INVERTER
FR-F700PJ
INSTRUCTION MANUAL (Applied)

Air-conditioning inverter

FR-F720PJ-0.4K to 15K (F)
FR-F740PJ-0.4K to 15K (F)

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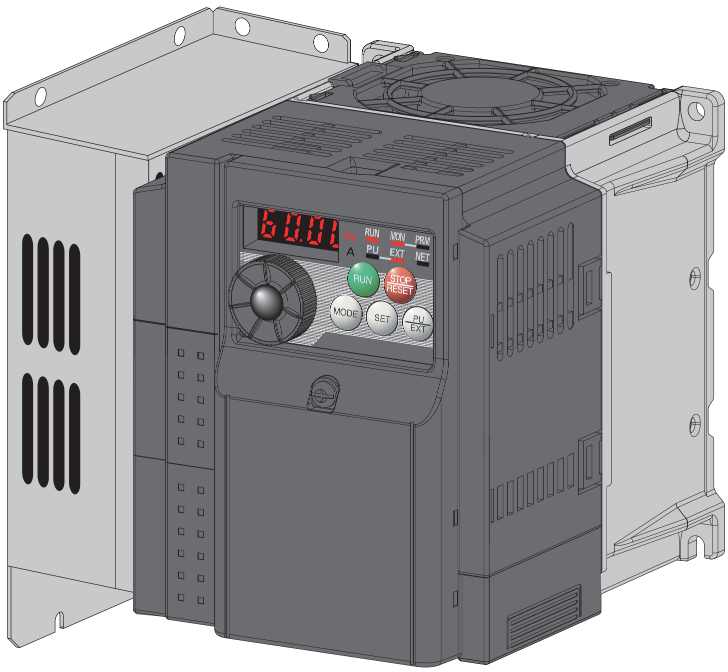

Thank you for choosing this Mitsubishi Inverter.
This Instruction Manual (Applied) provides instructions for advanced use of the FR-F700PJ series inverters.
Incorrect handling might cause an unexpected fault. Before using the inverter, always read this Instruction Manual and the Instruction Manual (Basic) [IB-0600425ENG] 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	Incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠CAUTION	Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.

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

1. Electric Shock Prevention

⚠WARNING

- While the inverter power is ON, do not open the front cover or the wiring cover. Do not run the inverter with the front cover or the wiring cover removed. Otherwise you may access the exposed high voltage terminals or the charging part of the circuitry and get an electric shock.
- Even if power is OFF, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before wiring or inspection, power must be switched OFF. To confirm that, LED indication of the operation panel must be checked. (It must be OFF.) Any person who is involved in wiring or inspection shall wait for at least 10 minutes after the power supply has been switched OFF and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
- This inverter must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 536 class 1 and other applicable standards).
  A neutral-point earthed (grounded) power supply for 400V class inverter in compliance with EN standard must be used.
- Any person who is involved in wiring or inspection of this equipment shall be fully competent to do the work.
- The inverter must be installed before wiring. Otherwise you may get an electric shock or be injured.
- Setting dial and key operations must be performed with dry hands to prevent an electric shock. 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 or handle the cables 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.
- IPM motor is a synchronous motor with high-performance magnets embedded in the rotor. Motor terminals hold high voltage while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. When the motor is driven by the load in applications such as fan and blower, a low-voltage manual contactor must be connected at the inverter's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.

2. Fire Prevention

⚠CAUTION

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

3.Injury Prevention

⚠CAUTION

- The voltage applied to each terminal must be the ones specified in the Instruction Manual. Otherwise burst, damage, etc. may occur.
- The cables must be connected to the correct terminals. Otherwise burst, damage, etc. may occur.
- Polarity must be correct. Otherwise burst, damage, etc. may occur.
- While power is ON or for some time after power-OFF, do not touch the inverter (Filterpack) since the inverter will be extremely hot. Doing so can cause burns.

4. Additional Instructions

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

(1) Transportation and Mounting

⚠CAUTION

- The product must be transported in correct method that corresponds to the weight. Failure to do so may lead to injuries.
- Do not stack the boxes containing inverters higher than the number recommended.
- The product must be installed to the position where withstands the weight of the product according to the information in the Instruction Manual.
- Do not install or operate the inverter (Filterpack) 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.
- The inverter mounting orientation must be correct.
- Foreign conductive objects must be prevented from entering the inverter (Filterpack). That includes screws and metal fragments or other flammable substance such as oil.
- Because the inverter (Filterpack) is a precision instrument, do not drop or subject it to impact.
- The inverter (Filterpack) must be used under the following environment: Otherwise the inverter may be damaged.

Environment	Surrounding air temperature	-10°C to +50°C (non-freezing)
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature	-20°C to +65°C *1
	Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude/ vibration	Maximum 1,000m above sea level. 5.9m/s^2 or less at 10 to 55Hz (directions of X, Y, Z axes) *2

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

*2 When installing the Filterpack of 11K or 15K on the rear panel of the inverter, do not install on moving objects or places which vibrates (exceeding 1.96m/s^2).

(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 affects the rotation direction of the motor.
- IPM motor terminals (U, V, W) hold high-voltage while the IPM motor is running even after the power is turned OFF. Before wiring, the IPM motor must be confirmed to be stopped. Otherwise you may get an electric shock.
- Never connect an IPM motor to the commercial power supply. Applying the commercial power supply to input terminals (U,V, W) of an IPM motor will burn the IPM motor. The IPM motor must be connected with the output terminals (U, V, W) of the inverter.

(3) Trial run

⚠CAUTION

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

(4) Usage

⚠WARNING

- The IPM motor capacity must be same with the inverter capacity.
- Do not use multiple IPM motors with one inverter.
- Any person must stay away from the equipment when the retry function is set as it will restart suddenly after trip.
- Since pressing STOP RESET key may not stop output depending on the function setting status, separate circuit and switch that make an emergency stop (power OFF, mechanical brake operation for emergency stop, etc.) must be provided.
- OFF status of the start signal must be confirmed before resetting the inverter fault. Resetting inverter alarm with the start signal ON restarts the motor suddenly.
- Do not use an IPM motor in an application where a motor is driven by its load and runs at a speed higher than the maximum motor speed.
- A dedicated IPM motor must be used under IPM motor control. Do not use a synchronous motor, induction motor, or synchronous induction motor under IPM motor control.
- The inverter must be used for three-phase induction motors or the dedicated IPM motor.
  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.
- The effect of electromagnetic interference must be reduced by using an EMC filter or by other means. Otherwise nearby electronic equipment may be affected.
- Appropriate measures must be taken to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power factor correction capacitor and generator.
- When driving a 400V class motor by the inverter, the motor must be an insulation-enhanced motor or measures must be taken to suppress surge voltage. Surge voltage attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations because all parameters return to the initial value.
- The inverter can be easily set for high-speed operation. Before changing its setting, the performances of the motor and machine must be fully examined.
- Stop status cannot be hold by the inverter's brake function. In addition to the inverter's brake function, a holding device must be installed to ensure safety.
- Before running an inverter which had been stored for a long period, inspection and test operation must be performed.
- Static electricity in your body must be discharged before you touch the product. Otherwise the product may be damaged.
- Do not connect an IPM motor under the general-purpose motor control settings (initial settings). Do not use a general-purpose motor under the IPM motor control setting. Doing so will cause a failure.
- In the system with an IPM motor, the inverter power must be turned ON before closing the contacts of the contactor at the output side.

(5) Emergency stop

⚠CAUTION

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

(6) Maintenance, inspection and parts replacement

⚠CAUTION

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

(7) Disposal

⚠CAUTION

- The inverter must be treated as industrial waste.

General instruction

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

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<Abbreviation>

PU ....Operation panel and parameter unit (FR-PU04/FR-PU07)
Inverter ....Mitsubishi inverter FR-F700PJ series
FR-F700PJ ....Mitsubishi inverter FR-F700PJ series
Pr. ....Parameter number (Number assigned to function)
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
General-purpose motor ....Three-phase induction motor
Mitsubishi standard motor ....SF-JR
Mitsubishi constant-torque motor ....SF-HRCA
Filterpack FR-BFP2
IPM motor.......................................High-efficiency IPM motor MM-EF (1800r/min specification)
Premium high-efficiency IPM motor MM-EFS (1500r/min specification)

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

Mark	Control method	Applied motor (control)
V/F	V/F control	Three-phase induction motor (general-purpose motor control)
GP MFVC	General-purpose magnetic flux vector control	
IPM	IPM motor control	Dedicated IPM motor (IPM motor control)

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<Mark>

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

Harmonic suppression guideline (when inverters are used in Japan)
All models of general-purpose inverters used by specific consumers are covered by "Harmonic suppression guideline for consumers who receive high voltage or special high voltage". (For further details, *refer to page 48*.)

MEMO

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.. 4
1.3 Removal and reinstallation of the cover..................................... 6
1.4 Installation of the inverter and enclosure design 9
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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.

(1) Inverter

●Inverter model

FR- F740PJ - 1.5 K [ ]

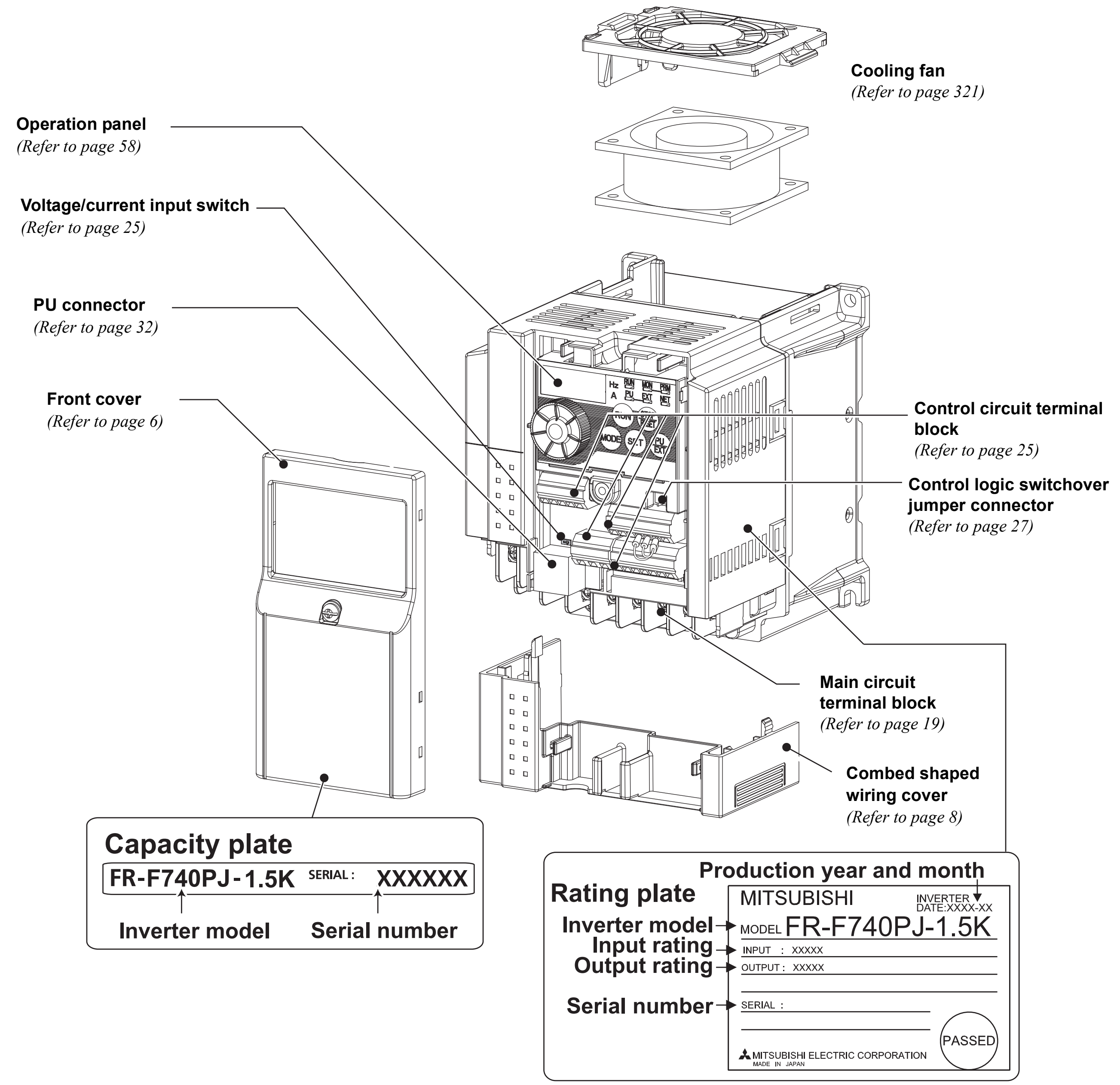
Symbol	Voltage class
F720PJ	Three-phase 200V class
F740PJ	Three-phase 400V class

Represents the inverter capacity [kW]

Symbol	Filterpack
None	Without
F	With

REMARKS

The Filterpack model ("F" at the end of its model name on the packaging box) comes with a Filterpack (FR-BFP2).



