. |

* The above parameters can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 162)*




#### (1) Set maximum frequency

- Use *Pr. 1 Maximum frequency* to set the maximum frequency. If the frequency of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.
- To perform operation above 120Hz, set the upper limit of the output frequency to *Pr. 18 High speed maximum frequency*.
  (When *Pr. 18* is set, *Pr. 1* automatically switches to the frequency of *Pr. 18*. Also, when *Pr. 1* is set, *Pr. 18* is automatically changed to the frequency set in *Pr. 1*.

**REMARKS**

- When performing operation above 60Hz using the frequency setting analog signal, change *Pr. 125 (Pr. 126) (frequency setting gain).*

#### (2) Set minimum frequency

- Use *Pr. 2 Minimum frequency* to set the minimum frequency.
- If the set frequency is less than *Pr. 2*, the output frequency is clamped at *Pr. 2* (will not fall below *Pr. 2* ).

**REMARKS**

- When *Pr. 15 Jog frequency* is equal to or less than *Pr. 2*, the *Pr. 15* setting has precedence over the *Pr. 2* setting.
- When stall prevention is activated to decrease the output frequency, the output frequency may drop to *Pr. 2* or below.

**⚠ CAUTION**

**⚠ Note that when *Pr. 2* is set to any value equal to or more than *Pr. 13 Starting frequency*, simply turning on the start signal will run the motor at the preset frequency according to the set acceleration time even if the command frequency is not input.**

**Parameters referred to**

*Pr. 13 Starting frequency* ☞ *Refer to page 98*
*Pr. 15 Jog frequency* ☞ *Refer to page 91*
*Pr. 125 Terminal 2 frequency setting gain frequency, Pr. 126 Terminal 4 frequency setting gain frequency* ☞ *Refer to page 153*





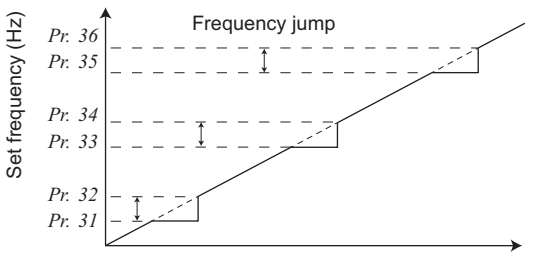
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### 4.4.2 Avoid mechanical resonance points (frequency jumps) (Pr. 31 to Pr. 36)

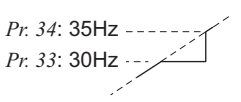
When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 31 | Frequency jump 1A | 9999 | 0 to 400Hz, 9999 | 1A to 1B, 2A to 2B, 3A to 3B are frequency jumps<br>9999: Function invalid |
| 32 | Frequency jump 1B | 9999 | 0 to 400Hz, 9999 | |
| 33 | Frequency jump 2A | 9999 | 0 to 400Hz, 9999 | |
| 34 | Frequency jump 2B | 9999 | 0 to 400Hz, 9999 | |
| 35 | Frequency jump 3A | 9999 | 0 to 400Hz, 9999 | |
| 36 | Frequency jump 3B | 9999 | 0 to 400Hz, 9999 | |

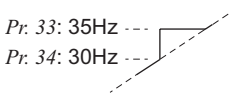
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*




- Up to three areas may be set, with the jump frequencies set to either the top or bottom point of each area.
- The value set to 1A, 2A or 3A is a jump point, and operation in the jump zone is performed at these frequencies.




Example 1 To fix the frequency to 30Hz in the range of 30Hz to 35Hz, set 35Hz in *Pr. 34* and 30Hz in *Pr. 33*.




Example 2 To jump the frequency to 35Hz in the range of 30Hz to 35Hz, set 35Hz in *Pr. 33* and 30Hz in *Pr. 34*.

**NOTE**

**During acceleration/deceleration, the running frequency within the set area is valid.**



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# 4.5 Set V/F pattern

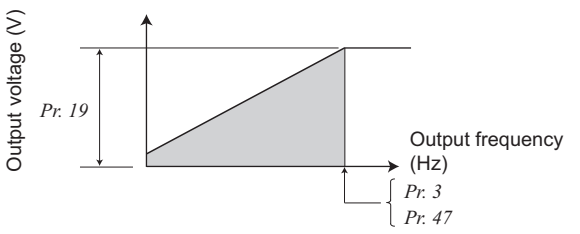
| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Set motor ratings | Base frequency,<br>Base frequency voltage | Pr. 3, Pr. 19, Pr. 47 | *85* |
| Select a V/F pattern according to applications. | Load pattern selection | Pr. 14 | *87* |

## *4.5.1 Base frequency, voltage (Pr. 3, Pr. 19, Pr. 47)* V/F

Used to adjust the inverter outputs (voltage, frequency) to the motor rating.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 3 | Base frequency | 60Hz | 0 to 400Hz | Rated motor frequency (50Hz/60Hz) |
| 19 * | Base frequency voltage | 9999 | 0 to 1000V | Base voltage |
| | | | 8888 | 95% of power supply voltage |
| | | | 9999 | Same as power supply voltage |
| 47 * | Second V/F (base frequency) | 9999 | 0 to 400Hz | Base frequency when the RT signal is on |
| | | | 9999 | Second V/F invalid |

* The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*




### (1) Base frequency setting *(Pr. 3)*

- When operating a standard motor, generally set the rated frequency of the motor to *Pr. 3 Base frequency*. When running the motor using commercial power supply-inverter switch-over operation, set *Pr. 3* to the same value as the power supply frequency.
- If the frequency given on the motor rating plate is "50Hz" only, always set to "50Hz". Leaving the base frequency unchanged from "60Hz" may make the voltage too low and the torque insufficient. It may result in an inverter trip due to overload.
  Special care must be taken when "1" (variable torque load) is set in *Pr. 14 Load pattern selection* .
- When using the Mitsubishi constant-torque motor, set *Pr. 3* to 60Hz.

### (2) Set two kinds of base frequencies *(Pr. 47)*

- To change the base frequency when switching two types of motors with one inverter, use the *Pr. 47 Second V/F (base frequency)*.

- *Pr. 47 Second V/F (base frequency)* is valid when the RT signal is on. Set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* and assign the RT signal.

**REMARKS**

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 116)*





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### (3) Base frequency voltage setting *(Pr. 19)*

•Use *Pr. 19 Base frequency voltage* to set the base voltage (e.g. rated motor voltage).
•If the setting is less than the power supply voltage, the maximum output voltage of the inverter is as set in *Pr. 19*.
•*Pr. 19* can be utilized in the following cases.

(a) When regeneration is high (e.g. continuous regeneration)

During regeneration, the output voltage becomes higher than the reference and may cause an overcurrent trip (E.OC☐) due to an increased motor current.

(b) When power supply voltage variation is large

When the power supply voltage exceeds the rated voltage of the motor, speed variation or motor overheat may be caused by excessive torque or increased motor current.

**NOTE**

- **When General-purpose magnetic flux vector control is selected, *Pr. 3, Pr. 47* and *Pr. 19* are invalid and *Pr. 83* and *Pr. 84* are valid.**
  **Note that *Pr. 3* or *Pr. 47* value is valid as inflection points of S-pattern when *Pr. 29 Acceleration/deceleration pattern selection* = "1" (S-pattern acceleration/deceleration A).**
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

**Parameters referred to**

*Pr. 14 Load pattern selection* ☞ *Refer to page 87*
*Pr. 29 Acceleration/deceleration pattern selection* ☞ *Refer to page 99*
*Pr. 83 Rated motor voltage, Pr. 84 Rated motor frequency* ☞ *Refer to page 105*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*
*General-purpose magnetic flux vector control* ☞ *Refer to page 75*



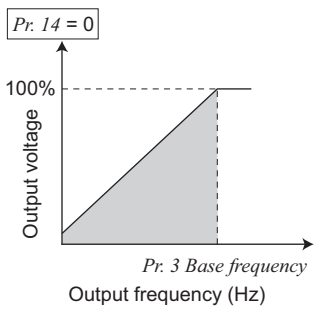
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### 4.5.2 Load pattern selection (Pr. 14) V/F

Optimum output characteristic (V/F characteristic) for the application and load characteristics can be selected.

| 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%) |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*



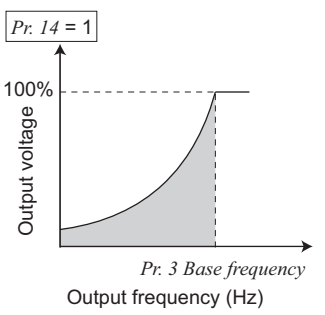

**(1) Constant-torque load application (setting "0", initial value)**

- At or less than the base frequency, the output voltage varies linearly with the output frequency.
- Set this value when driving the load whose load torque is constant even if the speed varies, e.g. conveyor, cart or roll drive.

**POINT**

If the load is a fan or pump, select for constant-torque load (setting "0") in any of the following cases.

- When a blower of large inertia moment (J) is accelerated in a short time
- For constant-torque load such as rotary pump or gear pump
- When load torque increases at low speed, e.g. screw pump



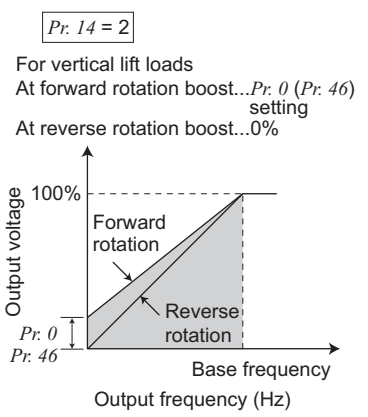

**(2) Variable-torque load application (setting "1")**

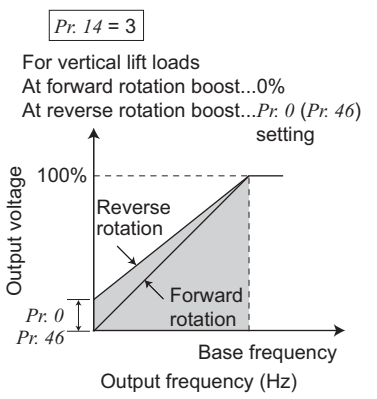
- At or less than the base frequency, the output voltage varies with the output frequency in a square curve.
- Set this value when driving the load whose load torque varies in proportion to the square of the speed, e.g. fan or pump.





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### (3) Constant-torque load application (setting "2, 3")

- Set "2" when a vertical lift load is fixed as power driving load at forward rotation and regenerative load at reverse rotation.
- *Pr. 0 Torque boost* is valid during forward rotation and torque boost is automatically changed to "0%" during reverse rotation. *Pr. 46 Second torque boost* is valid when the RT signal turns on.
- Set "3" for an elevated load that is in the driving mode during reverse rotation and in the regenerative load mode during forward rotation according to the load weight, e.g. counterweight system.
- For the RT signal, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

### REMARKS

- When torque is continuously regenerated as vertical lift load, it is effective to set the rated voltage in *Pr. 19 Base frequency voltage* to prevent trip due to current at regeneration.
- When the RT signal is on, the other second functions are also valid.

### NOTE

- **Load pattern selection does not function under General-purpose magnetic flux vector control.**
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

### Parameters referred to

*Pr. 0, Pr. 46 (Torque boost)* ☞ *Refer to page 73*
*Pr. 3 Base frequency* ☞ *Refer to page 85*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*
*General-purpose magnetic flux vector control* ☞ *Refer to page 75*



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# 4.6 Frequency setting by external terminals

| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Make frequency setting by combination of terminals | Multi-speed operation | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | *89* |
| Perform Jog operation | Jog operation | Pr. 15, Pr. 16 | *91* |
| Infinitely variable speed setting by terminals | Remote setting function | Pr. 59 | *93* |

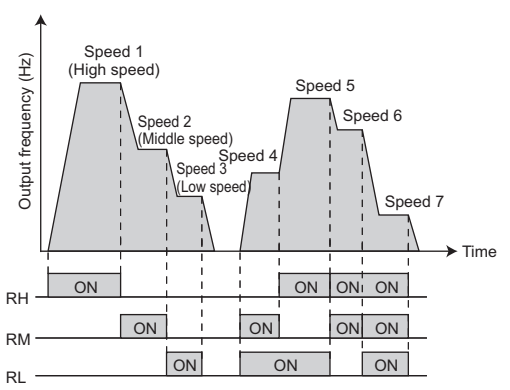
## *4.6.1 Operation by multi-speed operation (Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)*

Can be used to change the preset speed in the parameter with the contact signals.
Any speed can be selected by merely turning on-off the contact signals (RH, RM, RL, REX signals).

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 4 | Multi-speed setting (high speed) | 60Hz | 0 to 400Hz | Frequency when RH turns on |
| 5 | Multi-speed setting (middle speed) | 30Hz | 0 to 400Hz | Frequency when RM turns on |
| 6 | Multi-speed setting (low speed) | 10Hz | 0 to 400Hz | Frequency when RL turns on |
| 24 * | Multi-speed setting (speed 4) | 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 |
| 25 * | Multi-speed setting (speed 5) | 9999 | 0 to 400Hz, 9999 | |
| 26 * | Multi-speed setting (speed 6) | 9999 | 0 to 400Hz, 9999 | |
| 27 * | Multi-speed setting (speed 7) | 9999 | 0 to 400Hz, 9999 | |
| 232 * | Multi-speed setting (speed 8) | 9999 | 0 to 400Hz, 9999 | |
| 233 * | Multi-speed setting (speed 9) | 9999 | 0 to 400Hz, 9999 | |
| 234 * | Multi-speed setting (speed 10) | 9999 | 0 to 400Hz, 9999 | |
| 235 * | Multi-speed setting (speed 11) | 9999 | 0 to 400Hz, 9999 | |
| 236 * | Multi-speed setting (speed 12) | 9999 | 0 to 400Hz, 9999 | |
| 237 * | Multi-speed setting (speed 13) | 9999 | 0 to 400Hz, 9999 | |
| 238 * | Multi-speed setting (speed 14) | 9999 | 0 to 400Hz, 9999 | |
| 239 * | Multi-speed setting (speed 15) | 9999 | 0 to 400Hz, 9999 | |

The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

* The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*




### (1) 3-Speed setting *(Pr. 4 to Pr. 6)*

•The inverter operates at frequencies set in *Pr. 4* when RH signal is on, *Pr. 5* when RM signal is on and *Pr. 6* when RL signal is on.

**REMARKS**

- In the initial setting, if two or three of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal.
  For example, when the RH and RM signals turn on, the RM signal *(Pr. 5)* has a higher priority.
- The RH, RM, RL signals are assigned to the terminal RH, RM, RL in the initial setting. By setting "0 (RL)", "1 (RM)", "2 (RH)" in any of *Pr. 178 to Pr. 182 (input terminal function selection)*, you can assign the signals to other terminals.