- **Enclosed items**
  - **Fan cover fixing screws (M3 × 35mm)**
    These screws are necessary for compliance with the EU Directive. (*Refer to the Instruction Manual (Basic)*)

Capacity	Quantity
1.5K to 3.7K	1
5.5K to 15K	2

●SERIAL number check

Rating plate example

□ ○ ○ ○○○○○○
Symbol Year Month Control number
SERIAL (Serial No.)

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

(2) Filterpack

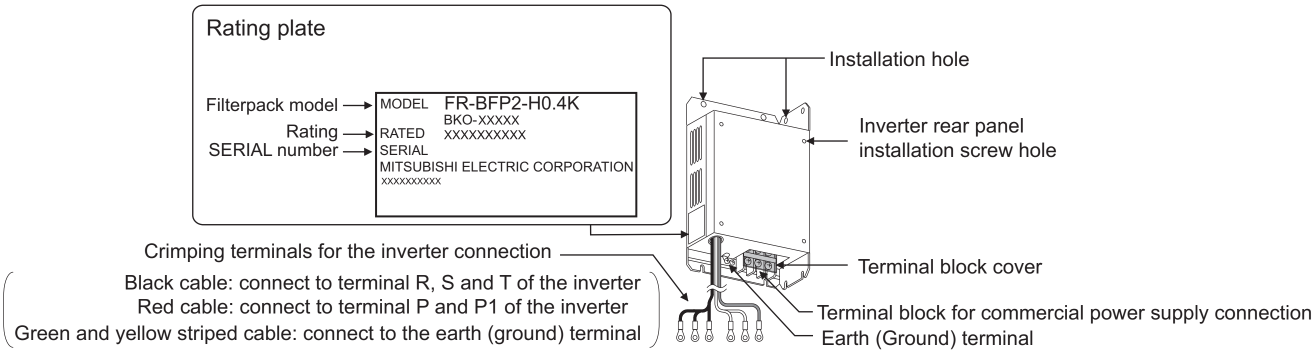
●Filterpack model

FR-BFP2- H □□ K

Symbol	Applicable power voltage
None	200V class
H	400V class

0.4 to 15	Represents the applicable inverter capacity (kW)

●Parts name and plate



●Enclosed items

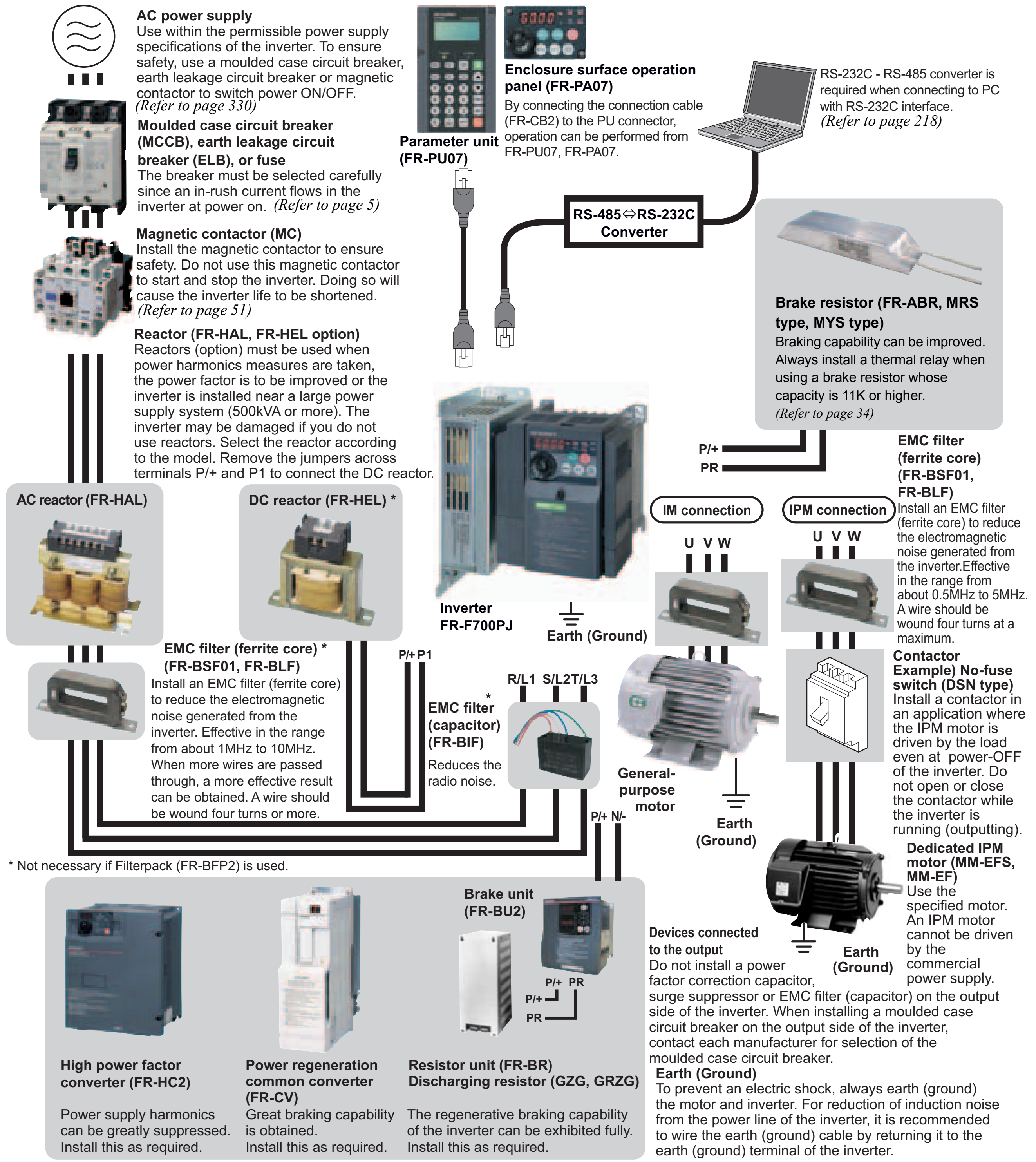
Name	Description	Quantity	Refer to page
Screw for leakage current countermeasure and spacer	When the earth leakage breaker or earth leakage relay operates unnecessarily due to leakage current, use this screw as a countermeasure.	1 for each	42
Rear panel installation L-bracket	Enclosed for the 5.5K or higher	1	12
Screw for inverter rear panel installation	Use these screws for installation of Filterpack onto the inverter rear panel.	4*	12

* The screw size differs according to capacities. ((H)7.5K or lower: M4×14, (H)11K and (H)15K: M5×20)

1

OUTLINE

1.2 Inverter and peripheral devices



NOTE

- **The life of the inverter is influenced by surrounding air temperature. Use the product within the permissible surrounding air temperature. This must be noted especially when the inverter is installed in an enclosure. *(Refer to page 9)***
- **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 18)***
- **Do not install a power factor correction capacitor, surge suppressor or EMC filter (capacitor) 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 EMC filter (capacitor) (for use in the input side only) or FR-BSF01 or FR-BLF EMC filter (ferrite core) to minimize interference. *(Refer to page 45)*.
- **Refer to the Instruction Manual of each option and peripheral devices for details of peripheral devices.**
- **An IPM motor cannot be driven by the commercial power supply.**
- **An IPM motor is a motor with permanent magnets embedded inside. High voltage is generated at the motor terminals while the motor is running. Before closing the contactor at the output side, make sure that the inverter power is ON and the motor is stopped.**

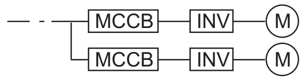
1.2.1 Peripheral devices

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

Inverter Model *1		Motor Output (kW)	Moulded Case Circuit Breaker (MCCB) *2 or Earth Leakage Circuit Breaker (ELB) *3 (NF or NV type)		Magnetic Contactor (MC) *4	
			Reactor or Filterpack connection			
			Without	With	Without	With
Three-Phase 200V	FR-F720PJ-0.4K	0.4	5A	5A	S-N10	S-N10
	FR-F720PJ-0.75K	0.75	10A	5A	S-N10	S-N10
	FR-F720PJ-1.5K	1.5	15A	10A	S-N10	S-N10
	FR-F720PJ-2.2K	2.2	20A	15A	S-N10	S-N10
	FR-F720PJ-3.7K	3.7	30A	30A	S-N20, S-N21	S-N10
	FR-F720PJ-5.5K	5.5	50A	40A	S-N20, S-N21	S-N20, S-N21
	FR-F720PJ-7.5K	7.5	60A	50A	S-N25	S-N20, S-N21
	FR-F720PJ-11K	11	75A	75A	S-N35	S-N35
	FR-F720PJ-15K	15	125A	100A	S-N50	S-N50
Three-Phase 400V	FR-F740PJ-0.4K	0.4	5A	5A	S-N10	S-N10
	FR-F740PJ-0.75K	0.75	5A	5A	S-N10	S-N10
	FR-F740PJ-1.5K	1.5	10A	10A	S-N10	S-N10
	FR-F740PJ-2.2K	2.2	15A	10A	S-N10	S-N10
	FR-F740PJ-3.7K	3.7	20A	15A	S-N10	S-N10
	FR-F740PJ-5.5K	5.5	30A	20A	S-N20, S-N21	S-N11, S-N12
	FR-F740PJ-7.5K	7.5	30A	30A	S-N20, S-N21	S-N20, S-N21
	FR-F740PJ-11K	11	50A	40A	S-N20, S-N21	S-N20, S-N21
	FR-F740PJ-15K	15	60A	50A	S-N25	S-N20, S-N21

*1 Assumes the power supply voltage is for a dedicated IPM motor or of a Mitsubishi 50Hz 4-pole standard motor.

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



*3 For the use in the United States or Canada, select a UL and cUL certified fuse with Class T fuse equivalent cut-off speed or faster with the appropriate rating for branch circuit protection. Alternatively, select a UL489 molded case circuit breaker (MCCB).

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

NOTE

- **When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter model, and cable and reactor according to the motor output.**
- **When the breaker on the inverter 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.**

1.3 Removal and reinstallation of the cover

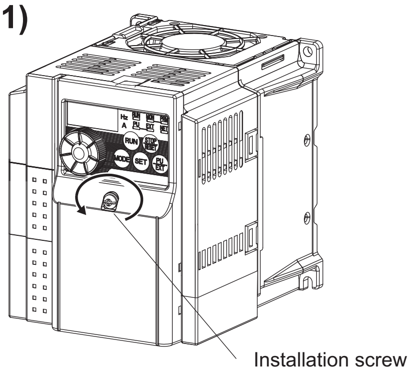
1.3.1 Front cover

3.7K or lower

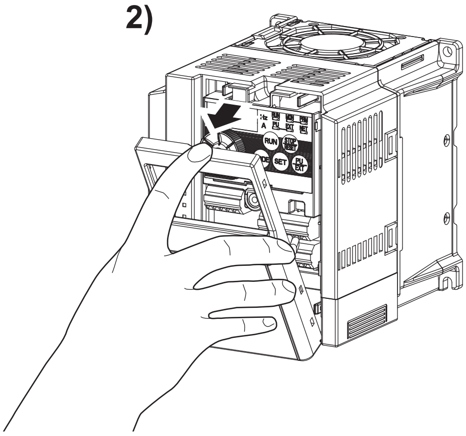
●Removal (Example of FR-F740PJ-1.5K)

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.

1)



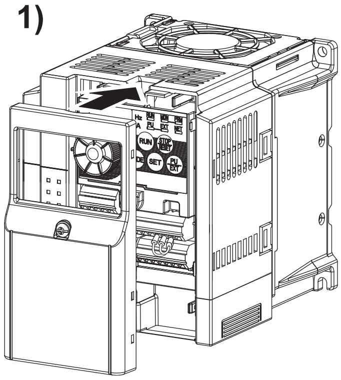
2)



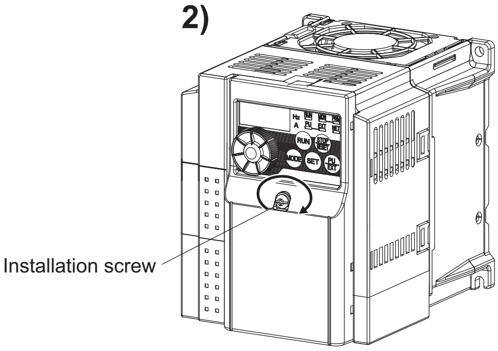
●Reinstallation (Example of FR-F740PJ-1.5K)

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

1)



2)

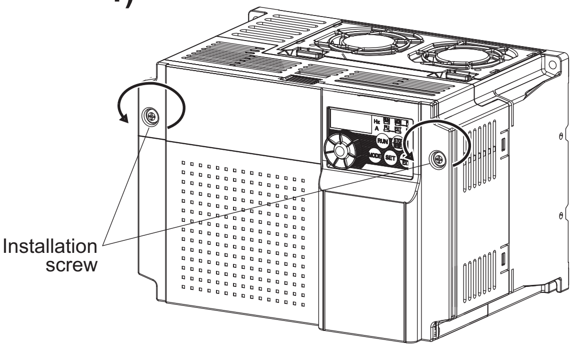


5.5K or higher

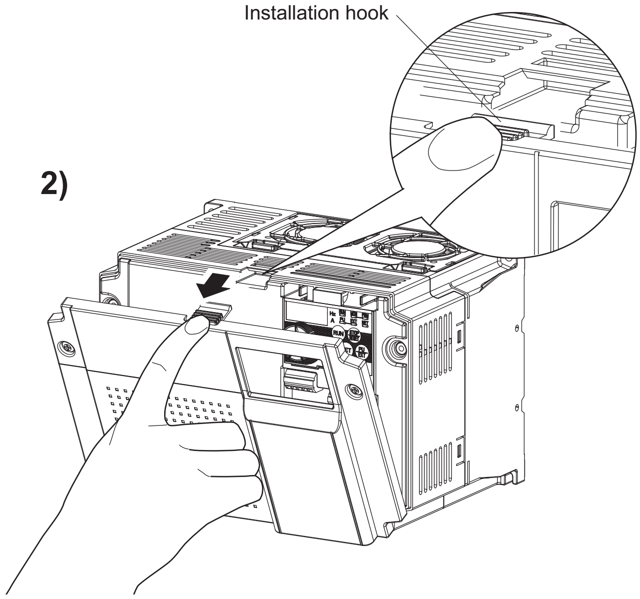
●Removal (Example of FR-F740PJ-7.5K)

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.