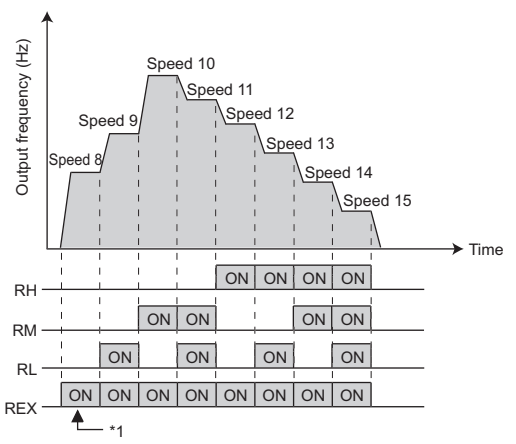




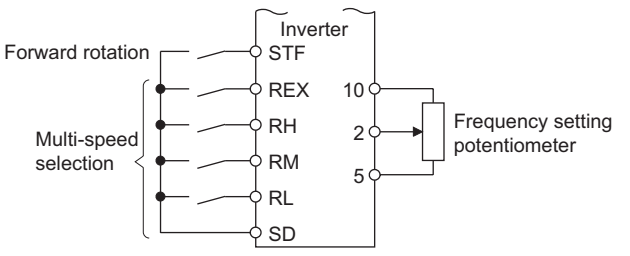
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### (2) Multi-speed setting for 4th speed or more *(Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)*

- Frequency from 4th speed to 15th speed can be set according to the combination of the RH, RM, RL and REX signals. Set the running frequencies in *Pr. 24 to Pr. 27, Pr. 232 to Pr. 239* (In the initial value setting, 4th speed to 15th speed are invalid).
- For the terminal used for REX signal input, set "8" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.




*1 When "9999" is set in *Pr. 232 Multi-speed setting (speed 8)*, operation is performed at frequency set in *Pr. 6* when RH, RM and RL are turned off and REX is turned on.




**Multi-speed operation connection example**

## REMARKS

- The priorities of the frequency commands by the external signals are "Jog operation > multi-speed operation > terminal 4 analog input > terminal 2 analog input".
  (Refer to *page 153* for the frequency command by analog input)
- Valid in the external operation mode or PU/external combined operation mode (*Pr. 79* = "3" or "4").
- Multi-speed parameters can also be set in the PU or external operation mode.
- *Pr. 24 to Pr. 27* and *Pr. 232 to Pr. 239* settings have no priority between them.
- When *Pr. 59 Remote function selection* ≠ "0", multi-speed setting is invalid as RH, RM and RL signals are remote setting signals.

## NOTE

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

## Parameters referred to

*Pr. 15 Jog frequency* ☞ *Refer to page 91*
*Pr. 59 Remote function selection* ☞ *Refer to page 93*
*Pr. 79 Operation mode selection* ☞ *Refer to page 165*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*



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### 4.6.2 Jog operation (Pr. 15, Pr. 16)

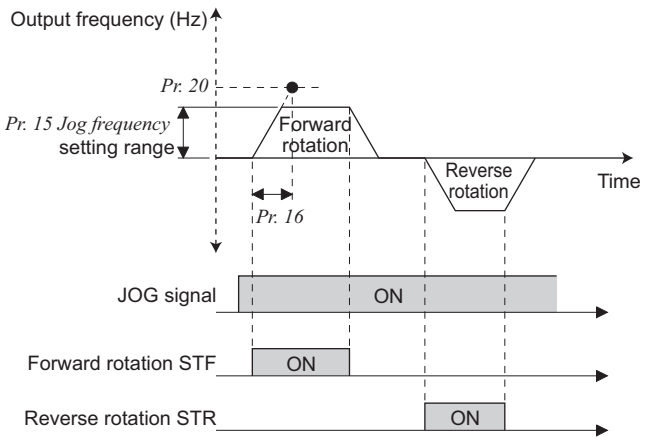
The frequency and acceleration/deceleration time for Jog operation can be set. Jog operation can be performed in either of the external and the PU operation mode.
This operation can be used for conveyor positioning, test operation, etc.

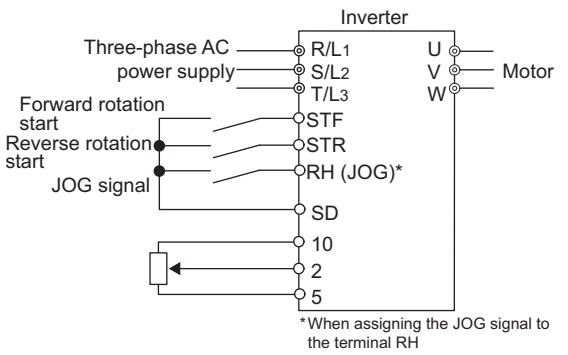
| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **15** | **Jog frequency** | 5Hz | 0 to 400Hz | Frequency for Jog operation. |
| **16** | **Jog acceleration/ deceleration time** | 0.5s | 0 to 3600s | Acceleration/deceleration time for Jog operation. Acceleration/ deceleration time is the time taken to reach the frequency set in *Pr. 20 Acceleration/deceleration reference frequency* (initial value is 60Hz). Acceleration/deceleration time can not be set separately. |

These parameters are displayed as simple mode parameter only when the parameter unit (FR-PU04/FR-PU07) is connected. When the parameter unit is not connected, the above parameters can be set by setting *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

**(1) Jog operation from outside**

- When the JOG signal is on, a start and stop can be made by the start signal (STF, STR).
- For the terminal used for Jog operation selection, set "5" in any of *Pr.178 to Pr.182 (input terminal function selection)* to assign the function.



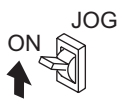




**Connection diagram for external Jog operation**

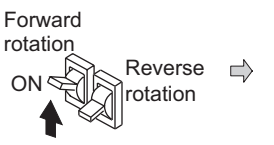
**Operation**

1. Screen at powering on
   - Confirm that the external operation mode is selected. ([EXT] lit)

     If not displayed, press PU/EXT to change to the external (EXT) operation mode. If the operation mode still does not change, set *Pr. 79* to change to the external operation mode.
2. Turn on the JOG switch.




3. Turn the start switch (STF or STR) on.
   - The motor runs while the start switch (STF or STR) is on.
   - The motor runs at 5Hz. (initial value of *Pr. 15*)




**Display**

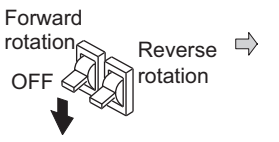






Rotates while ON

4. Turn the start switch (STF or STR) off.







**REMARKS**

- When you want to change the running frequency, change *Pr. 15 Jog frequency*. (initial value "5Hz")
- When you want to change the acceleration/deceleration time, change *Pr. 16 Jog acceleration/deceleration time*. (initial value "0.5s")
  The acceleration time and deceleration time cannot be set separately for Jog operation.

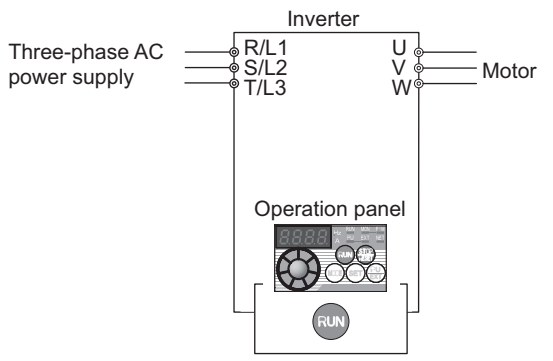




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### (2) Jog operation from PU

•Selects Jog operation mode from the operation panel and PU (FR-PU04/FR-PU07). Operation is performed only while the start button is pressed.




| Operation | | Display |
|---|---|---|
| 1. Confirmation of the RUN indication and operation mode indication<br>● The monitor mode should have been selected.<br>● The inverter should be at a stop. | |  |
| 2. Press (PU/EXT) to choose the PU Jog operation mode. | (PU/EXT) ⇨ |  |
| 3. Press (RUN).<br>● While (RUN) is pressed, the motor rotates.<br>● The motor runs at 5Hz. (*Pr. 15* initial value) | (RUN) Press ⇨ |  |
| 4. Release (RUN) | (RUN) Release ⇨ | Stop  |
| **[When changing the frequency of PU Jog operation]**<br>5. Press (MODE) to choose the parameter setting mode. | (MODE) ⇨ | PRM indication is lit.  (The parameter number read previously appears.) |
| 6. Turn (dial) until *Pr. 15 Jog frequency* appears. | (dial) ⇨ |  |
| 7. Press (SET) to show the present set value. (5Hz) | (SET) ⇨ |  |
| 8. Turn (dial) to set the value to "10.00". (10Hz) | (dial) ⇨ |  |
| 9. Press (SET) to set. | (SET) ⇨ |  **Flicker...Parameter setting complete!!** |
| 10. Perform the operations in steps 1 to 4.<br>The motor rotates at 10Hz. | | |



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**NOTE**

- When *Pr. 29 Acceleration/deceleration pattern selection* = "1" (S-pattern acceleration/deceleration A), the acceleration/deceleration time is the period of time required to reach *Pr. 3 Base frequency.*
- The *Pr. 15* setting should be equal to or higher than the *Pr. 13 Starting frequency.*
- The JOG signal can be assigned to the input terminal using any of *Pr. 178 to Pr. 182 (input terminal function selection)*. When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.
- During Jog operation, the second acceleration/deceleration via the RT signal cannot be selected. (The other second functions are valid. *(Refer to page 227)*)
- When *Pr. 79 Operation mode selection* = "4", pressing RUN of the operation panel and FWD / REV of the parameter unit (FR-PU04/FR-PU07) starts the inverter and pressing STOP/RESET stops the inverter.
- This function is invalid when *Pr. 79* = "3".

**Parameters referred to**

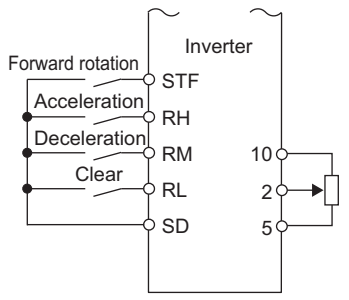
- *Pr. 13 Starting frequency* ☞ *Refer to page 98*
- *Pr. 29 Acceleration/deceleration pattern selection* ☞ *Refer to page 99*
- *Pr. 20 Acceleration/deceleration reference frequency, Pr. 21 Acceleration/deceleration time increments* ☞ *Refer to page 96*
- *Pr. 79 Operation mode selection* ☞ *Refer to page 165*
- *Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*

### 4.6.3 Remote setting function (Pr. 59)

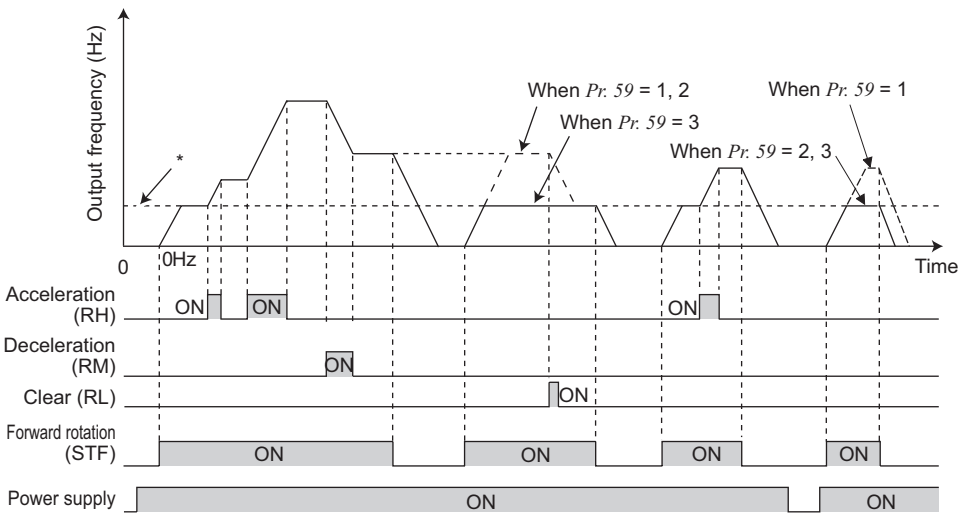
●Even if the operation panel is located away from the enclosure, you can use contact signals to perform continuous variable-speed operation, without using analog signals.

| Parameter Number | Name | Initial Value | Setting Range | Description | |
|---|---|---|---|---|---|
| | | | | RH, RM, RL signal function | Frequency setting storage function |
| 59 | Remote function selection | 0 | 0 | Multi-speed setting | — |
| | | | 1 | Remote setting | With |
| | | | 2 | Remote setting | Not used |
| | | | 3 | Remote setting | Not used (Turning STF/STR off clears remotely-set frequency.) |

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 156)*




**Connection diagram for remote setting**




* External running frequency (other than multi-speed) or PU running frequency





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## Frequency setting by external terminals

### (1) Remote setting function

- Use *Pr. 59* to select whether the remote setting function is used or not and whether the frequency setting storage function in the remote setting mode is used or not.
  When *Pr. 59* is set to any of "1 to 3" (remote setting function valid), the functions of the RH, RM and RL signals are changed to acceleration (RH), deceleration (RM) and clear (RL).
- When using the remote setting function, following frequencies can be compensated to the frequency set by RH and RM operation according to the operation mode.
  During external operation (including *Pr. 79* = "4") .....external frequency command other than multi-speed settings
  During external operation and PU combined operation (*Pr. 79* = "3") .....PU frequency command or terminal 4 input
  During PU operation .....PU frequency command

### (2) Frequency setting storage

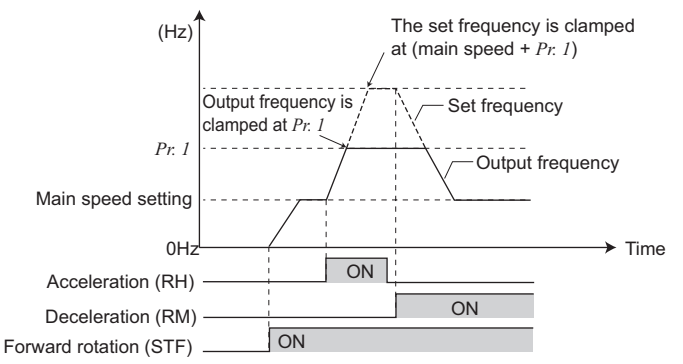
- The frequency setting storage function stores the remotely-set frequency (frequency set by RH/RM operation) into the memory (EEPROM). When power is switched off once, then on, operation is resumed with that output frequency value. (*Pr. 59* = 1)

<Frequency setting storage conditions>

- Frequency at the point when the start signal (STF or STR) turns off
- Remotely-set frequency is stored every minute after turning OFF (ON) the RH (acceleration) and RM(deceleration) signals together. (The frequency is overwritten if the latest frequency is different from the previous frequency when comparing the two. The state of the RH signal does not affect writing.)

**NOTE**

- **The range of frequency changeable by RH (acceleration) and RM (deceleration) is 0 to maximum frequency (*Pr. 1* or *Pr. 18* setting). Note that the maximum value of set frequency is (main speed + maximum frequency).**




- **When the acceleration or deceleration signal switches ON, acceleration/deceleration time is as set in *Pr. 44 Second acceleration/deceleration time* and *Pr. 45 Second deceleration time*. Note that when the time set in *Pr. 7 or Pr. 8* is longer than the time set in *Pr. 44 or Pr. 45*, the acceleration/deceleration time is as set in *Pr. 7 or Pr. 8*. (when RT signal is OFF)
  When the RT signal is on, acceleration/deceleration is made in the time set in *Pr. 44* and *Pr. 45*, regardless of the *Pr. 7* or *Pr. 8* setting.**
- **Even if the start signal (STF or STR) is off, turning on the acceleration (RH) or deceleration (RM) signal varies the preset frequency. (When *Pr. 59* = "1" or "2")**
- **When switching the start signal from ON to OFF, or changing frequency by the RH or RM signal frequently, set the frequency setting value storage function (write to EEPROM) invalid (*Pr. 59* = "2, 3"). If set valid (*Pr. 59* = "1"), frequency is written to EEPROM frequently, this will shorten the life of the EEPROM.**
- **The RH, RM, RL signals can be assigned to the input terminal using any *Pr. 178 to Pr. 182 (input terminal function selection)*. When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.**
- **Also available for the network operation mode.**



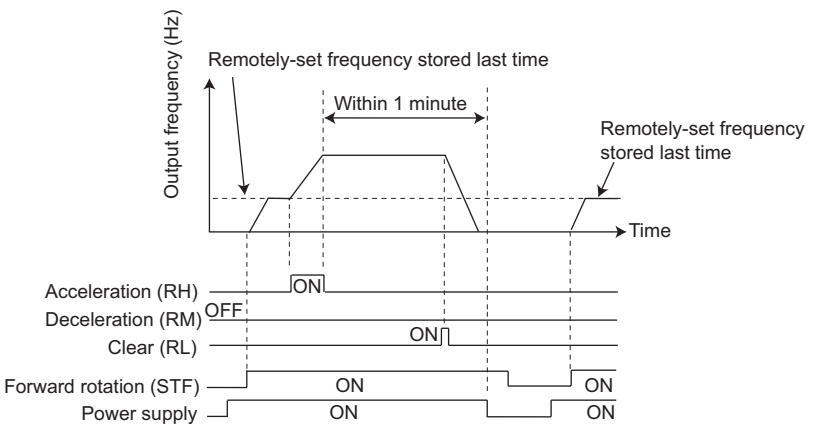
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## REMARKS

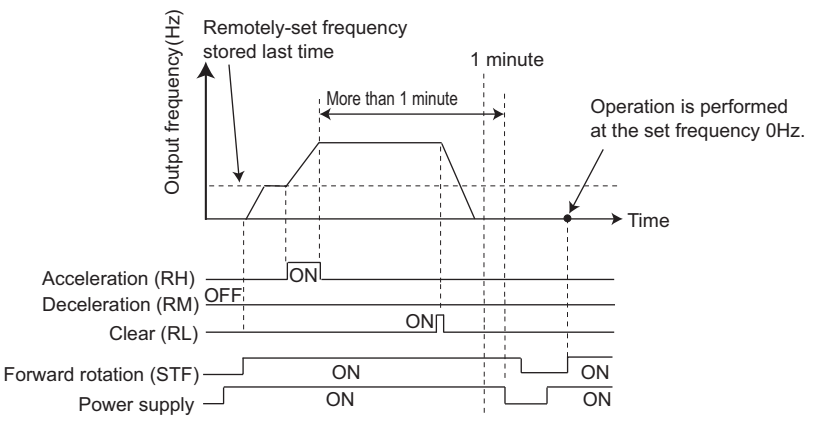
During Jog operation or PID control operation, the remote setting function is invalid.

Setting frequency is "0"

- Even when the remotely-set frequency is cleared by turning on the RL (clear) signal after turn off (on) of both the RH and RM signals, the inverter operates at the remotely-set frequency stored in the last operation if power is reapplied before one minute has elapsed since turn off (on) of both the RH and RM signals




- When the remotely-set frequency is cleared by turning on the RL (clear) signal after turn off (on) of both the RH and RM signals, the inverter operates at the frequency in the remotely-set frequency cleared state if power is reapplied after one minute has elapsed since turn off (on) of both the RH and RM signals.




## ⚠ CAUTION

**⚠ When selecting this function, re-set the maximum frequency according to the machine.**

## Parameters referred to

*Pr. 1 Maximum frequency, Pr. 18 High speed maximum frequency* ☞ *Refer to page 83*
*Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 44 Second acceleration/deceleration time, Pr. 45 Second deceleration time* ☞ *Refer to page 96*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*





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# 4.7 Setting of acceleration/deceleration time and acceleration/ deceleration pattern

| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Motor acceleration/deceleration time setting | Acceleration/deceleration times | Pr. 7, Pr. 8, Pr. 20, Pr. 44, Pr. 45 | 96 |
| Starting frequency | Starting frequency and start-time hold | Pr. 13, Pr. 571 | 98 |
| Set acceleration/deceleration pattern suitable for application | Acceleration/deceleration pattern | Pr. 29 | 99 |

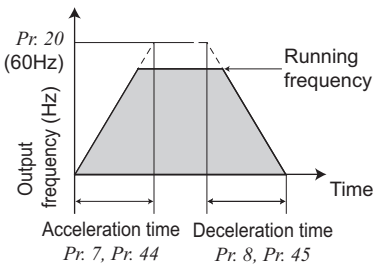
## 4.7.1 Setting of the acceleration and deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 44, Pr. 45)

Used to set motor acceleration/deceleration time.
Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease.
For the acceleration time at automatic restart after instantaneous power failure, refer to *Pr. 611 Acceleration time at a restart (page 136)*.

| Parameter Number | Name | Initial Value | | Setting Range | Description |
|---|---|---|---|---|---|
| 7 | Acceleration time | FR-D720-165 or less<br>FR-D740-080 or less<br>FR-D720S-008 to 100 | 5s | 0 to 3600s | Motor acceleration time. |
| | | FR-D720-238 or more<br>FR-D740-120 or more | 10s | | |
| 8 | Deceleration time | FR-D720-165 or less<br>FR-D740-080 or less<br>FR-D720S-008 to 100 | 5s | 0 to 3600s | Motor deceleration time. |
| | | FR-D720-238 or more<br>FR-D740-120 or more | 10s | | |
| 20 ∗1 | Acceleration/ deceleration reference frequency | 60Hz | | 1 to 400Hz | Frequency that will be the basis of acceleration/deceleration time.<br>As acceleration/deceleration time, set the frequency change time from stop to *Pr. 20*. |
| 44 ∗1 | Second acceleration/ deceleration time | FR-D720-165 or less<br>FR-D740-080 or less<br>FR-D720S-008 to 100 | 5s | 0 to 3600s | Acceleration/deceleration time when the RT signal is on. |
| | | FR-D720-238 or more<br>FR-D740-120 or more | 10s | | |
| 45 ∗1 | Second deceleration time | 9999 | | 0 to 3600s | Deceleration time when the RT signal is on. |
| | | | | 9999 | Acceleration time = deceleration time |

∗1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

### (1) Acceleration time setting *(Pr. 7, Pr. 20)*




•Use *Pr. 7 Acceleration time* to set the acceleration time required to reach *Pr. 20 Acceleration/deceleration reference frequency* from 0Hz.
•Set the acceleration time according to the following formula.

$$\text{Acceleration time setting} = \frac{Pr.\ 20}{\text{Maximum operating frequency - } Pr.\ 13} \times \text{Acceleration time from stop to maximum operating frequency}$$

Example)When *Pr. 20* = 60Hz (initial value), *Pr. 13* = 0.5Hz, and acceleration can be made up to the maximum operating frequency of 50Hz in 10s

$$Pr.\ 7 = \frac{60Hz}{50Hz - 0.5Hz} \times 10s \fallingdotseq 12.1s$$



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### (2) Deceleration time setting *(Pr. 8, Pr. 20)*

•Use *Pr. 8 Deceleration time* to set the deceleration time required to reach 0Hz from *Pr. 20 Acceleration/deceleration reference frequency*.

•Set the deceleration time according to the following formula.

$$\text{Deceleration time setting} = \frac{Pr.\ 20}{\text{Maximum operating frequency - } Pr.\ 10} \times \text{Deceleration time from maximum operating frequency to stop}$$

Example)When the frequency can be decelerated down to the maximum operating frequency of 50Hz in 10s with 120Hz set in *Pr. 20* and 3Hz set in *Pr. 10*

$$Pr.\ 8 = \frac{120\text{Hz}}{50\text{Hz-3Hz}} \times 10\text{s} \fallingdotseq 25.5\text{s}$$

### (3) Set two kinds of acceleration/deceleration times (RT signal, *Pr. 44, Pr. 45* )

•*Pr. 44* and *Pr. 45* are valid when the RT signal is on.

•When "9999" is set to *Pr. 45*, the deceleration time becomes equal to the acceleration time *(Pr. 44)*.

•For the RT signal, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

### NOTE

- **When the acceleration/deceleration pattern is S-pattern acceleration/deceleration A *(refer to page 99)*, the acceleration/ deceleration time is the time required to reach *Pr. 3 Base frequency*.**
- **Acceleration/deceleration time formula when the set frequency is the base frequency or higher**

$$t = \frac{4}{9} \times \frac{T}{(Pr.\ 3)^2} \times f^2 + \frac{5}{9} T$$

**T: Acceleration/deceleration time setting (s)**
**f: Set frequency (Hz)**

- **Guideline for acceleration/deceleration time at the *Pr. 3 Base frequency* of 60Hz (0Hz to set frequency)**

| Acceleration/ deceleration time (s) \ Frequency setting (Hz) | 60 | 120 | 200 | 400 |
|---|---|---|---|---|
| 5 | 5 | 12 | 27 | 102 |
| 15 | 15 | 35 | 82 | 305 |

- **Changing terminal assignment may affect the other functions. Make setting after confirming the function of each terminal.**

### REMARKS

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 116)*
- If the *Pr. 20* setting is changed, the *Pr. 125 and Pr. 126 (frequency setting signal gain frequency)* settings do not change. Set *Pr. 125 and Pr. 126* to adjust the gains.
- When the *Pr. 7, Pr. 8, Pr. 44 and Pr. 45* settings are 0.03s or less, the acceleration/deceleration time is 0.04s. At that time, set *Pr. 20* to "120Hz" or less.
- Any value can be set to the acceleration/deceleration time, but the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time determined by the mechanical system J (moment of inertia) and motor torque.

### Parameters referred to

*Pr. 3 Base frequency* ☞ *Refer to page 85*
*Pr. 10 DC injection brake operation frequency* ☞ *Refer to page 109*
*Pr. 29 Acceleration/deceleration pattern selection* ☞ *Refer to page 99*
*Pr. 125, Pr. 126 (frequency setting gain frequency)* ☞ *Refer to page 153*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*





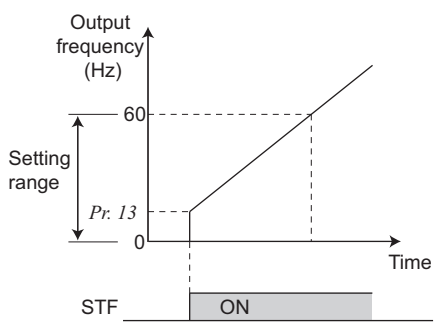
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## 4.7.2 Starting frequency and start-time hold function (Pr. 13, Pr. 571)

You can set the starting frequency and hold the set starting frequency for a certain period of time.
Set these functions when you need the starting torque or want to smooth motor drive at a start.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 13 | Starting frequency | 0.5Hz | 0 to 60Hz | Frequency at start can be set in the range of 0 to 60Hz.<br>Starting frequency at which the start signal is turned on. |
| 571 | Restart coasting time | 9999 | 0 to 10s | Holding time of *Pr. 13 Starting frequency*. |
| | | | 9999 | Holding function at a start is invalid |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

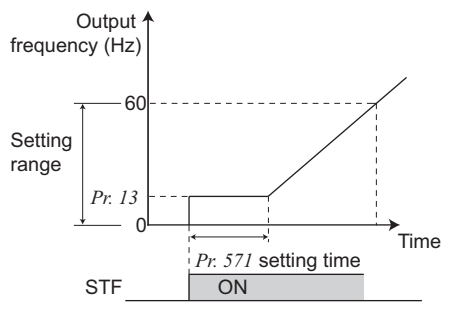



### (1) Starting frequency setting *(Pr. 13)*

- Frequency at start can be set in the range of 0 to 60Hz.
- You can set the starting frequency at which the start signal is turned on.

**NOTE**

**The inverter will not start if the frequency setting signal is less than the value set in *Pr. 13*.**
**For example, when 5Hz is set in *Pr. 13*, the motor will not start running until the frequency setting signal reaches 5Hz.**




### (2) Start-time hold function *(Pr. 571)*

- This function holds during the period set in *Pr. 571* and the output frequency set in *Pr. 13 Starting frequency*.
- This fnction performs initial excitation to smooth the motor drive at a start.

**REMARKS**

When *Pr. 13* = "0Hz", the starting frequency is held at 0.01Hz.

**NOTE**

- **When the start signal was turned off during start-time hold, deceleration is started at that point.**
- **At switching between forward rotation and reverse rotation, the starting frequency is valid but the start-time hold function is invalid.**

**CAUTION**

**Note that when *Pr. 13* is set to any value equal to or lower than *Pr. 2 Minimum frequency*, simply turning on the start signal will run the motor at the preset frequency even if the command frequency is not input.**

**Parameters referred to**

*Pr. 2 Minimum frequency* *Refer to page 83*



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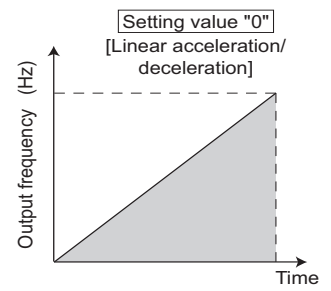
## 4.7.3 Acceleration/deceleration pattern (Pr. 29)

You can set the acceleration/deceleration pattern suitable for application.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 29 | Acceleration/deceleration pattern selection | 0 | 0 | Linear acceleration/ deceleration |
| | | | 1 | S-pattern acceleration/deceleration A |
| | | | 2 | S-pattern acceleration/deceleration B |

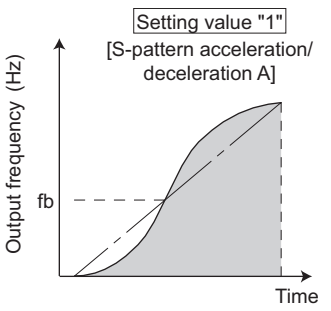
The above parameters can be set when *Pr. 160 Extended function display selection* ="0". *(Refer to page 162)*

### (1) Linear acceleration/deceleration (*Pr. 29* setting "0", initial value)




•For the inverter operation, the output frequency is made to change linearly (linear acceleration/deceleration) to prevent the motor and inverter from getting excessive stress to reach the set frequency during acceleration, deceleration, etc. when frequency changes. Linear acceleration/deceleration has a uniform frequency/time slope.

### (2) S-pattern acceleration/deceleration A (*Pr. 29* = "1")

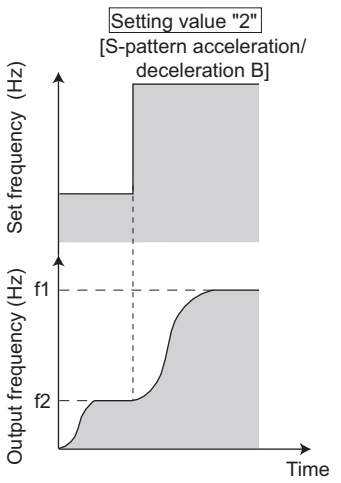



•For machine tool spindle applications, etc.
Use this pattern when acceleration/deceleration is required in a short time to a high-speed range higher than the base frequency.
In this acceleration/deceleration pattern, *Pr. 3 Base frequency* (fb) is the inflection point of the S pattern, and you can set the acceleration/deceleration time appropriate for motor torque reduction in a constant-power operation range of base frequency (fb) or higher.