1)



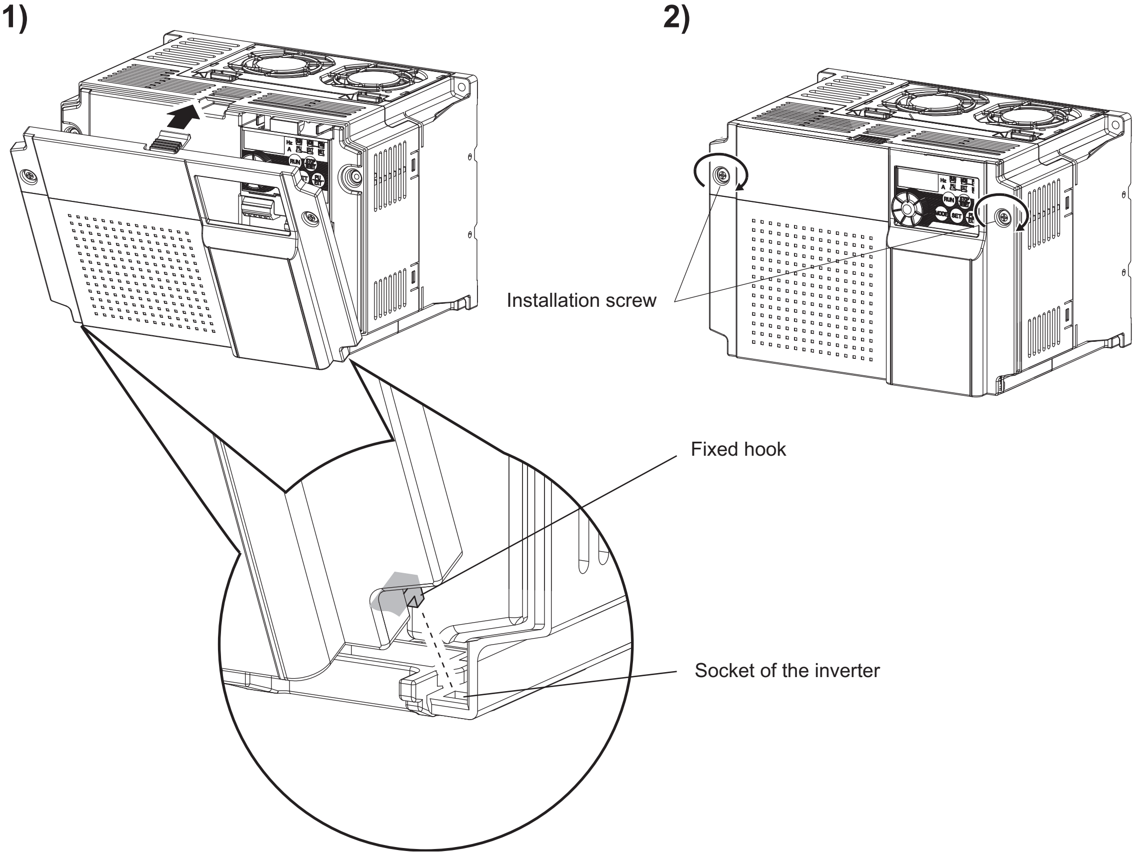
2)



●Reinstallation (Example of FR-F740PJ-7.5K)

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.

1) 2)



NOTE

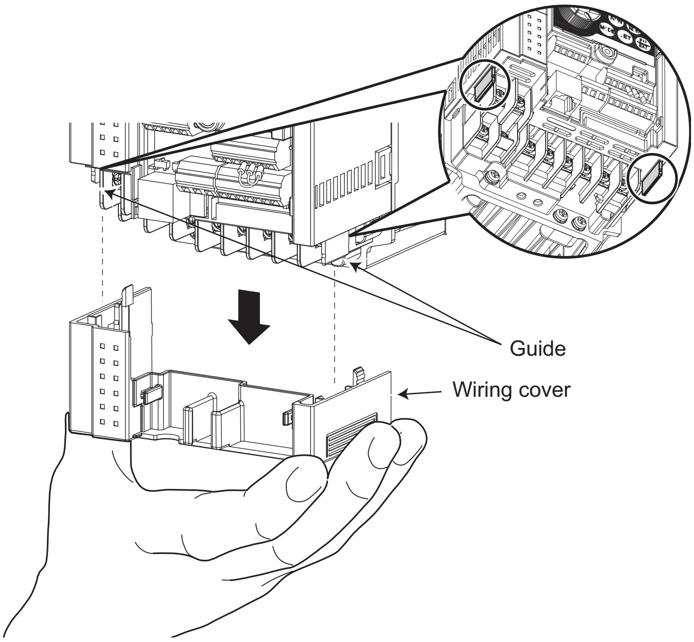
- **Fully make sure that the front cover has been reinstalled securely.**
- **The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Since these plates have the same serial numbers, always reinstall the removed cover onto the original inverter.**

1.3.2 Wiring cover

●Removal and reinstallation

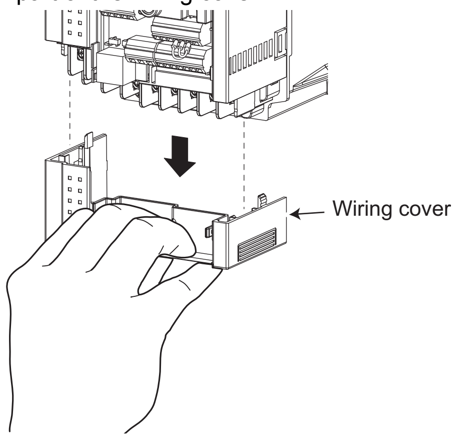
3.7K or lower

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



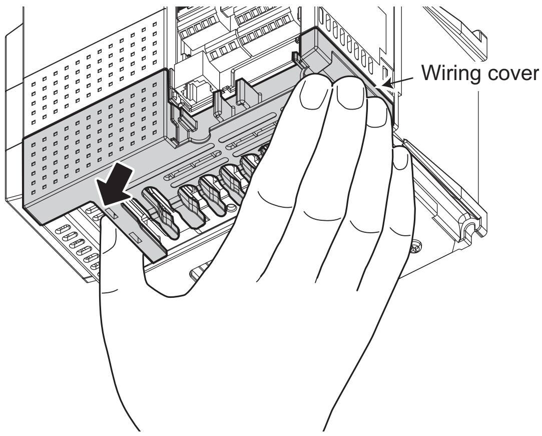
Example of FR-F740PJ-1.5K

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



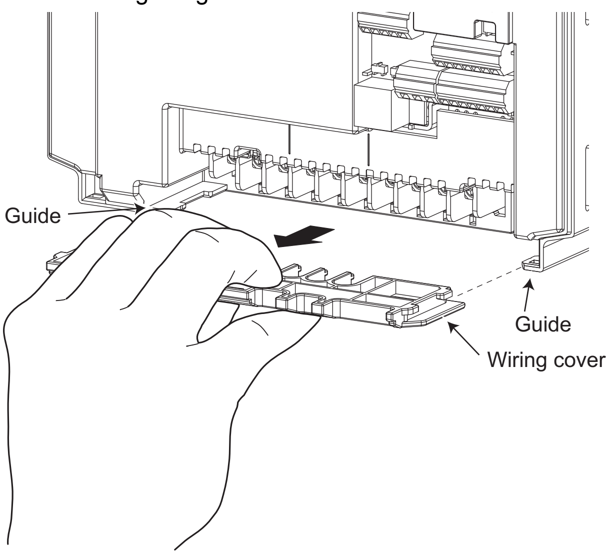
Example of FR-F740PJ-1.5K

- See below diagram for wiring cover of FR-F720PJ-3.7K. Hold the dent of the wiring cover (marked with an arrow) with thumb and the side with other fingers and pull downward for removal.



5.5K or higher

- 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-F740PJ-7.5K

1.4 Installation of the inverter and enclosure design

When an inverter enclosure 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 enclosure 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 Installation environment for the inverter (Filterpack)

As the installation environment for the inverter (Filterpack) should satisfy the standard specifications indicated in the following table, operation in any place that does not meet these conditions does not only degrades the performance and life of the inverter, but may also cause a failure. Refer to the following points and take cautious measures.

Environmental standard specifications of inverter (Filterpack)

Item	Description
Surrounding air temperature	-10°C to +50°C (non-freezing)
Ambient humidity	90%RH or less (non-condensing)
Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
Maximum altitude	1,000m or less
Vibration	5.9m/s^2 or less* at 10 to 55Hz (directions of X, Y, Z axes)

* When installing the Filterpack of 11K or 15K on the rear panel of the inverter, do not install on moving objects or places which vibrates (exceeding 1.96m/s^2).

(1) Temperature

The permissible surrounding air temperature of the inverter is between -10°C and +50°C. Always operate the inverter within this temperature range. Operation outside this range will considerably shorten the service lives of the semiconductors, parts, capacitors and others. Take the following measures 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 11)*
   - 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.)

(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 11)*
- 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. 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.

(7) Vibration, impact

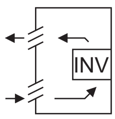
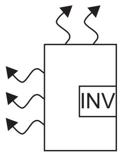
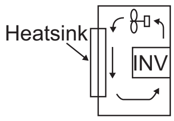
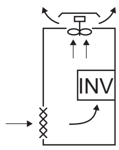
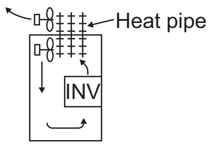
The vibration resistance of the inverter is up to $5.9m/s^2$ at 10 to 55Hz frequency and 1mm amplitude for the directions of X, Y, Z axes. Vibration or impact, if less than the specified value, applied for a long time may make the mechanism loose or cause poor contact to the connectors.
Especially when 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.

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-enclosure 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 heatsink (aluminum heatsink, 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.

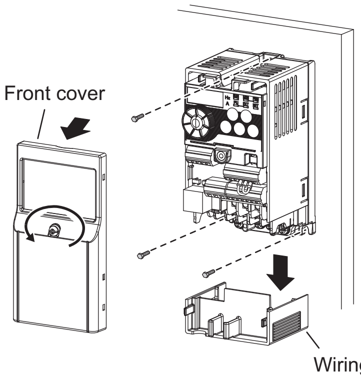
1.5 Inverter placement (Installation of Filterpack)

1.5.1 Installation of the inverter (without Filterpack)

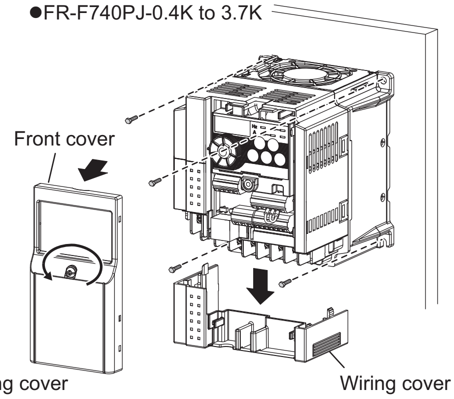
Enclosure surface mounting

Remove the front cover and wiring cover to mount the inverter to the surface. (Remove the covers in the directions of the arrows.)

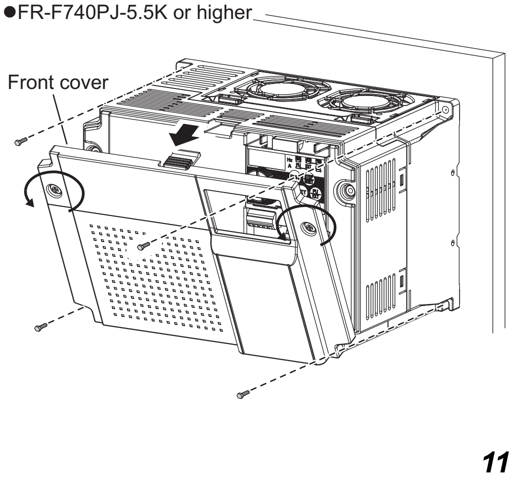
●FR-F720PJ-0.4K, 0.75K



●FR-F720PJ-1.5K to 3.7K
●FR-F740PJ-0.4K to 3.7K



●FR-F720PJ-5.5K or higher
●FR-F740PJ-5.5K or higher



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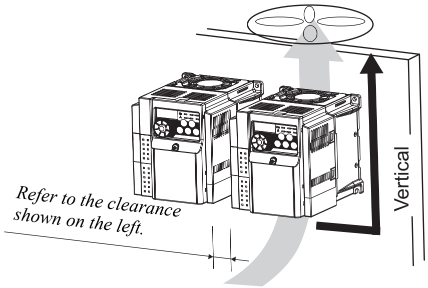
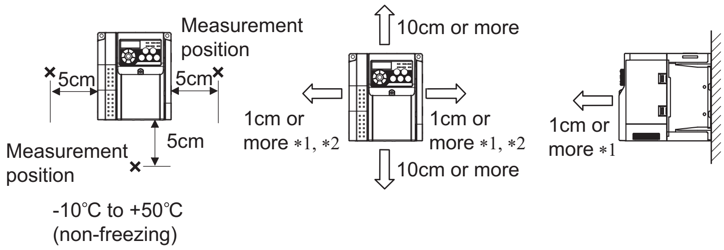
OUTLINE

NOTE

- **When encasing multiple inverters, install them in parallel as a cooling measure.**
- **Install the inverter vertically.**
- **For heat dissipation and maintenance, allow minimum clearance shown in the figures below from the inverter to the other devices and to the inner surface of the enclosure.**





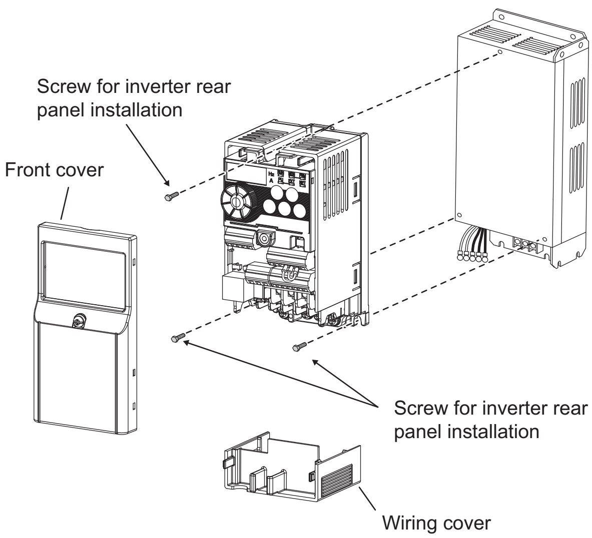
*1 Allow 5cm or more clearance for 5.5K or higher.
*2 When using the inverters at the surrounding air temperature of 40°C or less, the inverters can be installed without any clearance between them (0cm clearance).

1.5.2 Installation of the inverter and Filterpack (for rear panel installation)

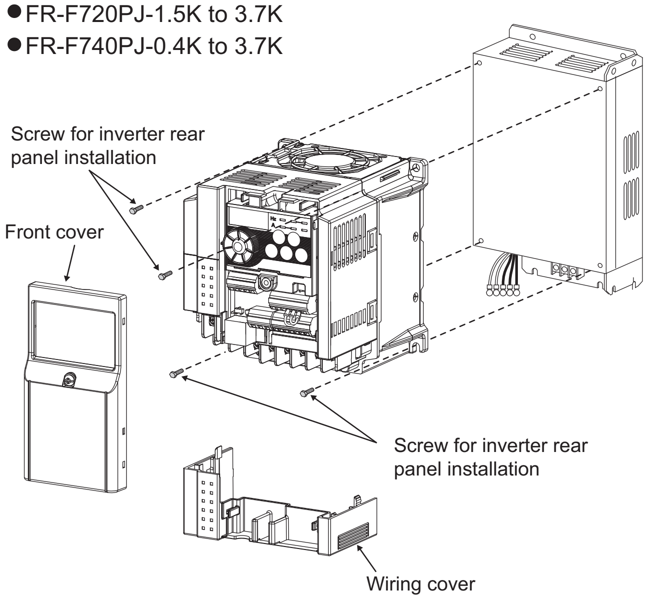
<0.4K to 3.7K>

Remove the front cover and wiring cover to attach the inverter.

● FR-F720PJ-0.4K to 0.75K

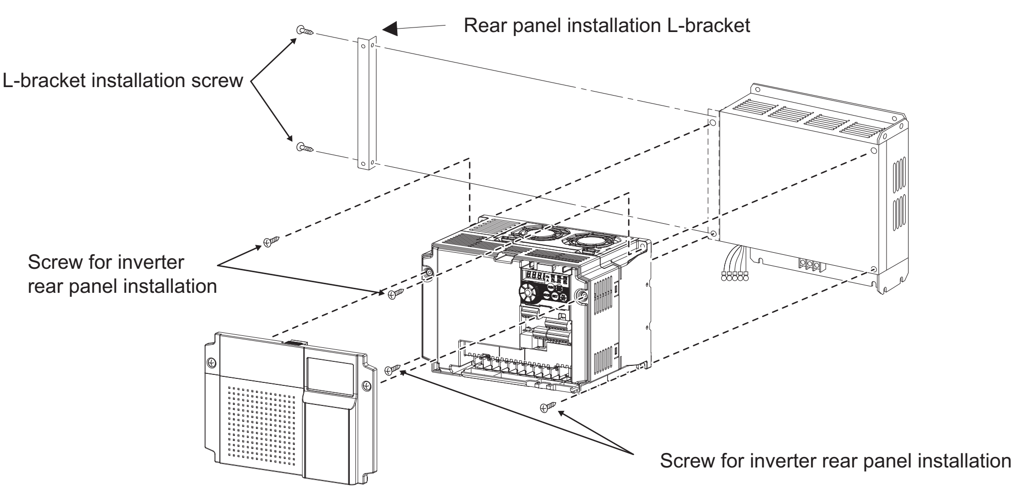


● FR-F720PJ-1.5K to 3.7K
● FR-F740PJ-0.4K to 3.7K

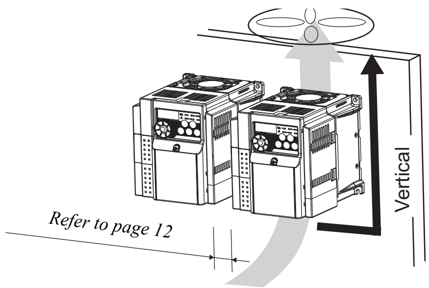


<5.5K to 15K>

Remove the L-bracket installation screws from Filterpack (two for the 7.5K or lower, three for the 11K or higher), and attach the included L-bracket to Filterpack with these screws.
Remove the front cover to attach the inverter.



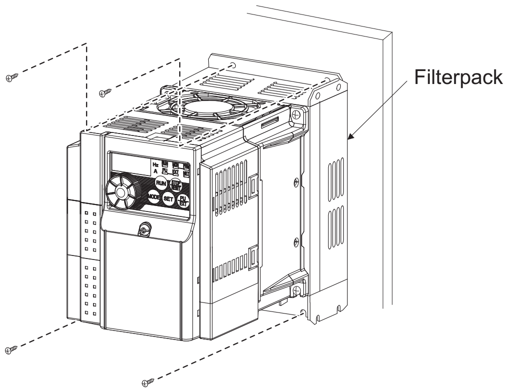
NOTE
- **When encasing multiple inverters, install them in parallel as a cooling measure.**
- **Install the inverter (Filterpack) vertically.**
- **When installing the Filterpack to the inverter, use the included installation screws for the inverter rear panel.**
  Using a longer screw may damage the Filterpack.



1.5.3 Installation of Filterpack

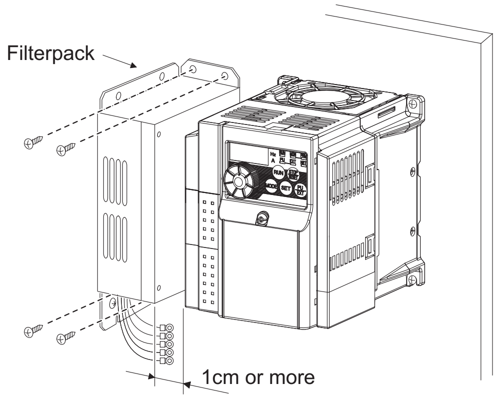
The following installations are recommended for Filterpack and the inverter.
For wiring of Filterpack and the inverter, *refer to page 19*.

●Rear panel installation



NOTE
- **When installing Filterpack of 11K or 15K on the rear panel of the inverter, do not install on moving objects or places which vibrates (exceeding 1.96m/s^2).**

●Side panel installation

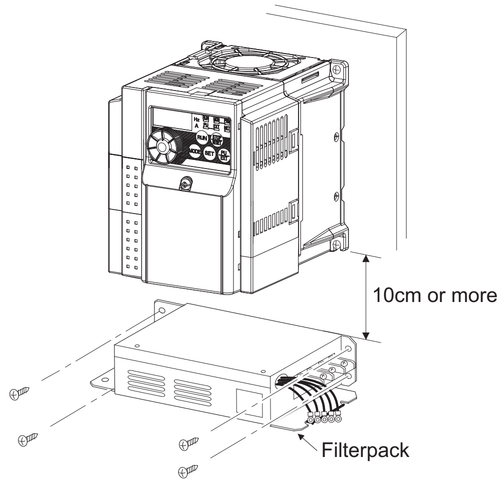


NOTE
- **To release heat of the inverter and Filterpack, leave clearance of 1 cm or more between the inverter and Filterpack.**

1

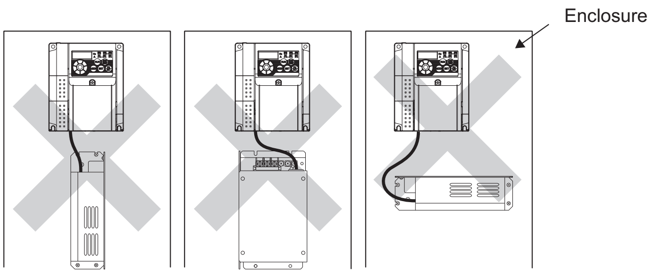
OUTLINE

●Underneath installation

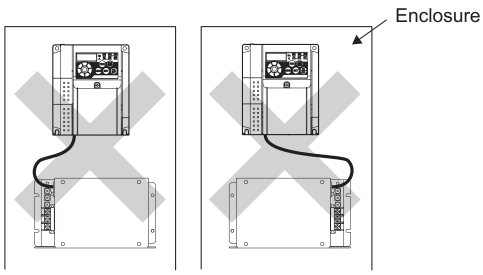


NOTE

- **Install Filterpack with the wiring portion facing right.**
- **Underneath installation is not available for 11K and 15K.**
- **To release heat, leave clearance of 10cm or more between the inverter and Filterpack.**
- **To prevent malfunctions and damages, never perform installations in the following manners. Only install according to the recommended installation methods.**



<Invert installation of Filterpack>



<Sideway installation of Filterpack>

1.5.4 Installation precautions

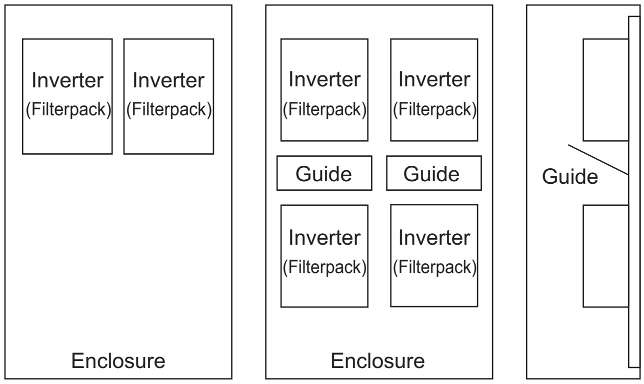
(1) Above inverter

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.

(2) Arrangement of multiple inverters (Filterpacks)

When multiple inverters (Filterpacks) 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 (Filterpacks) can increase the temperatures in the top inverters (Filterpacks), causing inverter (Filterpack) failures.

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

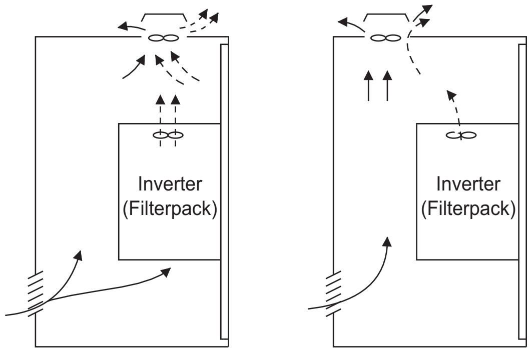


(a) Horizontal arrangement (b) Vertical arrangement

Arrangement of multiple inverters (Filterpacks)

(3) Arrangement of ventilation fan and inverter (Filterpack)

Heat generated in the inverter (Filterpack) 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 (Filterpack) to cool air.)