**NOTE**

**• As the acceleration/deceleration time of S-pattern acceleration/deceleration A, set the time taken until *Pr. 3 Base frequency* is reached, not *Pr. 20 Acceleration/deceleration reference frequency*.**

### (3) S-pattern acceleration/deceleration B (*Pr. 29* = "2")




•For prevention of load shifting in conveyor and other applications.
Since acceleration/deceleration is always made in an S shape from current frequency (f2) to target frequency (f1), this function eases shock produced at acceleration/deceleration and is effective for load collapse prevention, etc.

**Parameters referred to**

*Pr. 3 Base frequency* ☞ *Refer to page 85*
*Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 20 Acceleration/deceleration reference frequency* ☞ *Refer to page 96*





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# 4.8 Selection and protection of a motor

| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Motor protection from overheat | Electronic thermal O/L relay<br>PTC thermistor protection | Pr. 9, Pr. 51, Pr. 561 | *100* |
| Use the constant torque motor | Applied motor | Pr. 71 | *103* |
| The motor performance can be maximized for operation in magnetic flux vector control method. | Offline auto tuning | Pr. 71, Pr. 80, Pr. 82 to Pr. 84, Pr. 90, Pr. 96 | *105* |

## *4.8.1 Motor overheat protection (Electronic thermal O/L relay, PTC thermistor protection) (Pr. 9, Pr. 51, Pr. 561)*

Set the current of the electronic thermal relay function to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

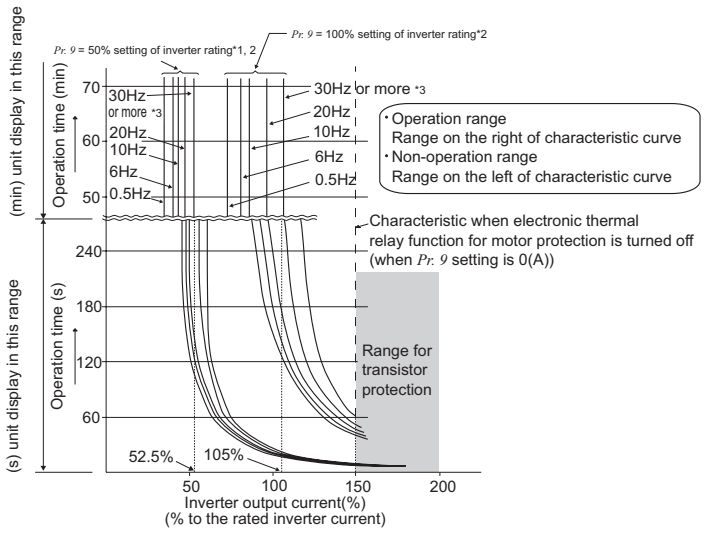
| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **9** | **Electronic thermal O/L relay** | Inverter rated current | 0 to 500A | Set the rated motor current. |
| **51**∗1 | **Second electronic thermal O/L relay** ∗2 | 9999 | 0 to 500A | Valid when the RT signal is on.<br>Set the rated motor current. |
| | | | 9999 | Second electronic thermal O/L relay invalid |
| **561**∗1 | **PTC thermistor protection level** | 9999 | 0.5 to 30kΩ | Set the level (resistance value) for PTC thermistor protection activates. |
| | | | 9999 | PTC thermistor protection is inactive. |

∗1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

∗2 When parameter is read using the FR-PU04, a parameter name different from an actual parameter is displayed.

### (1) Electronic thermal O/L relay *(Pr. 9)*

**Electronic thermal O/L relay operation characteristic**




This function detects the overload (overheat) of the motor and trips. (The operation characteristic is shown on the left)

- Set the rated current (A) of the motor in *Pr. 9*.
  (If the motor has both 50Hz and 60Hz rating and the *Pr. 3 Base frequency* is set to 60Hz, set the 1.1 times of the 60Hz rated motor current.)
- Set "0" in *Pr. 9* when you do not want to operate the electronic thermal O/L relay, e.g. when using an external thermal relay with the motor. (Note that the output transistor protection of the inverter functions (E.THT).)
- When using a Mitsubishi constant-torque motor
  1) Set "1" or "13", "50", "53" in any of *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 to *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 O/L relay dedicated to the Mitsubishi constant-torque motor, this characteristic curve applies to operation at 6Hz or higher.

**NOTE**

- **The protective function performed by the electronic thermal O/L relay 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 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.**
- **The operation time of the transistor protection thermal shortens when the *Pr. 72 PWM frequency selection* setting value increases.**
- **Electronic thermal relay does not function when 5% or less of inverter rated current is set to electronic thermal relay setting.**

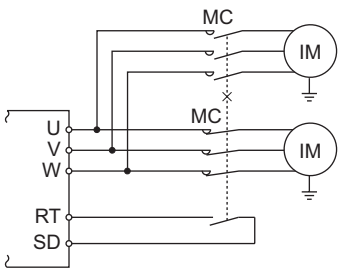


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### (2) Set two different electronic thermal O/L relays *(Pr. 51)*

Use this function when running two motors of different rated currents individually by a single inverter. (When running two motors together, use external thermal relays.)

- Set the rated current of the second motor to *Pr. 51*.
- When the RT signal is on, thermal protection is provided based on the *Pr. 51* setting.
- For the terminal used for RT signal input, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.




| *Pr. 450 Second applied motor* | *Pr. 9 Electronic thermal O/L relay* | *Pr.51 Second electronic thermal O/L relay* | RT = OFF | | RT = ON | |
|---|---|---|---|---|---|---|
| | | | First motor | Second motor | First motor | Second motor |
| 9999 | 0 | 9999 | × | × | × | × |
| | | 0 | × | × | × | × |
| | | 0.01 to 500 | × | Δ | × | ○ |
| 9999 | Other than 0 | 9999 | ○ | × | ○ | × |
| | | 0 | ○ | × | Δ | × |
| | | 0.01 to 500 | ○ | Δ | Δ | ○ |
| Other than 9999 | 0 | 9999 | × | × | × | × |
| | | 0 | × | × | × | × |
| | | 0.01 to 500 | × | Δ | × | ○ |
| Other than 9999 | Other than 0 | 9999 | ○ | Δ | Δ | ○ |
| | | 0 | ○ | × | Δ | × |
| | | 0.01 to 500 | ○ | Δ | Δ | ○ |

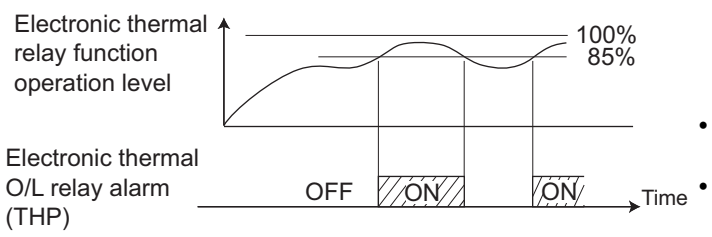
○... Output current value is used to perform integration processing.
Δ... Output current is assumed as 0A to perform integration processing. (cooling processing)
×... Electronic thermal relay function is not activated.

**REMARKS**

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 116)*

### (3) Electronic thermal relay function prealarm (TH) and alarm signal (THP signal)

100%: Electronic thermal O/L relay alarm operation value

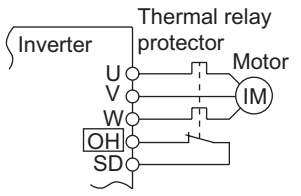



- The alarm signal (THP) is output and electronic thermal relay function prealarm (TH) is displayed when the electronic thermal O/L relay cumulative value reaches 85% of the level set in *Pr. 9 or Pr. 51*. If it reaches 100% of the *Pr. 9 Electronic thermal O/L relay* setting electronic-thermal relay protection (E.THM/E.THT) occurs.
- The inverter does not trip even when the alarm signal (THP) is output.
- For the terminal used for the THP signal output, assign the function by setting "8 (positive logic) or 108 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)* .

**NOTE**

- **Changing the terminal assignment using *Pr.190, Pr.192 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

### (4) External thermal relay input (OH signal)




**External thermal relay input connection example**

- To protect the motor against overheat, use the OH signal when using an external thermal relay or the built-in thermal protector of the motor.
- When the thermal relay operates, the inverter trips and outputs the fault signal (E.OHT).
- For the terminal used for OH signal input, assign the function by setting "7" in any of *Pr. 178 to Pr.182 (input terminal function selection)* .

**NOTE**

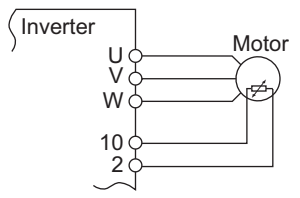
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**



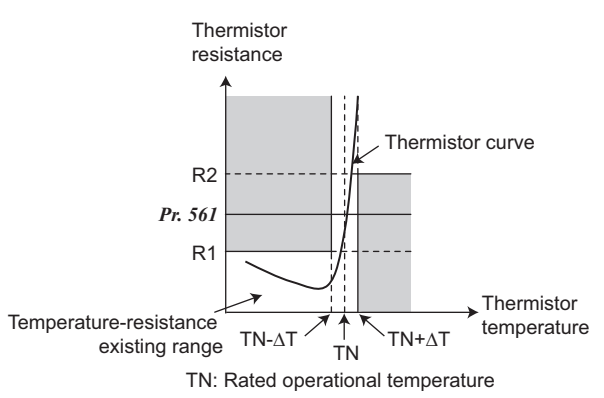


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### (5) PTC thermistor protection (Pr. 561)




**PTC thermistor input connection**




**PTC thermistor characteristics**

- Terminal 2 and terminal 10 are available for inputting of motor built-in PTC thermistor output. When the PTC thermistor input reaches to the resistance value set in *Pr. 561 PTC thermistor protection level*, inverter outputs PTC thermistor operation error signal (E.PTC) and trips.
- Check the characteristics of the using PTC thermistor, and set the resistance value within a protection providing temperature TN, just around the center of R1 and R2 in a left figure. If the *Pr. 561* setting is closer to R1 or R2, the working temperature of protection goes higher (protection works later), or lower (protection works earlier).
- PTC thermistor resistance can be displayed in operation panel, parameter unit (FR-PU07) *(Refer to page 128)*, or RS-485 communication *(Refer to page 180)* when PTC thermistor protection is active (*Pr. 561* ≠ "9999").

#### REMARKS

- When using terminal 2 as PTC thermistor input (*Pr. 561* ≠ "9999"), terminal 2 is not available for analog frequency command. Also unavailable when using terminal 2 for PID control and Dancer control. When PID control and Dancer control is not active (*Pr. 128 PID action selection* = "0"), terminal 4 functions as follows.
  When *Pr. 79* = "4" or in external operation mode ..... Terminal 4 is active whether AU signal is ON/OFF
  When *Pr. 79* = "3" ..... Terminal 4 is active for frequency command when AU signal is ON
- For the power supply terminal of PTC thermistor input, do not use power supply other than terminal 10 (external power supply, etc). PTC thermistor does not work properly.

#### Parameters referred to

*Pr. 71 Applied motor* ☞ *Refer to page 103*
*Pr. 72 PWM frequency selection* ☞ *Refer to page 148*
*Pr. 79 Operation mode selection* ☞ *Refer to page 165*
*Pr. 128 PID action selection* ☞ *Refer to page 212*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*
*Pr. 190, Pr. 192 (output terminal function selection)* ☞ *Refer to page 119*



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### 4.8.2 Applied motor (Pr. 71, Pr. 450)

Setting of the used motor selects the thermal characteristic appropriate for the motor.
Setting is required to use a constant-torque motor. Thermal characteristic of the electronic thermal relay function suitable for the motor is set.
When General-purpose magnetic flux vector is selected, the motor constants (SF-JR, SF-HR, SF-JRCA, SF-HRCA, etc.) necessary for control are selected as well.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **71** | **Applied motor** | 0 | 0, 1, 3, 13, 23, 40, 43, 50, 53 | Selecting the standard motor or constant-torque motor sets the corresponding motor thermal characteristic. |
| **450** | **Second applied motor** | 9999 | 0, 1 | Set when using the second motor. |
| | | | 9999 | Second motor is invalid. (thermal characteristic of the first motor (*Pr. 71*)) |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

#### (1) Set the motor to be used

Refer to the following list and set the parameter according to the motor used.

| *Pr. 71 (Pr. 450)* Setting | | Thermal Characteristic of the Electronic Thermal Relay Function | | Motor (O: Used motor) | |
|---|---|---|---|---|---|
| *Pr. 71* | *Pr. 450* | | | Standard (SF-JR, etc.) | Constant torque (SF-JRCA, etc.) |
| 0 (*Pr. 71* initial value) | | Thermal characteristics of a standard motor | | O | |
| 1 | | Thermal characteristics of the Mitsubishi constant-torque motor | | | O |
| 40 | — | Thermal characteristic of Mitsubishi high efficiency motor (SF-HR) | | O ∗1 | |
| 50 | — | Thermal characteristic of Mitsubishi constant torque motor (SF-HRCA) | | | O ∗2 |
| 3 | — | Standard motor | Select "Offline auto tuning setting" | O | |
| 13 | — | Constant-torque motor | | | O |
| 23 | — | Mitsubishi standard motor (SF-JR 4P 1.5kW or less) | | O | |
| 43 | — | Mitsubishi high efficiency motor (SF-HR) | | O ∗1 | |
| 53 | — | Mitsubishi constant-torque motor (SF-HRCA) | | | O ∗2 |
| — | 9999 (initial value) | Without second applied motor | | | |

∗1 Motor constants of Mitsubishi high efficiency motor SF-HR.
∗2 Motor constants of Mitsubishi constant-torque motor SF-HRCA.

**REMARKS**

- When performing offline auto tuning, set any of "3, 13, 23, 43, 53" in *Pr. 71*.
  (Refer to *page 105* for offline auto tuning.)
- For the FR-D720-238 and 318, FR-D740-120 and 160, the *Pr. 0 Torque boost* and *Pr. 12 DC injection brake operation voltage* settings are automatically changed according to the *Pr. 71* setting as follows.

| Automatic Change Parameter | Standard Motor Setting ∗1 | Constant-torque Motor Setting ∗2 |
|---|---|---|
| *Pr. 0* | 3% | 2% |
| *Pr. 12* | 4% | 2% |

∗1 *Pr. 71* setting: 0, 3, 23, 40, 43
∗2 *Pr. 71* setting: 1, 13, 50, 53





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### (2) Use two motors *(Pr. 450)*

- Set *Pr. 450 Second applied motor* to use two different motors with one inverter.
- When "9999" (initial value) is set, no function is selected.
- When a value other than 9999 is set in *Pr. 450*, the second motor is valid with the RT signal on.
- For the RT signal, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

**REMARKS**

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 116)*

**NOTE**

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect other functions. Make setting after confirming the function of each terminal.**

**CAUTION**

**Set this parameter correctly according to the motor used.**
**Incorrect setting may cause the motor to overheat and burn.**
**Set the electronic thermal relay function to the thermal characteristic for the constant-torque motor when using a geared motor (GM-G, GM-D, GM-SY, GM-HY2 series) to perform General-purpose magnetic flux vector control.**

**Parameters referred to**

*Pr. 0 Torque boost* *Refer to page 73*
*Pr. 12 DC injection brake operation voltage* *Refer to page 109*
*Pr. 80 Motor capacity* *Refer to page 105*



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### 4.8.3 To exhibit the best performance of the motor (offline auto tuning) (Pr. 71, Pr. 80, Pr. 82 to Pr. 84, Pr. 90, Pr. 96)

The motor performance can be maximized with offline auto tuning.

●What is offline auto tuning?

When performing General-purpose magnetic flux 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 |
|---|---|---|---|---|
| **71** | **Applied motor** | 0 | 0, 1, 3, 13, 23, 40, 43, 50, 53 | By selecting a standard motor or constant-torque motor, thermal characteristic and motor constants of each motor are set. |
| **80** | **Motor capacity** | 9999 | 0.1 to 7.5kW | Applied motor capacity. |
| | | | 9999 | V/F control |
| **82** | **Motor excitation current** | 9999 | 0 to 500A | Set motor excitation current (no load current) |
| | | | 9999 | Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants. |
| **83** | **Rated motor voltage** | 200V class 200V<br>400V class 400V | 0 to 1000V | Rated motor voltage (V). |
| **84** | **Rated motor frequency** | 60Hz | 10 to 120Hz | Rated motor frequency (Hz). |
| **90** | **Motor constant (R1)** | 9999 | 0 to 50Ω, 9999 | Tuning data<br>(The value measured by offline auto tuning is automatically set.)<br>9999: Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants. |
| **96** | **Auto tuning setting/ status** | 0 | 0 | Offline auto tuning is not performed. |
| | | | 11 | For General-purpose magnetic flux vector control<br>Offline auto tuning is performed without motor running.<br>(motor constant (R1) only) |
| | | | 21 | Offline auto tuning for V/F control (automatic restart after instantaneous power failure (with frequency search)) *(Refer to page 139)* |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

**POINT**

- This function is valid only when a value other than "9999" is set in *Pr. 80* and General-purpose magnetic flux vector control is selected.
- You can copy the offline auto tuning data (motor constants) to another inverter with the PU (FR-PU07).
- Even when motors (other manufacturer's motor, SF-JRC, etc.) other than Mitsubishi standard motor, high efficiency motor (SF-JR, SF-HR 0.2kW or more), and Mitsubishi constant-torque motor (SF-JRCA four-pole, SF-HRCA 0.4kW to 7.5kW) are used or the wiring length is long, using the offline auto tuning function runs the motor with the optimum operating characteristics.
- Tuning is enabled even when a load is connected to the motor.
  As the motor may run slightly, fix the motor securely with a mechanical brake or make sure that there will be no problem in safety if the motor runs (caution is required especially in elevator). Note that tuning performance is unaffected even if the motor runs slightly.
- Reading/writing/copy of motor constants *(Pr. 90)* tuned by offline auto tuning are enabled.
- The offline auto tuning status can be monitored with the operation panel and PU (FR-PU04/FR-PU07).
- Do not connect a surge voltage suppression filter (FR-ASF-H/FR-BMF-H) between the inverter and motor.





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## Selection and protection of a motor

### (1) Before performing offline auto tuning

Check the following before performing offline auto tuning.

- Make sure General-purpose magnetic flux vector control (*Pr. 80*) is selected. (Tuning can be performed even under V/F control selected by turning on X18.)
- 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 should be 0.1kW or more)
- The maximum frequency is 120Hz.
- A high-slip motor, high-speed motor and special motor cannot be tuned.
- As the motor may run slightly, fix the motor securely with a mechanical brake or make sure that there will be no problem in safety if the motor runs (caution is required especially in elevator). Note that tuning performance is unaffected even if the motor runs slightly.
- Offline auto tuning will not be performed properly if it is performed with a reactor or surge voltage suppression filter (FR-ASF-H/FR-BMF-H) connected between the inverter and motor. Remove it before start tuning.

### (2) Setting

1) Select General-purpose magnetic flux vector control (*Refer to page 75*).
2) Set "11" in *Pr. 96 Auto tuning setting/status*.
   Tuning motor constants (R1) only without running the motor. (It takes approximately 9s until tuning is completed.)
3) Set the rated motor current (initial value is rated inverter current) in *Pr. 9 Electronic thermal O/L relay*. (*Refer to page 100*)
4) Set the rated voltage of motor (initial value is 200V/400V) in *Pr. 83 Rated motor voltage* and rated motor frequency (initial value is 60Hz) in *Pr. 84 Rated motor frequency*.
   (For a Japanese standard motor, etc. which has both 50Hz and 60Hz rated values, use it with an initial value (200V/60Hz or 400V/60Hz).
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 | 3 |
| | SF-JR 4P 1.5kW or less | 23 |
| | SF-HR | 43 |
| | Others | 3 |
| Mitsubishi constant-torque motor | SF-JRCA 4P | 13 |
| | SF-HRCA | 53 |
| | Others (SF-JRC, etc.) | 13 |
| Other standard motor | — | 3 |
| Other constant-torque motor | — | 13 |



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### (3) Execution of tuning

**POINT**

Before performing tuning, check the monitor display of the operation panel or parameter unit (FR-PU04/FR-PU07) if the inverter is in the status for tuning. (Refer to 2) below) When the start command is turned on under V/F control, the motor starts.

1) When performing tuning for PU operation, press RUN of the operation panel or FWD or REV of the parameter unit (FR-PU04/FR-PU07).
For external operation, turn ON the run command (STF signal or STR signal). Tuning starts.
(Excitation noise is produced during tuning.)

**NOTE**

- **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 terminal <valid signal> STF, STR**
  **• Output terminal RUN, AM, A, B, C**
  **Note that the progress status of offline auto tuning is output in five steps from AM when speed and output frequency are selected.**
- **Since the RUN signal turns ON when tuning is started, caution is required especially when a sequerence 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.**
- **Do not perform ON/OFF switching of the second function selection signal (RT) during execution of offline auto tuning. Auto tuning is not excecuted properly.**

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

| | Parameter Unit (FR-PU04/FR-PU07) Display | Operation Panel Indication |
|---|---|---|
| *Pr. 96* setting | 11 | 11 |
| (1) Setting | READ:List<br>11<br>- - - STOP PU | 11 MON EXT |
| (2)Tuning in progress | TUNE 12<br>STF FWD PU | 12 RUN MON EXT |
| (3)Normal end | TUNE 13<br>COMPETION<br>STF STOP PU | Flickering<br>13 RUN MON EXT |
| (4)Error end<br>(when inverter protective function operation is activated) | TUNE 9<br>ERROR<br>STF STOP PU | 9 RUN MON EXT |

**REMARKS**

- It takes approximately 9s until tuning is completed.
- The set frequency monitor displayed during the offline auto tuning is 0Hz.





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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) once.
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.)

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 "11" in *Pr. 96* and perform tuning again. |
| 9 | Inverter protective function operation | Make setting again. |
| 91 | Current limit (stall prevention) function was activated. | 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.<br>Set the rated current of the motor in *Pr. 9*. |

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 normally. (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*.

7) When you know motor excitation current (no load current), set the value in *Pr. 82 Motor excitation current*.

**NOTE**

- **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.**
- **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.**

## ⚠CAUTION

⚠ As the motor may run slightly during offline auto tuning, fix the motor securely with a mechanical brake or make sure that there will be no problem in safety if the motor runs. Note that if the motor runs slightly, tuning performance is unaffected.

**Parameters referred to**

*Pr. 9 Electronic thermal O/L relay* ☞ *Refer to page 100*
*Pr. 71 Applied motor* ☞ *Refer to page 100*
*Pr. 80 Motor capacity* ☞ *Refer to page 75*
*Pr. 156 Stall prevention operation selection* ☞ *Refer to page 79*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*
*Pr. 190, Pr. 192 (output terminal function selection)* ☞ *Refer to page 119*



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# 4.9 Motor brake and stop operation

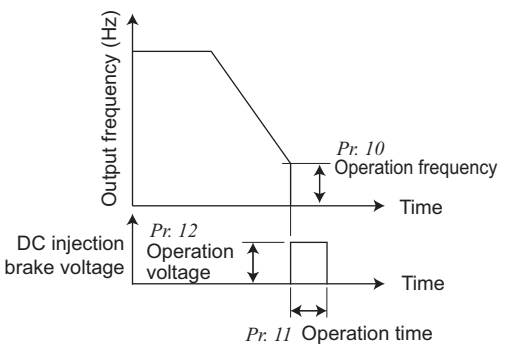
| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Motor braking torque adjustment | DC Injection brake | Pr. 10 to Pr. 12 | *109* |
| Improve the motor braking torque with an option | Selection of a regenerative brake | Pr. 30, Pr. 70 | *110* |
| Coast the motor to a stop | Selection of motor stopping method | Pr. 250 | *112* |

## *4.9.1 DC injection brake (Pr. 10 to Pr. 12)*

The DC injection brake can be operated at a motor stop to adjust the stop timing and braking torque.
In DC injection brake operation, DC voltage is directly applied to the motor to prevent the motor shaft from rotating. The motor will not return to the original position if the motor shaft rotates due to external force.

| Parameter Number | Name | Initial Value | | Setting Range | Description |
|---|---|---|---|---|---|
| 10 | DC injection brake operation frequency | 3Hz | | 0 to 120Hz | Operation frequency of the DC injection brake. |
| 11 | DC injection brake operation time | 0.5s | | 0 | DC injection brake disabled |
| | | | | 0.1 to 10s | Operation time of the DC injection brake. |
| 12 | DC injection brake operation voltage | FR-D720-008 and 014<br>FR-D720S-008 and 014 | 6% | 0 to 30% | DC injection brake voltage (torque). When "0" is set, DC injection brake is disabled. |
| | | FR-D720-025 to 318<br>FR-D740-012 to 160<br>FR-D720S-025 to 100 | 4% | | |

The above parameters can be set when *Pr. 160 Extended function display selection* ="0". *(Refer to page 162)*




### (1) Operation frequency setting *(Pr. 10)*

• When the frequency at which the DC injection brake will be operated is set to *Pr. 10*, the DC voltage is applied to the motor upon reaching to the set frequency during deceleration.

### (2) Operation time setting *(Pr. 11)*

•In *Pr. 11*, set the time of the DC injection brake.
•When the motor does not stop due to large load moment (J), increasing the setting produces an effect.
•When *Pr. 11* = "0s", the DC injection brake is disabled. (At a stop, the motor coasts.)

### (3) Operation voltage (torque) setting *(Pr. 12)*

• Use *Pr. 12* to set the percentage to the power supply voltage.
• When *Pr. 12* = "0%", the DC injection brake is disabled. (At a stop, the motor coasts.)
•When using the constant-torque motor (SF-JRCA) and energy saving motor (SF-HR, SF-HRCA), change the *Pr. 12* setting as follows:
SF-JRCA:
FR-D720-165 or less, FR-D740-080 or less, FR-D720S-100 or less...4%
FR-D720-238 or more, FR-D740-120 or more...2%
SF-HR, SF-HRCA:
FR-D720-165 or less, FR-D740-080 or less, FR-D720S-100 or less...4%
FR-D720-238 or more, FR-D740-120 or more...3%





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**REMARKS**

- For the FR-D720-238 and 318, FR-D740-120 and 160, when the *Pr. 12* setting is the following, changing the *Pr. 71 Applied motor* setting automatically changes the *Pr. 12* setting. Therefore, it is not necessary to change the *Pr. 12* setting.
  (a) When 4% (initial value) is set in *Pr. 12*
  The *Pr. 12* setting is automatically changed to 2% if the *Pr. 71* value is changed from the value selecting the standard motor (0, 3, 23, 40, 43) to the value selecting the constant torque motor (1, 13, 50, 53).
  (b) When 2% is set in *Pr. 12*
  The *Pr. 12* setting is automatically changed to 4% (initial value) if the *Pr. 71* value is changed from the value selecting the constant-torque motor (1, 13, 50, 53) to the value selecting the standard motor (0, 3, 23, 40, 43).
- Even if the value of *Pr. 12* setting is increased, braking torque is limited so that the output current is within the rated inverter current.

**CAUTION**

**As stop holding torque is not produced, install a mechanical brake.**

**Parameters referred to**

*Pr. 13 Starting frequency* *Refer to page 98*
*Pr. 71 Applied motor* *Refer to page 103*

### 4.9.2 Selection of a regenerative brake (Pr. 30, Pr. 70)

- When making frequent starts/stops, use the optional brake resistor (MRS type, MYS type), high-duty brake resistor (FR-ABR) and brake unit (FR-BU2) to increase the regenerative brake duty.
- Use a power regeneration common converter (FR-CV) for continuous operation in regeneration status.
  Use the high power factor converter (FR-HC) to reduce harmonics, improve the power factor, or continuously use the regenerative status.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **30** | **Regenerative function selection** | 0 | 0 | Without regenerative function,<br>Brake resistor (MRS type, MYS type),<br>Brake unit (FR-BU2)<br>Power regeneration common converter (FR-CV)<br>High power factor converter (FR-HC) |
| | | | 1 | Brake resistor (MYS type) used at 100% torque/6%ED,<br>High-duty brake resistor (FR-ABR) |
| | | | 2 | High power factor converter (FR-HC) when automatic restart after instantaneous power failure is selected |
| **70** | **Special regenerative brake duty** | 0% | 0 to 30% | Brake duty when using the high-duty brake resistor (FR-ABR) |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

**(1) When using the brake resistor (MRS type, MYS type), brake unit (FR-BU2), power regeneration common converter (FR-CV), and high power factor converter (FR-HC).**

•Set *Pr. 30* to "0" (initial value). The *Pr. 70* setting is invalid.
At this time, the regenerative brake duty is as follows.
• FR-D720-025 to 165, FR-D720S-025 or more.....3%
• FR-D720-238 and 318, FR-D740-012 or more .....2%
•Assign the inverter operation enable signal (X10) to the contact input terminal. To make protective coordination with the FR-HC and FR-CV, use the inverter operation enable signal to shut off the inverter output.
Input the RDY signal of the FR-HC (RDYB signal of the FR-CV).
•For the terminal used for X10 signal input, assign its function by setting "10" (X10) to any of *Pr. 178 to Pr. 182*.

**(2) Brake resistor (MYS type) used at 100% torque/6%ED (FR-D720-165 only)**

•Set "1" in *Pr. 30*.
•Set "6%" in *Pr. 70*.



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**(3) When using the high-duty brake resistor (FR-ABR) (FR-D720-025 or more, FR-D740-012 or more, FR-D720S-025 or more)**

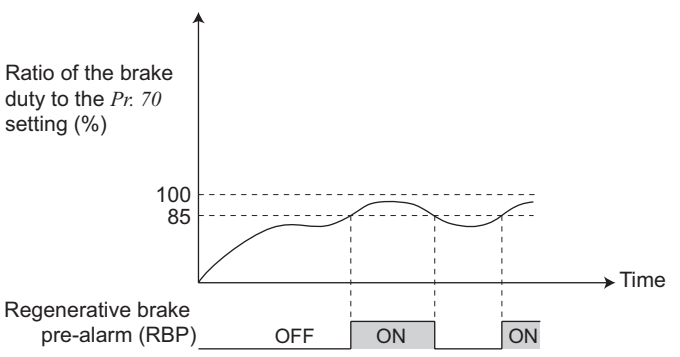
•Set "1" in *Pr. 30*.
•Set "10%" in *Pr. 70*.

**(4) When a high power factor converter (FR-HC) is used and automatic restart after instantaneous power failure function is valid.**

•When automatic restart after instantaneous power failure function of both the FR-HC and inverter is valid (when a value other than "9999" is set in *Pr. 57 Restart coasting time*), set "2" in *Pr. 30* .
•Set *Pr. 70* to "0%" (initial value).
•When the FR-HC detects power failure during inverter operation, the RDY signal turns on, resulting in the motor coasting. Turning the RDY signal off after power restoration, the inverter detects the motor speed (depends on the *Pr.162 Automatic restart after instantaneous power failure selection* ) and restarts automatically after instantaneous power failure.