<Good example> <Bad example>

Arrangement of ventilation fan and inverter (Filterpack)

MEMO

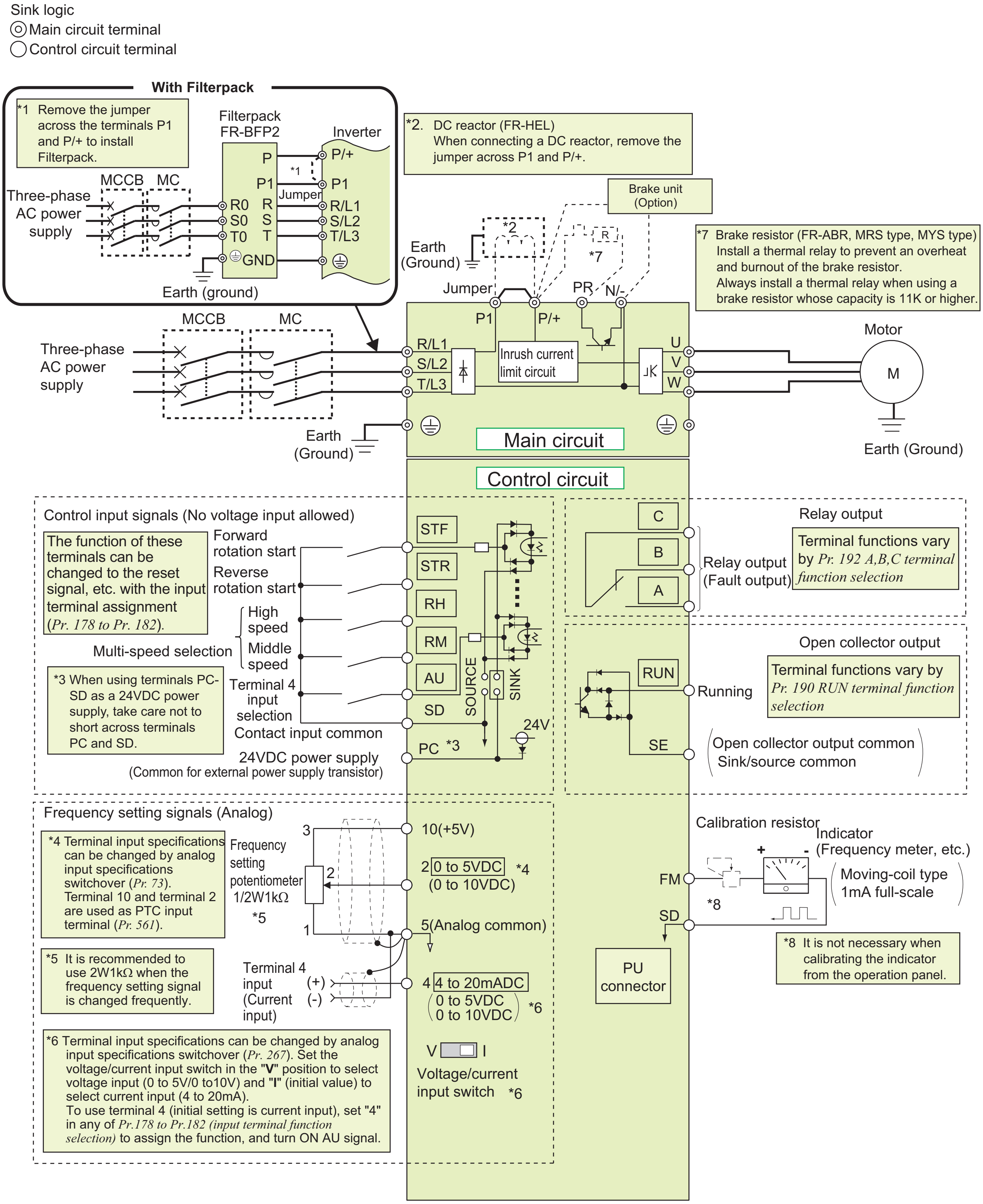
2 WIRING

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

2.1 Wiring 18
2.2 Main circuit terminal specifications 19
2.3 Control circuit specifications 25
2.4 Connection of stand-alone option unit 34

2.1 Wiring

2.1.1 Terminal connection diagram



NOTE

- **To prevent a malfunction caused by noise, separate the signal cables more than 10cm 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 terminals S1, S2, SC, and SO are for manufacturer setting. Do not remove the shortening wires across the terminals S1 and SC and the terminals S2 and SC.**

2.2 Main circuit terminal specifications

2.2.1 Specification of main circuit terminal

●**Inverter**

Terminal Symbol	Terminal Name	Description	Refer to page
R/L1, S/L2, T/L3	AC power input	Connect to the commercial power supply. *1 Do not connect anything to these terminals when using the high power factor converter (FR-HC2) or power regeneration common converter (FR-CV).	*20*
U, V, W	Inverter output	Connect a three-phase squirrel-cage motor or a dedicated IPM motor.	*20*
P/+, PR	Brake resistor connection	Connect a brake resistor (FR-ABR, MRS type, MYS type) across terminals P/+ and PR.	*34*
P/+, N/-	Brake unit connection	Connect the brake unit (FR-BU2), power regeneration common converter (FR-CV) or high power factor converter (FR-HC2).	*36*
P/+, P1	DC reactor (Filterpack) connection	Remove the jumper across terminals P/+ and P1 and connect a DC reactor. *2 Do not remove the jumper across terminals P/+ and P1 when neither a Filterpack nor a DC reactor is connected.	*21*
⏚	Earth (Ground)	For earthing (grounding) the inverter chassis. Must be earthed (grounded). *3	*23*

*1 To use Filterpack, connect the R, S, and T cables of Filterpack.
*2 To use Filterpack, remove the jumper across the terminals P/+ and P1, then connect the P and P1 cables of Filterpack.
*3 To use Filterpack, connect the GND cable of Filterpack.

●**Filterpack**

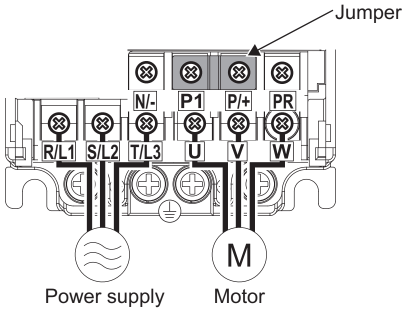
Terminal Symbol	Terminal Name	Description	Refer to page
R0, S0, T0	Commercial power supply input	Connect to the commercial power supply.	*21*
⏚	Earth (Ground)	For earthing (grounding) the Filterpack. Must be earthed (grounded).	

Crimping Terminal Symbol	Terminal Name	Cable Color	Description	Refer to page
R, S, T	Inverter power supply	Black	Connect to R/L1, S/L2, and T/L3 of the inverter.	*21*
P, P1	DC reactor terminal	Red	Remove the jumper across terminals P/+ and P1, and connect to the terminals P/+ and P1 of the inverter.	
GND	Inverter earth (ground) connection	Green and yellow stripe	Connect to the earth (ground) terminal of the inverter. *(Refer to page 18)*	

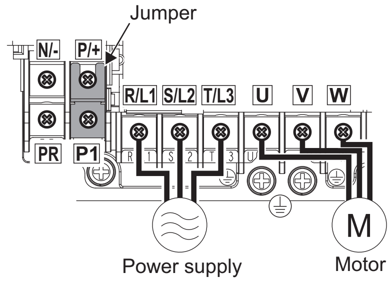
2.2.2 Terminal arrangement of the main circuit terminal, power supply and the motor wiring

●Three-phase 200V class

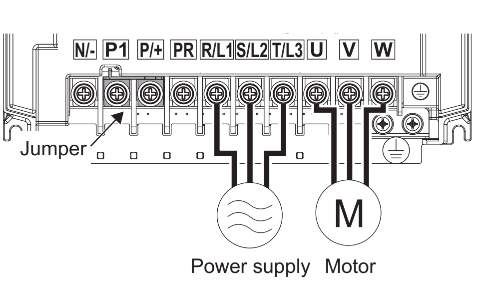
FR-F720PJ-0.4K to 0.75K



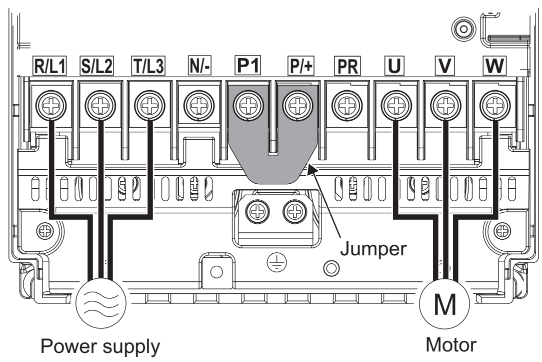
FR-F720PJ-1.5K to 3.7K



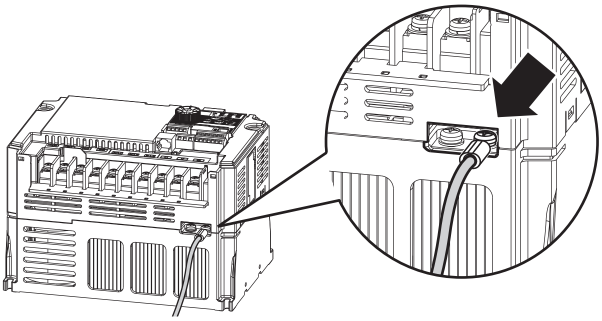
FR-F720PJ-5.5K, 7.5K



FR-F720PJ-11K, 15K

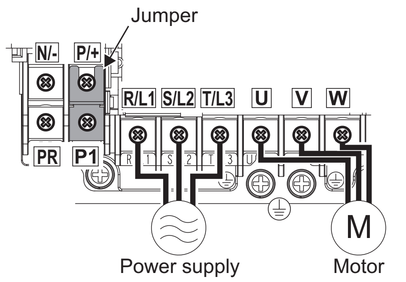


* For wiring to earth (ground) terminals of FR-F720PJ-5.5K and 7.5K, use the earthing (grounding) cable wiring space (marked with an arrow) to route the wires.

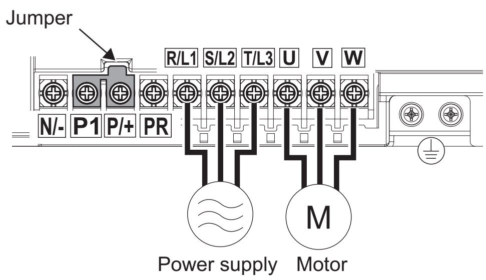


●**Three-phase 400V class**

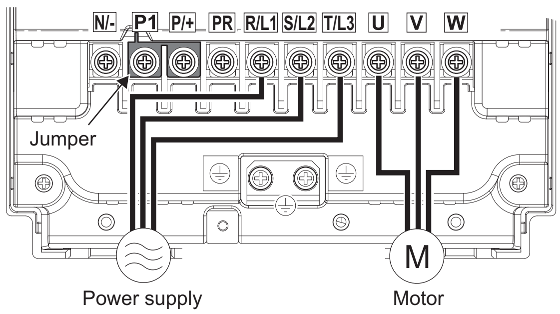
FR-F740PJ-0.4K to 3.7K



FR-F740PJ-5.5K, 7.5K



FR-F740PJ-11K, 15K



NOTE

- **For the inverters without Filterpacks, make sure the power cables are connected to R/L1, S/L2, and T/L3. (Phase does not need to be matched.) Never connect the power cable to the U, V, and W of the inverter. Doing so will damage the inverter.**
- **Connect the motor to U, V, and W. Turning ON the forward rotation switch (signal) at this time rotates the motor counterclockwise when viewed from the load shaft.**

2.2.3 Wiring of the inverter and Filterpack

Perform wiring of the inverter and Filterpack in the following procedure.

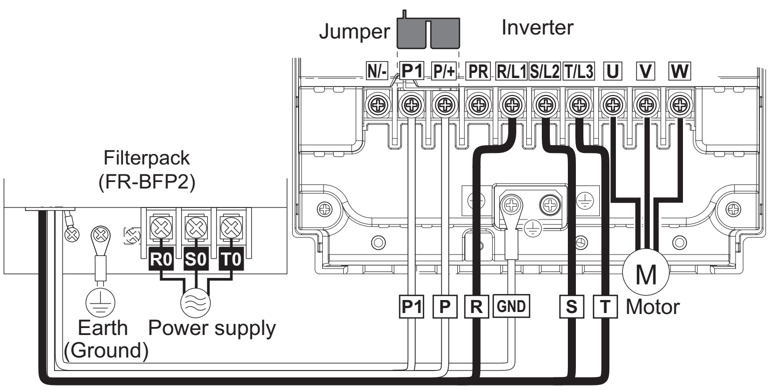
(1) Connect the commercial power supply to the terminal R0, S0 and T0 of the Filterpack.

(2) Connect the earthing (grounding) cable (green and yellow striped cable) of the Filterpack to the inverter earth (ground) terminal.

(3) Connect the power supply cable (black cable) of the Filterpack to the terminal R, S and T. (Phase sequence need not be matched.)