**(5) Regenerative brake duty alarm output and alarm signal (RBP signal)**

100%: regenerative overvoltage protection operation value




•[RB] appears on the operation panel and an alarm signal (RBP) is output when 85% of the regenerative brake duty set in *Pr. 70* is reached. If the regenerative brake duty reaches 100% of the *Pr. 70* setting, a regenerative overvoltage (E.OV1 to E.OV3) occurs.
Note that [RB] is not displayed when *Pr. 30* = "0".
•The inverter does not trip even when the alarm (RBP) signal is output.
•For the terminal used for the RBP signal output, assign the function by setting "7 (positive logic) or 107 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)* .

**REMARKS**

- The MRS signal can also be used instead of the X10 signal. *(Refer to page 115)*
- Refer to *page 31* to *35* for connecting the brake resistor (MRS type, MYS type), high-duty brake resistor (FR-ABR), brake unit (FR-BU2), high power factor converter (FR-HC), and power regeneration common converter (FR-CV).

**NOTE**

- **When terminal assignment is changed using *Pr. 178 to Pr. 182 (input terminal function selection) and Pr. 190, Pr. 192 (output terminal function selection)*, the other functions may be affected. Make setting after confirming the function of each terminal.** *(Refer to page 113)*

**WARNING**

**The value set in *Pr. 70* must not exceed the setting of the brake resistor used. Otherwise, the resistor can overheat.**

**Parameters referred to**

*Pr. 57 Restart coasting time* ☞ *Refer to page 136*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*
*Pr. 190, Pr. 192 (output terminal function selection)* ☞ *Refer to page 119*





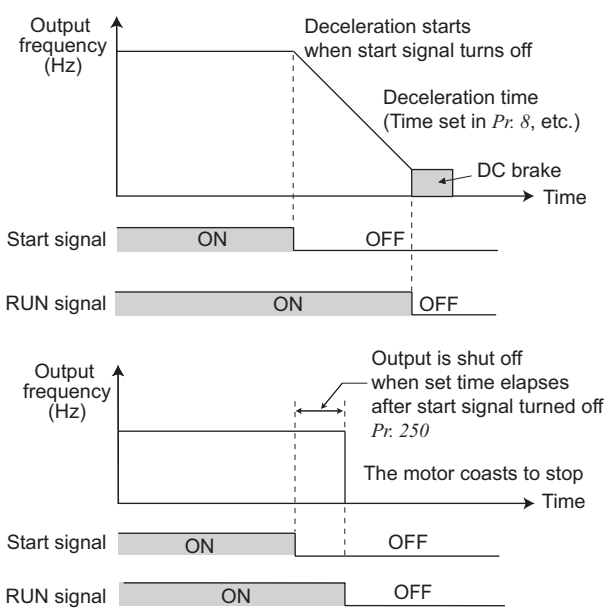
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### 4.9.3 Stop selection (Pr. 250)

Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns OFF.
Used to stop the motor with a mechanical brake, etc. together with switching OFF of the start signal.
You can also select the operations of the start signals (STF/STR). (Refer to *page 117* for start signal selection)

| Parameter Number | Name | Initial Value | Setting Range | Description | |
|---|---|---|---|---|---|
| | | | | Start signal (STF/STR) *(Refer to page 117)* | Stop operation |
| **250** | **Stop selection** | 9999 | 0 to 100s | STF signal: Forward rotation start<br>STR signal: Reverse rotation start | The motor is coasted to a stop when the preset time elapses after the start signal is turned OFF. |
| | | | 1000s to 1100s | STF signal: Start signal<br>STR signal: Forward/reverse signal | The motor is coasted to a stop (*Pr. 250* - 1000)s after the start signal is turned OFF. |
| | | | 9999 | STF signal: Forward rotation start<br>STR signal: Reverse rotation start | When the start signal is turned OFF, the motor decelerates to stop. |
| | | | 8888 | STF signal: Start signal<br>STR signal: Forward/reverse signal | |

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*




#### (1) Decelerate the motor to a stop

- Set *Pr. 250* to "9999" (initial value) or "8888".
- The motor decelerates to a stop when the start signal (STF/STR) turns OFF.

#### (2) Coast the motor to a stop

- Use *Pr. 250* to set the time from when the start signal turns OFF until the output is shut off. When any of "1000 to 1100" is set, the output is shut off in (*Pr. 250* - 1000)s.
- The output is shut off when the time set in *Pr. 250* has elapsed after the start signal had turned OFF. The motor coasts to a stop.
- The RUN signal turns OFF when the output stops.

**REMARKS**

- Stop selection is invalid when the following functions are activated.
  - Power failure stop function (*Pr. 261*)
  - PU stop (*Pr. 75*)
  - Deceleration stop because of communication error (*Pr. 502*)
  - Jog operation mode
- When setting of *Pr. 250* is not 9999 nor 8888, acceleration/deceleration is performed according to the frequency command, until start signal is OFF and output is shutoff.

**NOTE**

- **When the start signal is turned ON again during motor coasting, the motor starts at *Pr. 13 Starting frequency*.**

**Parameters referred to**

*Pr. 7 Acceleration time, Pr. 8 Deceleration time* ☞ *Refer to page 96*
*Pr. 13 Starting frequency* ☞ *Refer to page 98*



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# 4.10 Function assignment of external terminal and control

| Purpose | Parameter that should be Set | | Refer to Page |
|---|---|---|---|
| Assign function to input terminal | Input terminal function selection | Pr. 178 to Pr. 182 | 113 |
| Set MRS signal (output shutoff) to NC contact specification | MRS input selection | Pr. 17 | 115 |
| Assign start signal and forward/ reverse command to other signals | Start signal (STF/STR) operation selection | Pr. 250 | 117 |
| Assign function to output terminal | Output terminal function assignment | Pr. 190, Pr. 192 | 119 |
| Detect output frequency | Up-to-frequency sensitivity<br>Output frequency detection | Pr. 41 to Pr. 43 | 123 |
| Detect output current | Output current detection<br>Zero current detection | Pr. 150 to Pr. 153, Pr. 166, Pr. 167 | 124 |
| Remote output function | Remote output | Pr. 495, Pr. 496 | 126 |

## 4.10.1 Input terminal function selection (Pr. 178 to Pr. 182)

Use these parameters to select/change the input terminal functions.

| Parameter Number | Name | Initial Value | Initial Signal | Setting Range |
|---|---|---|---|---|
| 178 | STF terminal function selection | 60 | STF (forward rotation command) | 0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 60, 62, 65 to 67, 9999 |
| 179 | STR terminal function selection | 61 | STR (reverse rotation command) | 0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 61, 62, 65 to 67, 9999 |
| 180 | RL terminal function selection | 0 | RL (low-speed operation command) | 0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 62, 65 to 67, 9999 |
| 181 | RM terminal function selection | 1 | RM (middle speed operation command) | |
| 182 | RH terminal function selection | 2 | RH (high-speed operation command) | |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*





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## Function assignment of external terminal and control

### (1) Input terminal function assignment

•Using *Pr. 178 to Pr. 182*, set the functions of the input terminals.
•Refer to the following table and set the parameters:

| Setting | Signal | Function | | Related Parameters | Refer to Page |
|---|---|---|---|---|---|
| 0 | RL | *Pr. 59* = 0 (initial value) | Low-speed operation command | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27 Pr.232 to Pr.239 | *89* |
| | | *Pr. 59* ≠ 0 ∗1 | Remote setting (setting clear) | Pr. 59 | *93* |
| 1 | RM | *Pr. 59* = 0 (initial value) | Middle-speed operation command | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | *89* |
| | | *Pr. 59* ≠ 0 ∗1 | Remote setting (deceleration) | Pr. 59 | *93* |
| 2 | RH | *Pr. 59* = 0 (initial value) | High-speed operation command | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | *89* |
| | | *Pr. 59* ≠ 0 ∗1 | Remote setting (acceleration) | Pr. 59 | *93* |
| 3 | RT | Second function selection | | Pr. 44 to Pr. 51 | *116* |
| 4 | AU | Terminal 4 input selection | | Pr. 267 | *150* |
| 5 | JOG | Jog operation selection | | Pr. 15, Pr. 16 | *91* |
| 7 | OH | External thermal relay input ∗2 | | Pr. 9 | *100* |
| 8 | REX | 15-speed selection (combination with three speeds RL, RM, RH) | | Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 | *89* |
| 10 | X10 | Inverter run enable signal (FR-HC, FR-CV connection) | | Pr. 30, Pr. 70 | *110* |
| 12 | X12 | PU operation external interlock | | Pr. 79 | *165* |
| 14 | X14 | PID control valid terminal | | Pr. 127 to Pr. 134 | *212* |
| 16 | X16 | PU-external operation switchover (turning ON X16 selects external operation) | | Pr. 79, Pr. 340 | *172* |
| 18 | X18 | V/F switchover (V/F control is exercised when X18 is ON) | | Pr. 80 | *75*, *105* |
| 24 | MRS | Output stop | | Pr. 17 | *115* |
| 25 | STOP | Start self-holding selection | | — | *117* |
| 60 | STF | Forward rotation command (assigned to STF terminal *(Pr. 178)* only) | | — | *117* |
| 61 | STR | Reverse rotation command (assigned to STR terminal *(Pr. 179)* only) | | — | *117* |
| 62 | RES | Inverter reset | | — | — |
| 65 | X65 | PU/NET operation switchover (turning ON X65 selects PU operation) | | Pr. 79, Pr. 340 | *173* |
| 66 | X66 | External/NET operation switchover (turning ON X66 selects NET operation) | | Pr. 79, Pr. 340 | *173* |
| 67 | X67 | Command source switchover (turning ON X67 makes *Pr. 338 and Pr. 339* commands valid) | | Pr. 338, Pr. 339 | *176* |
| 9999 | — | No function | | — | — |

∗1 When *Pr. 59 Remote function selection* ≠ "0", the functions of the RL, RM and RH signals are changed as given in the table.
∗2 The OH signal turns ON when the relay contact "opens".

**NOTE**

- **Changing the terminal assignment using *Pr.178 to Pr.182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**
- **One function can be assigned to two or more terminals. In this case, the terminal inputs are ORed.**
- **The priorities of the speed commands are in order of jog > multi-speed setting (RH, RM, RL, REX) > PID (X14).**
- **When the X10 signal (FR-HC, FR-CV connection-inverter operation enable signal) is not set or when the PU operation external interlock (X12) signal is not assigned with *Pr.79 Operation mode selection* set to "7", the MRS signal shares this function.**
- **Same signal is used to assign multi-speed (7th speed) and remote setting. They cannot be set individually. (Same signal is used since multi-speed (7th speed) setting and remote setting are not used to set speed at the same time.)**
- **When V/F control is selected by V/F switchover (X18 signal), second function is also selected at the same time. Control between V/F and General-purpose magnetic flux can not be switched during operation. In case control is switched between V/F and General-purpose magnetic flux, only second function is selected.**
- **Turning the AU signal ON makes terminal 2 (voltage input) invalid.**

### (2) Response time of each signal

- The response time of the X10 signal and MRS signal is within 2ms.
  The response time of other signals is within 20ms.



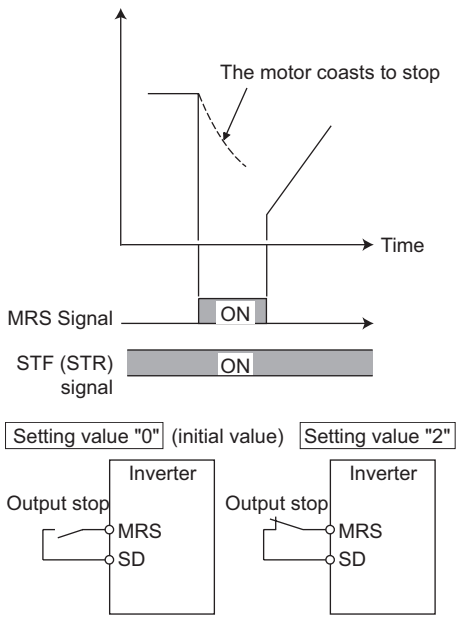
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## 4.10.2 Inverter output shutoff signal (MRS signal, Pr. 17)

The inverter output can be shut off by the MRS signal. Also, logic for the MRS signal can be selected.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| 17 | MRS input selection | 0 | 0 | Normally open input |
| | | | 2 | Normally closed input (NC contact input specifications) |
| | | | 4 | External terminal: Normally closed input (NC contact input specifications) Communication: Normally open input |

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 162*)




### (1) Output shutoff signal (MRS signal)

- Turning ON the output shutoff signal (MRS) during inverter running shuts off the output immediately.
  Set "24" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign a function to the MRS signal.
- MRS signal may be used as described below.

(a) When mechanical brake (e.g. electromagnetic brake) is used to stop motor
The inverter output is shut off when the mechanical brake operates.

(b) To provide interlock to disable operation by the inverter
With the MRS signal ON, the inverter cannot be operated if the start signal is entered into the inverter.

(c) Coast the motor to a stop.
When the start signal is turned OFF, the inverter decelerates the motor to a stop in the preset deceleration time, but when the MRS signal is turned ON, the motor coasts to a stop.

### (2) MRS signal logic inversion *(Pr. 17)*

- When *Pr. 17* is set to "2", the MRS signal (output stop) can be changed to the normally closed (NC contact) input specification. When the MRS signal turns ON (opens), the inverter shuts off the output.

### (3) Assign a different action for each MRS signal input from communication and external terminal (*Pr. 17* = "4")

- When *Pr. 17* is set to "4", the MRS signal from external terminal (output stop) can be changed to the normally closed (NC contact) input, and the MRS signal from communication can be changed to the normally open (NO contact) input.
  This function is useful to perform operation by communication with MRS signal from external terminal remained on.

| External MRS | Communication MRS | *Pr. 17* Setting | | |
|---|---|---|---|---|
| | | 0 | 2 | 4 |
| OFF | OFF | Operation enabled | Output shutoff | Output shutoff |
| OFF | ON | Output shutoff | Output shutoff | Output shutoff |
| ON | OFF | Output shutoff | Output shutoff | Operation enabled |
| ON | ON | Output shutoff | Operation enabled | Output shutoff |

**REMARKS**

- The MRS signal can shut off the output, independently of the PU, external or network operation mode.

**NOTE**

- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

**Parameters referred to**

*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*





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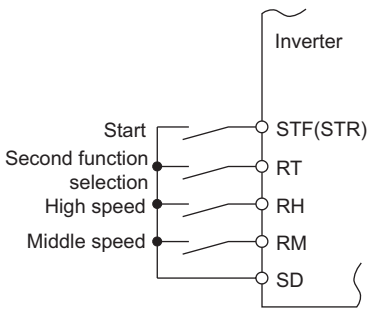
### 4.10.3 Condition selection of function validity by second function selection signal (RT)

You can select the second function using the RT signal.

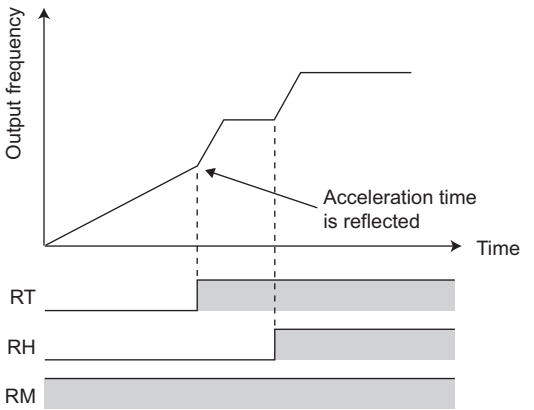
- When the RT signal turns ON, the second function becomes valid.
- For the RT signal, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.
- The second function has the following applications.