(4) Remove the jumper across terminals P/+ and P1 of the inverter, and connect the P and P1 cables (red cable) of the Filterpack.

(5) Connect the motor cable to the inverter output terminals (U, V, W). (Match the phase sequence.)



Connection example with FR-F740PJ-11K

NOTE

- **For the inverters with Filterpacks, make sure the power cables are connected to R0, S0, and T0 of the Filterpack (FR-BFP2). (Phase sequence does not need to be matched)**
  Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter.
- **When connecting Filterpack, make sure that the jumper across the terminal P/+ and P1 of the inverter is removed.**
- **Connect the GND cable of Filterpack to the earth (ground) terminal of the inverter.**
  Use the earth (ground) terminal of Filterpack for earthing (grounding). The inverter is earthed (grounded) through Filterpack.

2.2.4 Cables and wiring length

(1) Applicable wire size

Select the recommended cable size to ensure that a voltage drop will be 2% or less.
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.

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. (mm^2) *1			Cable Size: AWG *2		Cable Size: PVC Cables, etc. (mm^2) *3		
			R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	Earthing (grounding) cable *7	R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	Earthing (grounding) cable *7
FR-F720PJ-0.4K, 0.75K	M3.5	1.2	2-3.5	2-3.5	2	2	2	14	14	2.5	2.5	2.5
FR-F720PJ-1.5K, 2.2K	M4	1.5	2-4	2-4	2	2	2	14	14	2.5	2.5	2.5
FR-F720PJ-3.7K	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	12	12	4	4	4
FR-F720PJ-5.5K	M5	2.5	5.5-5	5.5-5	5.5	5.5	5.5	10	10	6	6	6
FR-F720PJ-7.5K	M5	2.5	14-5	8-5	14	8	5.5	6	8	16	10	6
FR-F720PJ-11K	M5	2.5	14-5	14-5	14	14	8	6	6	16	16	16
FR-F720PJ-15K *5	M6 (M5)	4.4 (2.5)	22-6 (14-5)	22-6 (14-5)	22	22	14	4	4	25	25	16

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. (mm^2) *1			Cable Size: AWG *2		Cable Size: PVC Cables, etc. (mm^2) *3		
			R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	Earthing (grounding) cable *7	R/L1 S/L2 T/L3	U, V, W	R/L1 S/L2 T/L3	U, V, W	Earthing (grounding) cable *7
FR-F740PJ-0.4K to 3.7K	M4	1.5	2-4	2-4	2	2	2	14	14	2.5	2.5	2.5
FR-F740PJ-5.5K	M4	1.5	5.5-4	2-4	3.5	2	3.5	12	14	4	2.5	4
FR-F740PJ-7.5K	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	12	12	4	4	4
FR-F740PJ-11K	M4	1.5	5.5-4	5.5-4	5.5	5.5	5.5	10	10	6	6	10
FR-F740PJ-15K *6	M5 (M6)	2.5 (4.4)	8-5 (14-6)	8-5 (14-6)	8	8	5.5	8	8	10	10	10

*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. Assumes that the surrounding air temperature is 50°C or less and the wiring distance is 20m or less.
*2 The recommended cable size is that of the cable (THHW cable) with continuous maximum permissible temperature of 75°C. Assumes that the surrounding air temperature is 40°C or less and the wiring distance is 20m or less.
(Selection example for use mainly in the United States.)
*3 The recommended cable size is that of the cable (PVC cable) with continuous maximum permissible temperature of 70°C. Assumes that the surrounding air temperature is 40°C or less and the wiring distance is 20m or less.
(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). Terminal screw size for Filterpack (FR-BFP2) is same as the terminal screw size for the inverter.
*5 Screw size for earthing (grounding) the FR-F720PJ-15K is indicated in parentheses.
*6 Screw sizes of the terminals R0, S0, and T0 and the earthing terminal of FR-BFP2-H15K are indicated in parentheses.
*7 For the earthing (grounding) cable size for Filterpack, use the same size as for the inverter.

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.

(2) Earthing (Grounding) precautions

- Always earth (ground) the motor and inverter (Filterpack).

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 flows 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):

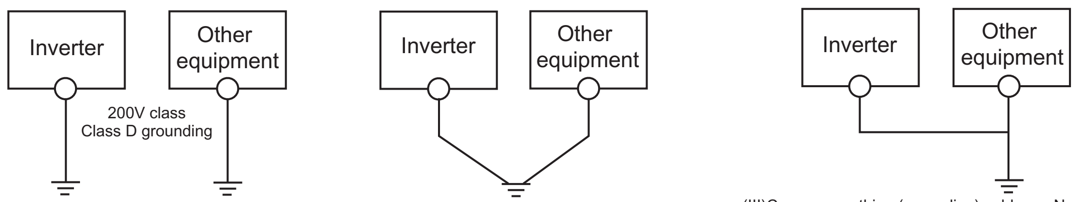
(a)If possible, use (I) independent earthing (grounding) in figure below for the inverter (Filterpack). If independent earthing (grounding) is not available, use (II) common earthing (grounding) in the figure below where the inverter (Filterpack) is connected with the other equipment at an earthing (grounding) point.
The (III) common earthing (grounding) as in the figure below, where the inverter (Filterpack) shares a common earthing (grounding) cable with the other equipment, must be avoided.
A leakage current including many high frequency components flows in the earthing (grounding) cables of the inverter (Filterpack) and inverter-driven motor. Therefore, use the independent earthing (grounding) and separate the earthing (grounding) cable of the inverter from equipment sensitive to EMI.
In a high building, it may be effective to use the EMI prevention type earthing (grounding) connecting to an iron structure frame, and electric shock prevention type earthing (grounding) with the independent earthing (grounding) together.

(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 earthing (grounding) cable. The earthing (grounding) cable should be no less than the size indicated in the table on *page 22*.

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

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



(I)Independent earthing (grounding).......Good (II)Common earthing (grounding).......Good (III)Common earthing (grounding) cable.......Not allowed

POINT

To be compliant with the EU Directive (Low Voltage Directive), *refer to the Instruction Manual (Basic)*.

2

WIRING

(3) Total wiring length

●Under general-purpose motor control

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

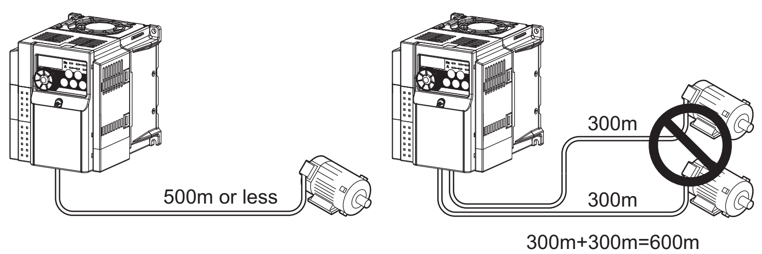
200V class

Pr. 72 PWM frequency selection Setting (carrier frequency)	0.4K	0.75K	1.5K or higher
1 (1kHz) or less	300m	500m	500m
2 to 15 (2kHz to 14.5kHz)	200m	300m	500m

400V class

Pr. 72 PWM frequency selection Setting (carrier frequency)	0.4K	0.75K	1.5K	2.2K	3.7K or higher
1 (1kHz) or less	200m	200m	300m	500m	500m
2 to15 (2kHz to 14.5kHz)	30m	100m	200m	300m	500m

Total wiring length when using a general-purpose motor
(FR-F720PJ-1.5K or higher, FR-F740PJ-3.7K or higher)



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. If that is the case, use a "400V class inverter-driven insulation-enhanced motor" and set a frequency in *Pr. 72 PWM frequency selection* according to the total wiring length shown in the following table. (*Refer to page 52* to drive a 400V class motor with an inverter.)

	Wiring Length		
	50m or less	50m to 100m	Exceeding 100m
Pr. 72 PWM frequency selection Setting (carrier frequency)	15 (14.5kHz) or less	8 (8kHz) or less	2 (2kHz) or less

●Under IPM motor control

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

Pr. 72 PWM frequency selection Setting (carrier frequency)	400V class 0.4K	200V class 0.4K or higher 400V class 0.75K or higher
4 (2.5kHz) or less	50m	100m
5 (5kHz) or higher	30m	

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

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 96 for Pr. 22 Stall prevention operation level* and *Pr. 156 Stall prevention operation selection)
- **When using the automatic restart after instantaneous power failure function for a general-purpose motor with the wiring length longer than 100m, select "without frequency search" by setting *Pr.162* = "1 or 11." *(Refer to page 161)***
- **The surge voltage suppression filter (FR-ASF-H/FR-BMF-H) option cannot be used under IPM motor control, so do not connect them.**

Parameters referred to

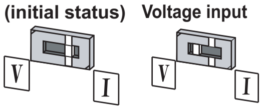
Pr.72 PWM frequency selection *Refer to page 181*

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, and Pr. 192 (I/O terminal function selection)*. *(Refer to page 134.)*

(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 Voltage when contacts are open 21 to 26VDC When contacts are short-circuited 4 to 6mADC	*138*
	STR	Reverse rotation start	Turn ON the STR signal to start reverse rotation and turn it OFF to stop. / When the STF and STR signals are turned ON simultaneously, the stop command is given.		
	RH, RM	Multi-speed selection	Multi-speed can be selected according to the combination of RH and RM signals.		*106*
	AU	Terminal 4 input selection	The terminal 4 function is available only when the AU signal is ON. (The operation with the frequency setting signal of 4 to 20mA DC is available)		*183*
	SD	Contact input common (sink) (initial setting)	Common terminal for contact input terminal (sink logic) and terminal FM.	—	—
		External transistor common (source)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable current.		
		24VDC power supply common	Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE.		
	PC	External transistor common (sink) (initial setting)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic to avoid malfunction by undesirable current.	Power supply voltage range 22 to 26.5VDC permissible load current 100mA	*28*
		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 permissible load current 10mA	*183*
	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 Permissible maximum voltage 20VDC	*183*
	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. The input signal to terminal 4 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 (initial status) Voltage input  	Current input: Input resistance 249Ω ± 5Ω Maximum permissible current 30mA Voltage input: Input resistance10kΩ ± 1kΩ Permissible maximum voltage 20VDC	*183*
	5	Frequency setting common	Frequency setting signal (terminal 2, 4) common terminal. Do not earth (ground).	—	—
Thermistor	10 2	PTC thermistor input	For connecting PTC thermistor output. When PTC thermistor protection is valid (*Pr. 561* ≠ "9999"), terminal 2 is not available for frequency setting.	Adaptive PTC thermistor specification Heat detection resistance : 500Ω to 30kΩ (Set by *Pr. 561*)	*119*

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 183 for details.)***

2

WIRING

(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	*140*
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 is when the open collector output transistor is ON (conducts). High is when 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)	*140*
	SE	Open collector output common	Common terminal of terminal RUN.		—	—
Pulse	FM	For meter	Select one e.g. output frequency from monitored items. Not output during inverter reset. The output signal is proportional to the magnitude of the corresponding monitored item. To set a full-scale value for monitoring the output frequency and the output current, set *Pr. 55* and *Pr. 56*. *(Refer to page 157.)*	Output item: Output frequency (initial setting)	Permissible load current 1mA 1440 pulse/s at 60Hz (general-purpose motor control) 1440 pulse/s at 90Hz (IPM motor control)	*152*

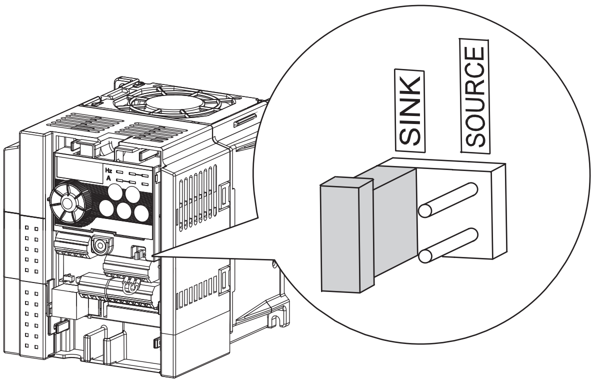
(3) Communication

Type	Terminal Symbol	Terminal Name	Description	Reference Page
Communication	—	PU connector	With the PU connector, communication can be made through RS-485. • Conforming standard: EIA-485 (RS-485) • Transmission format: Multidrop link • Communication speed: 4800 to 38400bps • Overall length: 500m	*218*

NOTE

The terminals S1, S2, SC, and SO are for manufacturer setting. Do not connect anything to these.
Doing so may cause an inverter failure. Do not remove the shortening wires across the terminals S1 and SC and the terminals S2 and SC. Removing either shortening wire disables the inverter operation.

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.