(a) Switching between normal use and emergency use
(b) Switching between heavy load and light load
(c) Changing of acceleration/deceleration time by broken line acceleration/deceleration
(d) Switching of characteristic between the main motor and sub motor

**Second function connection diagram**




**Second acceleration/deceleration time**




| Function | First Function Parameter Number | Second Function Parameter Number | Refer to Page |
|---|---|---|---|
| Torque boost | Pr. 0 | Pr. 46 | *73* |
| Base frequency | Pr. 3 | Pr. 47 | *85* |
| Acceleration time | Pr. 7 | Pr. 44 | *96* |
| Deceleration time | Pr. 8 | Pr. 44, Pr. 45 | *96* |
| Electronic thermal O/L relay | Pr. 9 | Pr. 51 | *100* |
| Stall prevention | Pr. 22 | Pr. 48 | *79* |
| Applied motor | Pr. 71 | Pr. 450 | *103* |

**NOTE**

- **When the RT signal is ON, the above second function is selected at the same time.**
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

**Parameters referred to**

*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*



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### 4.10.4 Start signal operation selection (STF, STR, STOP signal, Pr. 250)

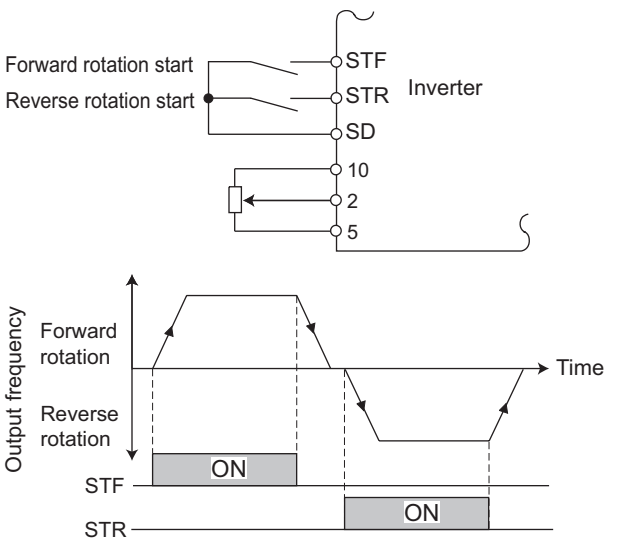
You can select the operation of the start signal (STF/STR).
Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns OFF.
Used to stop the motor with a mechanical brake, etc. together with switching off of the start signal.
(Refer to *page 112* for stop selection)

| Parameter Number | Name | Initial Value | Setting Range | Description | |
|---|---|---|---|---|---|
| | | | | Start signal (STF/STR) | Stop operation *Refer to page 112* |
| **250** | **Stop selection** | 9999 | 0 to 100s | STF signal: Forward rotation start<br>STR signal: Reverse rotation start | The motor is coasted to a stop when the preset time elapses after the start signal is turned OFF. |
| | | | 1000s to 1100s | STF signal: Start signal<br>STR signal: Forward/reverse signal | When the setting is any of 1000s to 1100s, the inverter coasts to a stop in (*Pr. 250* - 1000)s. |
| | | | 9999 | STF signal: Forward rotation start<br>STR signal: Reverse rotation start | When the start signal is turned OFF, the motor decelerates to stop. |
| | | | 8888 | STF signal: Start signal<br>STR signal: Forward/reverse signal | |

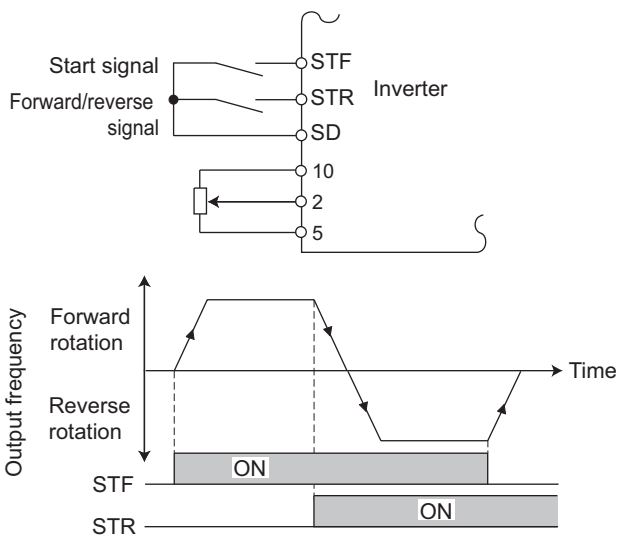
The above parameter can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 162)*

#### (1) Two-wire type connection (STF, STR signal)

- The two-wire connection is shown below.
- In the initial setting, the forward/reverse rotation signals (STF/STR) are used as start and stop signals. Turn ON either of the forward and reverse rotation signals to start the motor in the corresponding direction. Switch both OFF (or both ON) the start signal during operation to decelerate the inverter to a stop.
- The speed setting signal may either be given by entering 0 to 10VDC across the speed setting input terminal 2-5, or by setting the required values in *Pr. 4 to Pr. 6 Multi-speed setting (high, middle, low speeds)*, etc.
  (For multi-speed operation, refer to *page 89*.)
- When *Pr. 250* is set to any of "1000 to 1100, 8888", the STF signal becomes a start command and the STR signal a forward/reverse command.




**2-wire connection example (*Pr. 250* = "9999")**




**2-wire connection example (*Pr. 250* = "8888")**

**REMARKS**

- When *Pr. 250* is set to any of "0 to 100, 1000 to 1100", turning off the start command coasts the inverter to a stop. *(Refer to page 112)*
- The STF and STR signals are assigned to the STF and STR terminals in the initial setting. The STF signal can be assigned to *Pr. 178 STF terminal function selection*, and the STR signal to *Pr. 179 STR terminal function selection* only.

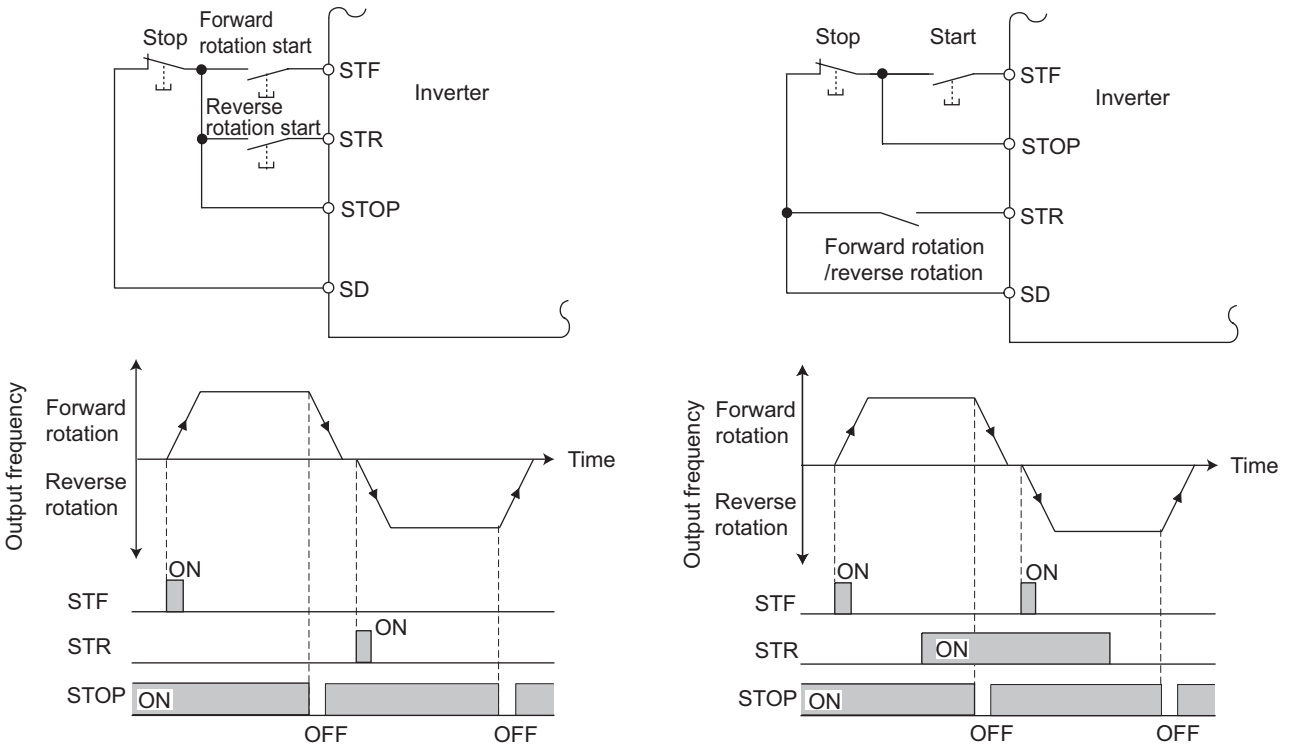




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### (2) Three-wire type (STF, STR, STOP signal)

- The three-wire connection is shown below.
- Turning the STOP signal ON makes start self-holding function valid. In this case, the forward/reverse rotation signal functions only as a start signal.
- If the start signal (STF or STR) is turned ON and then OFF, the start signal is held and makes a start. When changing the direction of rotation, turn STR (STF) ON once and then OFF.
- To stop the inverter, turning OFF the STOP signal once decelerates it to a stop.
- When using the STOP signal, set "25" in any of *Pr.178 to Pr.182* to assign function.




**3-wire connection example (*Pr. 250* = "9999")**




**3-wire connection example (*Pr. 250* = "8888")**

**REMARKS**

- When the JOG signal is turned ON to enable Jog operation, the STOP signal becomes invalid.
- If the MRS signal is turned ON to stop the output, the self-holding function is not canceled.

### (3) Start signal selection

| STF | STR | *Pr. 250* Setting Inverter Status | |
|---|---|---|---|
| | | 0 to 100s, 9999 | 1000s to 1100s 8888 |
| OFF | OFF | Stop | Stop |
| OFF | ON | Reverse rotation | |
| ON | OFF | Forward rotation | Forward rotation |
| ON | ON | Stop | Reverse rotation |

**Parameters referred to**

*Pr. 4 to Pr. 6 (multi-speed setting)* ☞ *Refer to page 89*
*Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 113*



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### 4.10.5 Output terminal function selection (Pr. 190, Pr. 192)

You can change the functions of the open collector output terminal and relay output terminal.

| Parameter Number | Name | | Initial Value | Initial Signal | Setting Range |
|---|---|---|---|---|---|
| 190 | RUN terminal function selection | Open collector output terminal | 0 | RUN (inverter running) | 0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46, 47, 64, 70, 80, 90, 91, 93*, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146, 147, 164, 170, 180, 190, 191, 193*, 195, 196, 198, 199, 9999 |
| 192 | A,B,C terminal function selection | Relay output terminal | 99 | ALM (fault output) | |

* "93" and "193" can not be set in *Pr. 192*.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

#### (1) Output signal list

•You can set the functions of the output terminals.

•Refer to the following table and set the parameters: (0 to 99: positive logic, 100 to 199: negative logic)

| Setting | | Signal | Function | Operation | Related Parameter | Refer to Page |
|---|---|---|---|---|---|---|
| Positive logic | Negative logic | | | | | |
| 0 | 100 | RUN | Inverter running | Output during operation when the inverter output frequency rises to or above *Pr. 13 Starting frequency*. | — | *121* |
| 1 | 101 | SU | Up to frequency ∗1 | Output when the output frequency is reached to the set frequency. | Pr. 41 | *123* |
| 3 | 103 | OL | Overload alarm | Output while stall prevention function is activated. | Pr. 22, Pr. 23, Pr. 66 | *79* |
| 4 | 104 | FU | Output frequency detection | Output when the output frequency reaches the frequency set in *Pr. 42* (*Pr. 43* for reverse rotation). | Pr. 42, Pr. 43 | *123* |
| 7 | 107 | RBP | Regenerative brake pre-alarm | Output when 85% of the regenerative brake duty set in *Pr. 70* is reached. | Pr. 70 | *110* |
| 8 | 108 | THP | Electronic thermal O/L relay pre-alarm | Output when the electronic thermal value reaches 85% of the trip level. (Electronic thermal relay function protection (E.THT/E.THM) activates, when the value reached 100%. | Pr. 9, Pr. 51 | *100* |
| 11 | 111 | RY | Inverter operation ready | Output when reset process is completed (when the inverter can be started by switching the start signal on or while it is running) after powering on inverter. | — | *121* |
| 12 | 112 | Y12 | Output current detection | Output when the output current is higher than the *Pr. 150* setting for longer than the time set in *Pr. 151* . | Pr. 150, Pr. 151 | *124* |
| 13 | 113 | Y13 | Zero current detection | Output when the output power is lower than the *Pr. 152* setting for longer than the time set in *Pr. 153* . | Pr. 152, Pr. 153 | *124* |
| 14 | 114 | FDN | PID lower limit | Output when the feedback value falls below the lower limit of PID control. | Pr. 127 to Pr. 134 Pr. 575 to Pr. 577 | *212* |
| 15 | 115 | FUP | PID upper limit | Output when the feedback value rises above the upper limit of PID control | | |
| 16 | 116 | RL | PID forward/reverse rotation output | Output when forward rotation is performed in PID control. | | |
| 25 | 125 | FAN | Fan fault output | Output at the time of a fan fault. | Pr. 244 | *228* |
| 26 | 126 | FIN | Heatsink overheat pre-alarm | Output when the heatsink temperature reaches about 85% of the heatsink overheat protection providing temperature. | — | *255* |
| 46 | 146 | Y46 | During deceleration at occurrence of power failure | Output when the power failure-time deceleration function is executed. (retained until release) | Pr. 261 | *142* |
| 47 | 147 | PID | During PID control activated | Output during PID control. | Pr. 127 to Pr. 134 Pr. 575 to Pr. 577 | *212* |
| 64 | 164 | Y64 | During retry | Output during retry processing. | Pr. 65 to Pr. 69 | *144* |
| 70 | 170 | SLEEP | PID output interruption | Output when the PID output interruption function is executed. | Pr. 127 to Pr. 134, Pr. 575 to Pr. 577 | *212* |
| 80 | 180 | For manufacturer setting | | | | |





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## Function assignment of external terminal and control

| Setting | | Signal | Function | Operation | Related Parameter | Refer to Page |
|---|---|---|---|---|---|---|
| Positive logic | Negative logic | | | | | |
| 90 | 190 | Y90 | Life alarm | Output when any of the control circuit capacitor, main circuit capacitor and inrush current limit circuit or the cooling fan approaches the end of its service life. | Pr. 255 to Pr. 259 | *229* |
| 91 | 191 | Y91 | Fault output 3 (power-off signal) | Output when a fault occurs due to the internal circuit failure or the inverter wiring mistake, etc. | — | *122* |
| 93 | 193 | Y93 | Current average value monitor signal | Average current value and maintenance timer value are output as pulses.<br>The signal can not be set in *Pr. 192 A,B,C terminal function selection* . | Pr. 555 to Pr. 557 | *234* |
| 95 | 195 | Y95 | Maintenance timer signal | Output when *Pr. 503* rises to or above the *Pr. 504* setting. | Pr. 503, Pr. 504 | *233* |
| 96 | 196 | REM | Remote output | Output to the terminal when a value is set to the parameter. | Pr. 495, Pr. 496 | *126* |
| 98 | 198 | LF | Alarm output | Output when an alarm (fan failure or communication error warning) occurs. | Pr. 121, Pr. 244 | *183*, *228* |
| 99 | 199 | ALM | Fault output | Output when a fault occurs.<br>The signal output is stopped when the fault is reset. | — | *122* |
| 9999 | | — | No function | — | — | — |

*1 Note that when the frequency setting is varied using an analog signal or of the operation panel, the output of the SU (up to frequency) signal may alternate on and off depending on that varying speed and the timing of the varying speed due to acceleration/deceleration time setting.
(The output will not alternate on and off when the acceleration/deceleration time setting is "0s".)