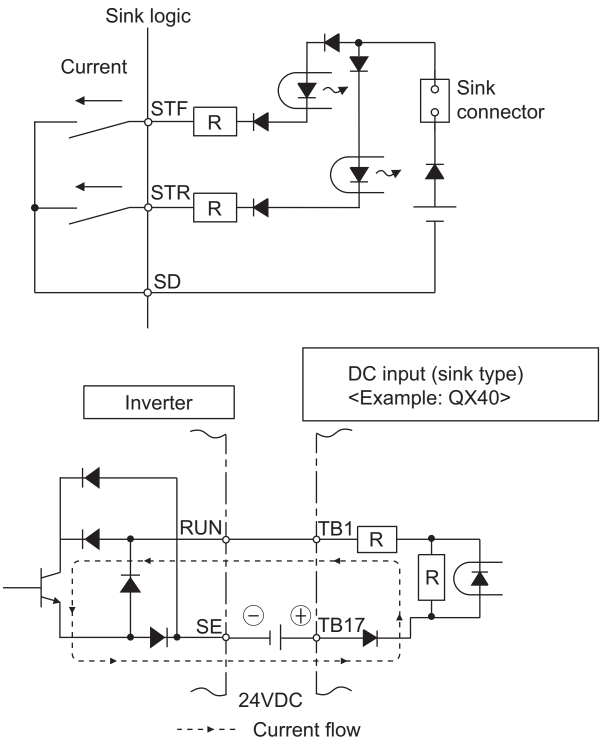
NOTE

- **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.**

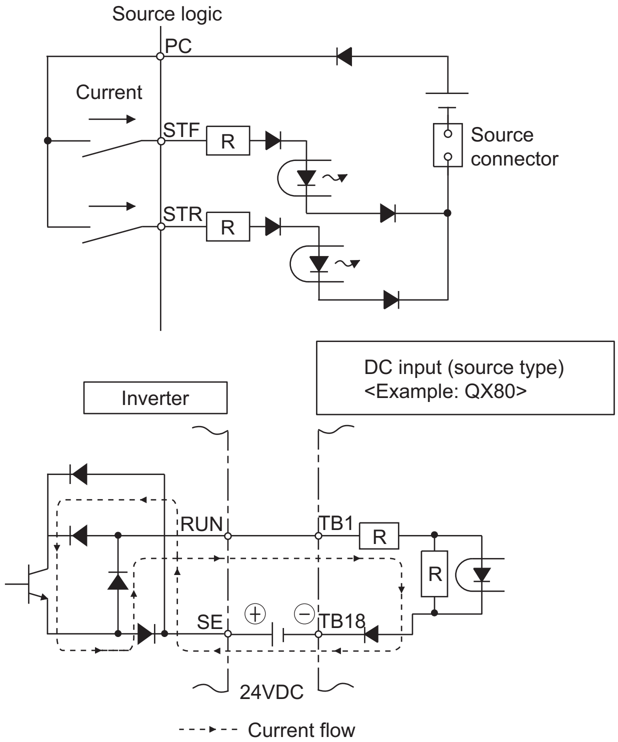
(1) Sink logic type and source logic type

- 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

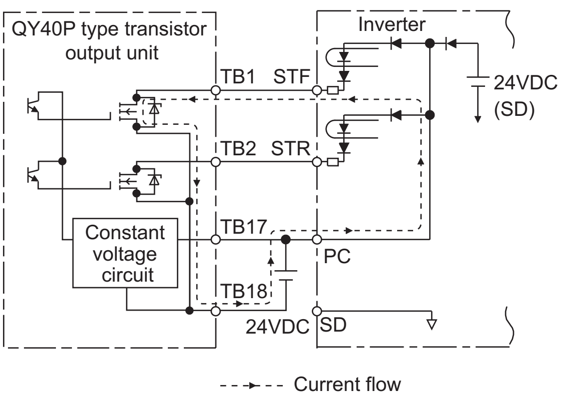


●Current flow concerning the input/output signal when source logic is selected

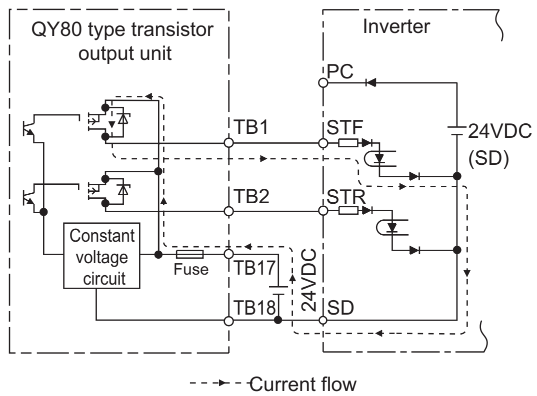


●When using an external power supply for transistor output

- 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.)



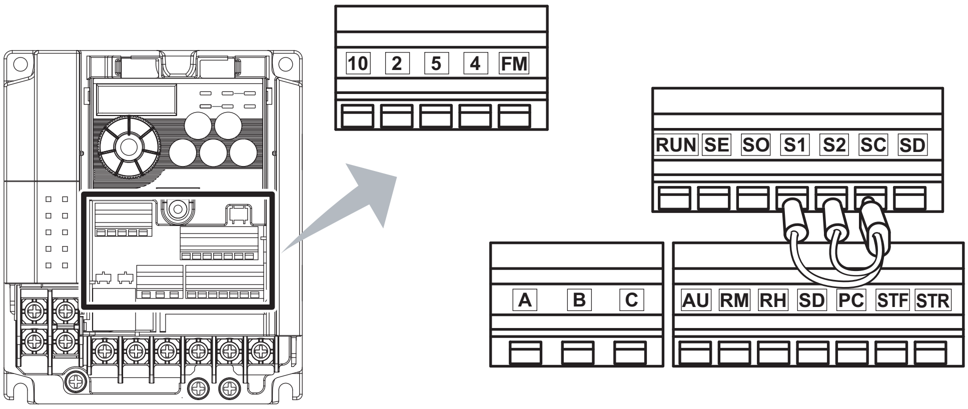
- Source logic type
  Use terminal SD as a common terminal, and perform wiring as shown below. (Do not connect terminal PC of the inverter with terminal +24V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install an external power supply in parallel with the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



2.3.3 Wiring of control circuit

(1) Control circuit terminal layout

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



NOTE

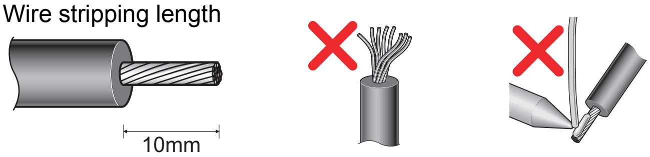
- **Do not remove the shortening wires across the terminals S1 and SC and the terminals S2 and SC. Removing either shortening wire disables the inverter operation.**

(2) Wiring method

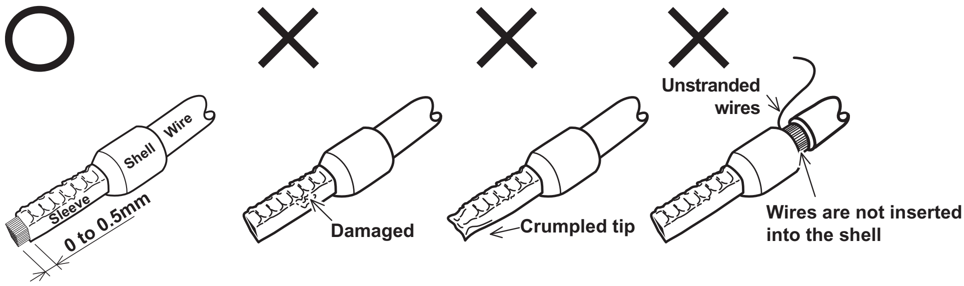
●Wiring

Use a blade 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 blade terminal or the single wire into a socket of the terminal.

1) Strip off the sheath about the length 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.

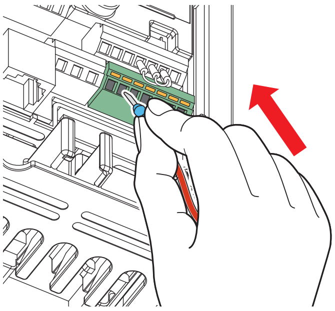


2) Crimp the blade terminal.
   Insert wires to a blade terminal, and check that the wires come out for about 0 to 0.5 mm from a sleeve.
   Check the condition of the blade terminal after crimping. Do not use a blade terminal of which the crimping is inappropriate, or the face is damaged.

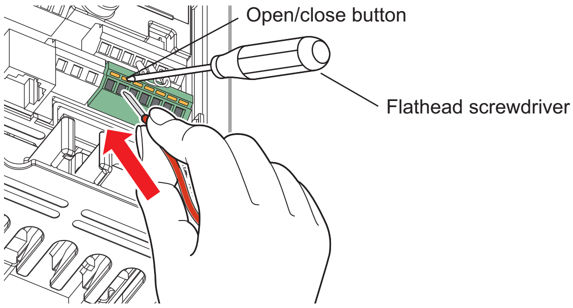


Refer to page 344 for the blade terminals commercially available.

3) Insert the wire into a socket.



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

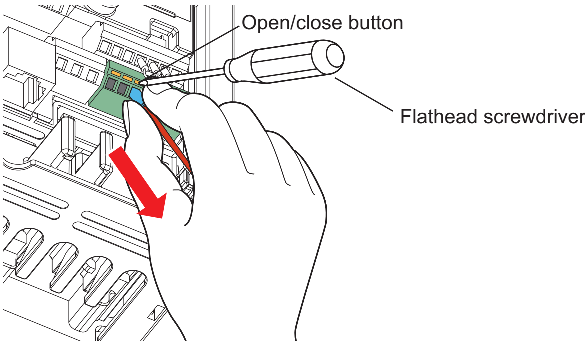


NOTE

- **When using a stranded wire without a blade 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

- **Pulling out the terminal block forcefully without pushing the open/close button all the way down may damage the terminal block.**
- **Use a small flathead screwdriver (Tip thickness: 0.4mm/ tip width: 2.5mm).**
  If a flathead screwdriver with a narrow tip is used, terminal block may be damaged. *Refer to page 344* **for the flathead drivers commercially available.**
- **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.**

(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.

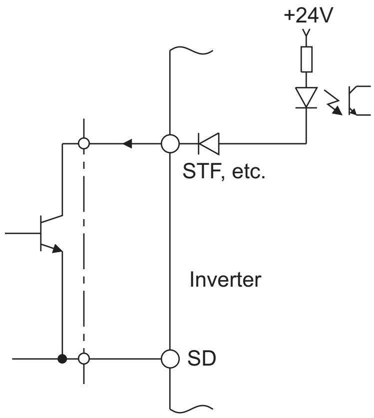
Terminal SD is a common terminal for the contact input terminals (STF, STR, RH, RM, AU) and the pulse train output terminal (FM). The open collector circuit is isolated from the internal control circuit by photocoupler

Terminal 5 is a common terminal for the frequency setting signals (terminals 2 or 4). 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.

(4) Signal inputs by contactless switches

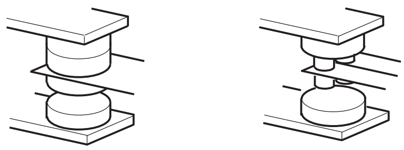
The contacted input terminals of the inverter (STF, STR, RH, RM, AU) can be controlled using a transistor instead of a contacted switch as shown on the right.



External signal input using transistor

(5) Wiring instructions

1) It is recommended to use the cables of 0.3mm^2 to 0.75mm^2 gauge for connection to the control circuit terminals.
2) The maximum wiring length should be 30m (200m for terminal FM).
3) Do not short across terminals PC and SD. Inverter may be damaged.
4) 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.

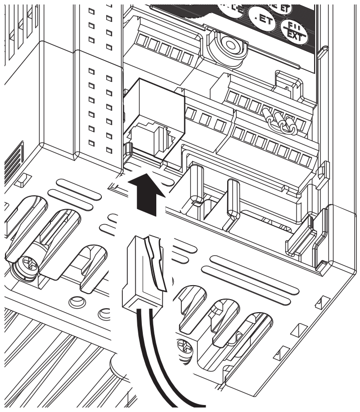


Micro signal contacts Twin contacts

5) 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).
6) Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
7) Always apply a voltage to the fault output terminals (A, B, C) via a relay coil, lamp, etc.

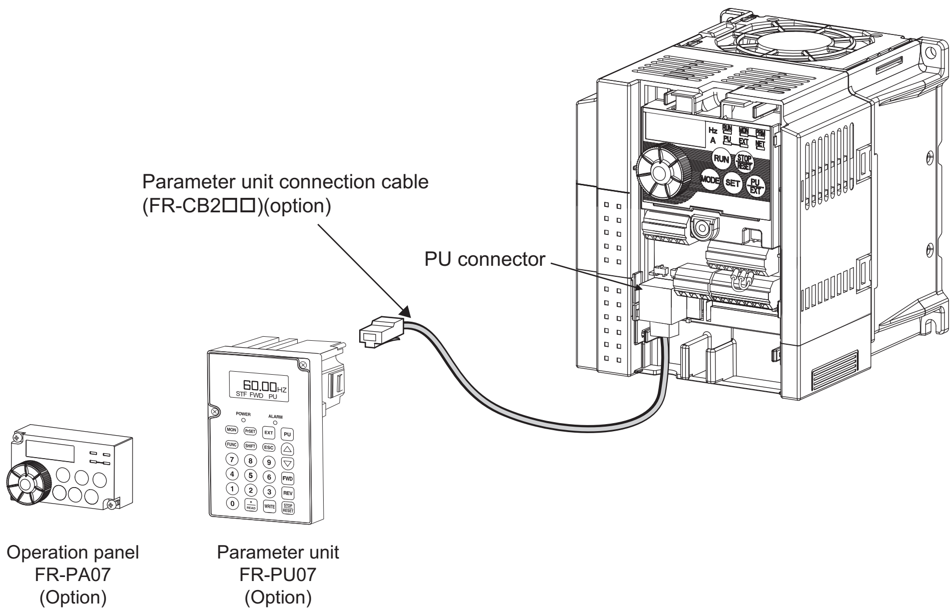
2.3.4 Connection to the PU connector

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.