### REMARKS

- The same function may be set to more than one terminal.
- When the function is executed, the terminal conducts at the setting of any of "0 to 99", and does not conduct at the setting of any of "100 to 199".

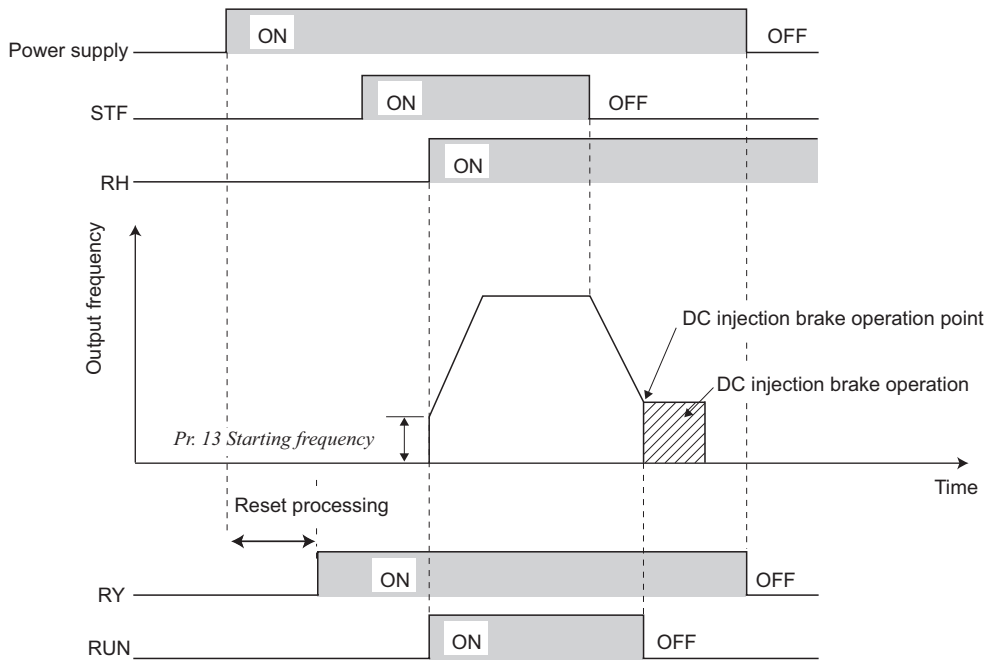
### NOTE

- **Changing the terminal assignment using *Pr.190, Pr.192 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**
- **Do not assign signals which repeat frequent ON/OFF to A, B, and C. Otherwise, the life of the relay contact decreases.**



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### (2) Inverter operation ready signal (RY signal) and inverter running signal (RUN signal)




- When the inverter is ready to operate, the output of the operation ready signal (RY) is ON. (It is also ON during inverter running.)
- When the output frequency of the inverter rises to or above *Pr. 13 Starting frequency* , the output of the inverter running signal (RUN) is turned on. During an inverter stop or DC injection brake operation, the output is off.
- When using the RY and RUN signals, assign functions to *Pr.190 or Pr.192 (output terminal selection function)* referring to the table below.

| Output Signal | *Pr. 190 to Pr. 192* Setting | |
|---|---|---|
| | Positive logic | Negative logic |
| RY | 11 | 111 |
| RUN | 0 | 100 |

| Inverter Status / Output signal | Start Signal OFF (during stop) | Start Signal ON (during stop) | Start Signal ON (during operation) | Under DC Injection Brake | At Alarm Occurrence or MRS Signal ON (output shutoff) | Automatic Restart after Instantaneous Power Failure | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Coasting | | Restarting |
| | | | | | | Start signal ON | Start signal OFF | |
| RY | ON | ON | ON | ON | OFF | ON ∗1 | | ON |
| RUN | OFF | OFF | ON | OFF | OFF | OFF | | ON |

∗1 This signal turns OFF during power failure or undervoltage.

**REMARKS**

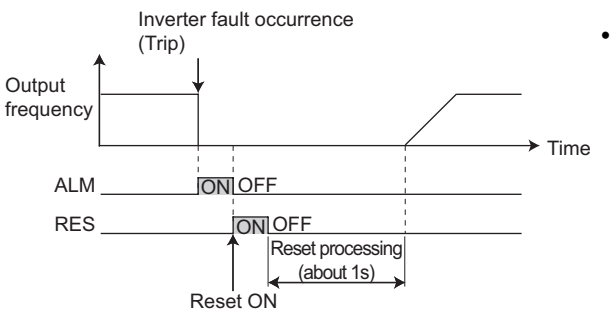
- The RUN signal (positive logic) is assigned to the terminal RUN in the initial setting.





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### (3) Fault output signal (ALM signal)




- If the inverter comes to trip, the ALM signal is output.

**REMARKS**

- The ALM signal is assigned to the ABC contact in the initial setting. By setting "99 (positive logic) or 199 (negative logic) in *Pr.190 or Pr.192 (output terminal function selection)*, the ALM signal can be assigned to the other signal.
- Refer to *page 250* for the inverter fault description.

### (4) Fault output 3 (power-off signal) (Y91 signal)

- The Y91 signal is output at occurrence of a fault attributable to the failure of the inverter circuit or a fault caused by a wiring mistake.
- When using the Y91 signal, set "91 (positive logic)" or "191 (negative logic)" to *Pr.190 or Pr.192 (output terminal function selection)* to assign the function to the output terminal.
- The following table indicates the faults that will output the Y91 signal. (Refer to *page 249* for the fault description.)

| Operation Panel Indication | | Name |
|---|---|---|
| E. bE | **E. BE** | Brake transistor alarm detection |
| E. GF | **E.GF** | Output side earth (ground) fault overcurrent at start |
| E. LF | **E.LF** | Output phase loss |
| E. PE | **E.PE** | Parameter storage device fault |
| E.CPU | **E.CPU** | CPU fault |
| E.I OH | **E.IOH** | Inrush current limit circuit fault |

**REMARKS**

- At occurrence of output side earth (ground) fault overcurrent (E.GF), overcurrent trip during acceleration(E.OC1) may be displayed. At this time, the Y91 signal is output.

**Parameters referred to**

*Pr. 13 Starting frequency* *Refer to page 98*



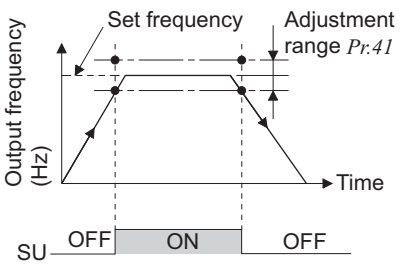
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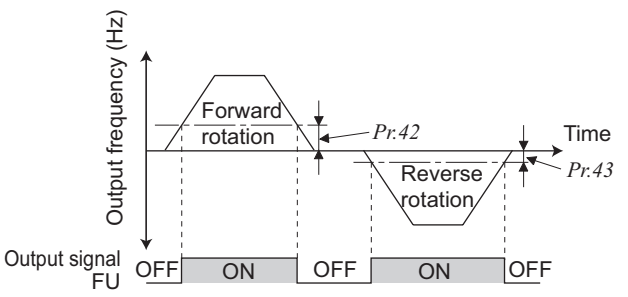
## 4.10.6 Detection of output frequency (SU, FU signal, Pr. 41 to Pr. 43)

The inverter output frequency is detected and output at the output signals.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **41** | **Up-to-frequency sensitivity** | 10% | 0 to 100% | Level where the SU signal turns ON. |
| **42** | **Output frequency detection** | 6Hz | 0 to 400Hz | Frequency where the FU signal turns ON. |
| **43** | **Output frequency detection for reverse rotation** | 9999 | 0 to 400Hz | Frequency where the FU signal turns ON in reverse rotation. |
| | | | 9999 | Same as *Pr. 42* setting |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*




### (1) Up-to-frequency sensitivity (SU signal, *Pr. 41*)

- When the output frequency reaches the set frequency, the up-to-frequency signal (SU) is output.
- The *Pr. 41* value can be adjusted within the range 0% to ±100% on the assumption that the set frequency is 100%.
- This parameter can be used to ensure that the running frequency has been reached to provide the operation start signal etc. for related equipment.
- When using the SU signal, set "1 (positive logic) or 101 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)* to assign function to the output terminal.

### (2) Output frequency detection (FU signal, *Pr. 42*, *Pr. 43*)

- The output frequency detection signal (FU) is output when the output frequency reaches or exceeds the *Pr. 42* setting.
- This function can be used for electromagnetic brake operation, open signal, etc.
- Frequency detection that is dedicated to reverse operation use can be set by setting detection frequency to *Pr. 43*. This function is effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during vertical lift operation, etc.
- When *Pr. 43* ≠ "9999", the *Pr. 42* setting is used for forward rotation and the *Pr. 43* setting is used for reverse rotation.
- When using the FU signal, set "4 (positive logic)" or "104 (negative logic)" to *Pr. 190 or Pr. 192 (output terminal function selection)* to assign the function to the output terminal.

**REMARKS**

- All signals are off during DC injection brake.
- The output frequency to be compared with the set frequency is the output frequency before slip compensation is performed.

**NOTE**

- **Changing the terminal assignment using *Pr.190, Pr.192 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

**Parameters referred to**

*Pr. 190, Pr. 192 (output terminal function selection)* ☞ *(Refer to page 119)*





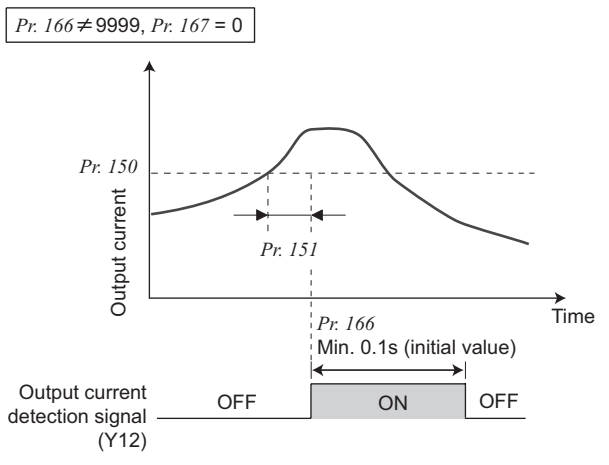
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### 4.10.7 Output current detection function (Y12 signal, Y13 signal, Pr. 150 to Pr. 153, Pr. 166, Pr. 167)

The output current during inverter running can be detected and output to the output terminal.

| Parameter Number | Name | Initial Value | Setting Range | Description |
|---|---|---|---|---|
| **150** | **Output current detection level** | 150% | 0 to 200% | 100% is the rated inverter current. |
| **151** | **Output current detection signal delay time** | 0s | 0 to 10s | Output current detection period.<br>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** | 5% | 0 to 200% | The rated inverter current is assumed to be 100%. |
| **153** | **Zero current detection time** | 0.5s | 0 to 1s | 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 to 10s | Set the retention time when the Y12 signal is ON. |
| | | | 9999 | The Y12 signal ON status is retained. The signal is turned off at the next start. |
| **167** | **Output current detection operation selection** | 0 | 0 | Operation continues when the Y12 signal is ON |
| | | | 1 | The inverter is brought to trip when the Y12 signal is ON. (E.CDO) |

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 162)*

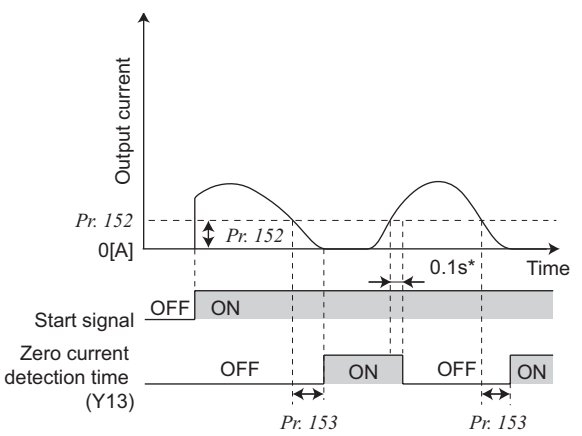



#### (1) Output current detection (Y12 signal, *Pr. 150, Pr. 151, Pr. 166, Pr. 167* )

- The output current detection function can be used for excessive torque detection, etc.
- If the output current remains higher than the *Pr. 150* setting during inverter operation for longer than the time set in *Pr. 151*, the output current detection signal (Y12) is output from the inverter's open collector or relay output terminal.
- When the Y12 signal turns ON, the ON state is held for the time set in *Pr. 166*.
- When *Pr. 166* = "9999", the ON state is held until a next start.
- At the *Pr. 167* setting of "1", the inverter trips, and the output current detection fault (E.CDO) is displayed when the Y12 signal turns ON. When fault occurs, the Y12 signal is ON for the time set in *Pr. 166* at the *Pr. 166* setting of other than 9999, and remains ON until a reset is made at the *Pr. 166* setting of 9999. E.CDO does not occur even if "1" is set in *Pr. 167* while Y12 is ON. The *Pr. 167* setting is valid after Y12 turns OFF.
- For the Y12 signal, set "12 (positive logic) or 112 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)* and assign functions to the output terminal.



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* The zero current detection signal (Y13) holds the signal for approximately 0.1s once turned on.

### (2) Zero current detection (Y13 signal, *Pr. 152, Pr. 153*)

- If the output current remains lower than the *Pr. 152* setting during inverter operation for longer than the time set in *Pr. 153*, the zero current detection (Y13) signal is output from the inverter's open collector or relay output terminal.
- When the inverter's output current falls to "0", torque will not be generated. This may cause a drop due to gravity when the inverter is used in vertical lift application.
  To prevent this, the Y13 signal can be output from the inverter to close the mechanical brake when the output current has fallen to "zero".
- For the Y13 signal, set "13 (positive logic) or 113 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)* and assign functions to the output terminal.

**REMARKS**

- This function is also valid during execution of the offline auto tuning.
- The response time of Y12 and Y13 signals is approximately 0.1s. Note that the response time changes according to the load condition.
- When *Pr. 152* = "0", detection is disabled.

**NOTE**

- **Changing the terminal assignment using *Pr. 190, Pr. 192 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.**

## ⚠ CAUTION

**⚠ The zero current detection level setting should not be too high, and the zero current detection time setting not too long. Otherwise, the detection signal may not be output when torque is not generated at a low output current.**

**⚠ To prevent the machine and equipment from resulting in hazardous conditions detection signal, install a safety backup such as an emergency brake even the zero current detection function is set valid.**

**Parameters referred to**

*Offline auto tuning* ☞ *Refer to page 105*
*Pr. 190, Pr. 192 (output terminal function selection)* ☞ *Refer to page 119*





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