(1) When connecting the parameter unit or 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.



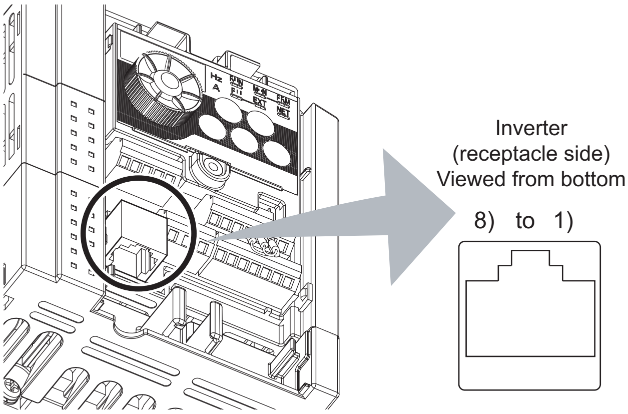
REMARKS

- *Refer to page 344* for the commercially available communication cables and connectors when making your own cable. Keep the total cable length within 20m.

(2) 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 with a combination of the FR-F700PJ series, FR-F500J 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 218*.
•Conforming standard: EIA-485 (RS-485)
•Transmission form: Multidrop link
•Communication speed: Maximum 38400 bps
•Overall extension: 500m

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.

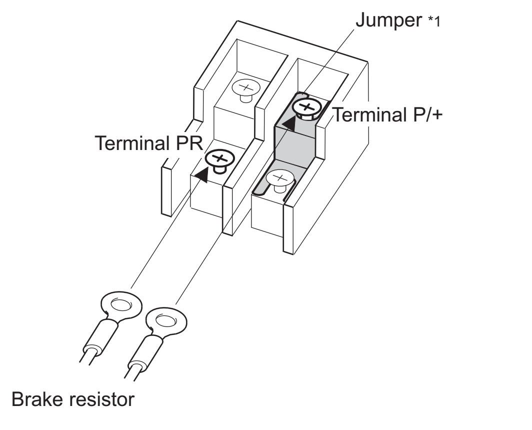
2.4.1 Connection of a dedicated external brake resistor (MRS type, MYS type, FR-ABR)

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 terminals P/+ and PR. (For the locations of terminals P/+ and PR, refer to the terminal block layout *(page 20)*.)
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 131*
FR-ABR	1	7.5K or lower	10%	*Refer to page 131*
		11K or higher	6%	

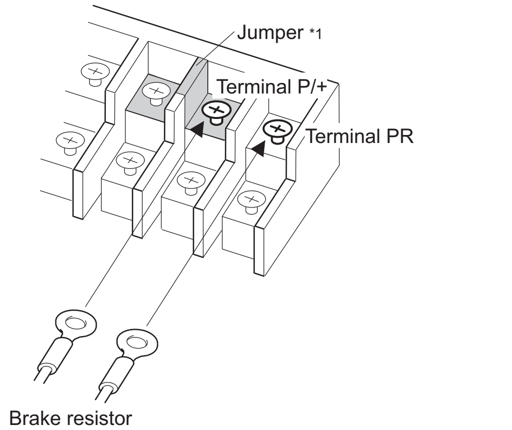
FR-F720PJ-1.5K to 3.7K
FR-F740PJ-0.4K to 3.7K

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



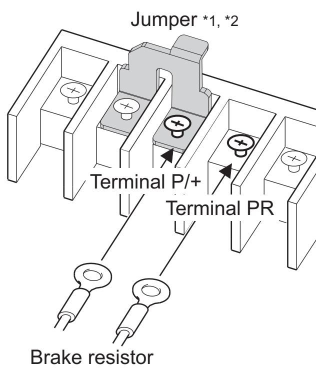
FR-F720PJ-0.4K, 0.75K

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



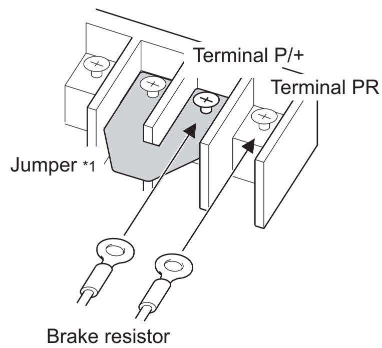
FR-F720PJ-5.5K, 7.5K
FR-F740PJ-5.5K to 15K

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



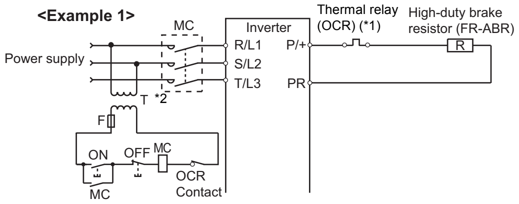
FR-F720PJ-11K, 15K

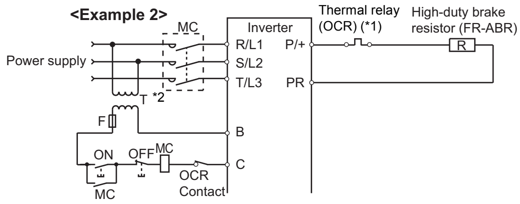
Connect the brake resistor across terminals P/+ and PR.



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

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.



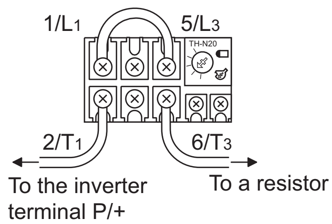


*1 Refer to the table below for the type number of each capacity of thermal relay and the diagram below for the connection. (Always install a thermal relay when using a brake resistor whose capacity is 11K or higher.)

*2 When the power supply is 400V class, install a stepdown 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	
	FR-ABR-11K	TH-N20CXHZ-11A	
	FR-ABR-15K	TH-N20CXHZ-11A	
400V	FR-ABR-H0.4K	TH-N20CXHZ-0.24A	
	FR-ABR-H0.75K	TH-N20CXHZ-0.35A	
	FR-ABR-H1.5K	TH-N20CXHZ-0.9A	
	FR-ABR-H2.2K	TH-N20CXHZ-1.3A	
	FR-ABR-H3.7K	TH-N20CXHZ-2.1A	
	FR-ABR-H5.5K	TH-N20CXHZ-2.5A	
	FR-ABR-H7.5K	TH-N20CXHZ-3.6A	
	FR-ABR-H11K	TH-N20CXHZ-6.6A	
	FR-ABR-H15K	TH-N20CXHZ-6.6A	



NOTE

- **The brake resistor connected should only be the dedicated brake resistor.**
- **Brake resistor cannot be used with the brake unit, high power factor converter, power supply regeneration converter, etc.**
- **Do not use the brake resistor (MRS type, MYS type) with a lead wire extended.**
- **Do not connect a resistor directly to terminals P/+ and N/-. This could cause a fire.**

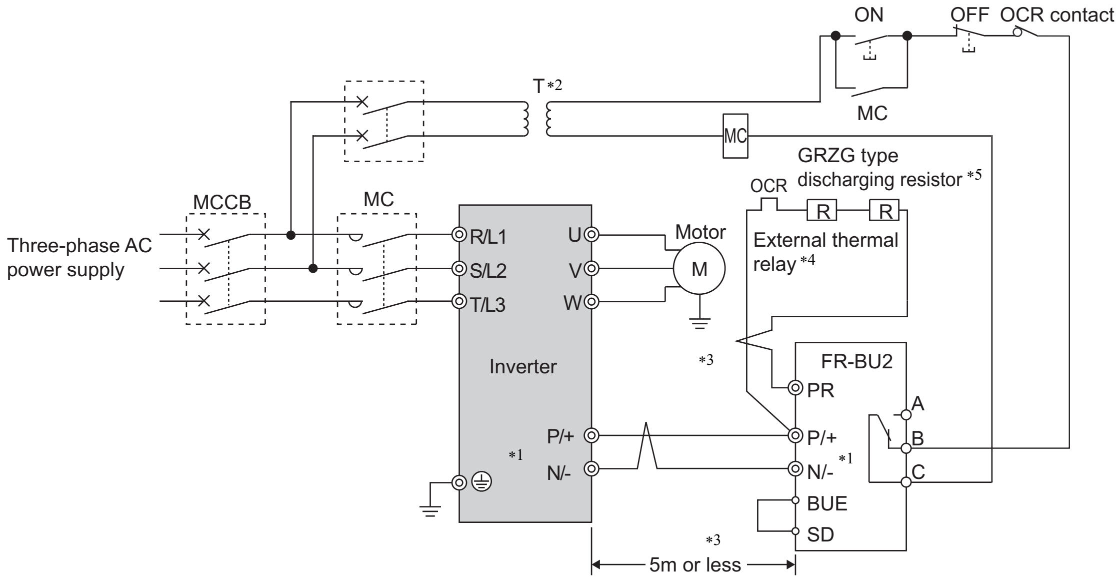
Parameters referred to

Pr. 30 Regenerative function selection *Refer to page 131*

2.4.2 Connection of the brake unit (FR-BU2)

Connect the brake unit (FR-BU2) 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.

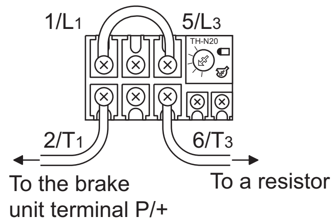
(1) Connection example with the GRZG type discharging resistor



*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 stepdown transformer.
*3 The wiring distance between the inverter, brake unit (FR-BU2) and discharging resistor should be within 5m. Even when the wiring is twisted, the cable length must not exceed 10m.
*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>

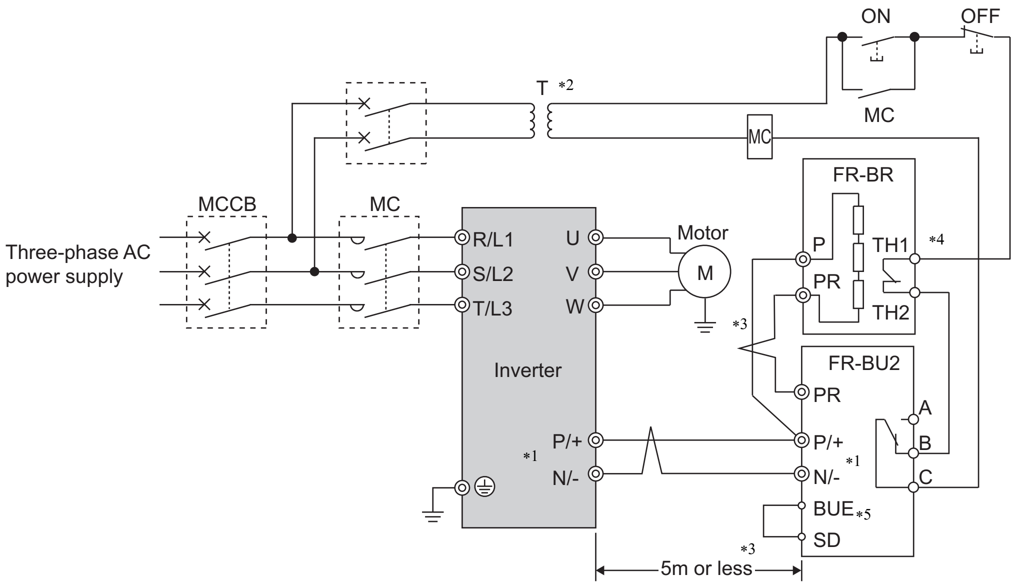
Brake Unit	Discharging Resistor	Recommended External Thermal Relay
FR-BU2-1.5K	GZG 300W-50Ω (one)	TH-N20CXHZ 1.3A
FR-BU2-3.7K	GRZG 200-10Ω (three in series)	TH-N20CXHZ 3.6A
FR-BU2-7.5K	GRZG 300-5Ω (four in series)	TH-N20CXHZ 6.6A
FR-BU2-15K	GRZG 400-2Ω (six in series)	TH-N20CXHZ 11A
FR-BU2-H7.5K	GRZG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



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 Filterpack or a DC reactor.**

(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 stepdown transformer.
*3 The wiring distance between the inverter, brake unit (FR-BU2) and resistor unit (FR-BR) should be within 5m each. Even when the wiring is twisted, the cable length must not exceed 10m.
*4 The contact between TH1 and TH2 is closed in the normal status and is open at a fault.
*5 A jumper is connected across BUE and SD in the initial status.

NOTE

- **Do not remove the jumper across terminals P/+ and P1 except when connecting a Filterpack or a DC reactor.**

2

WIRING

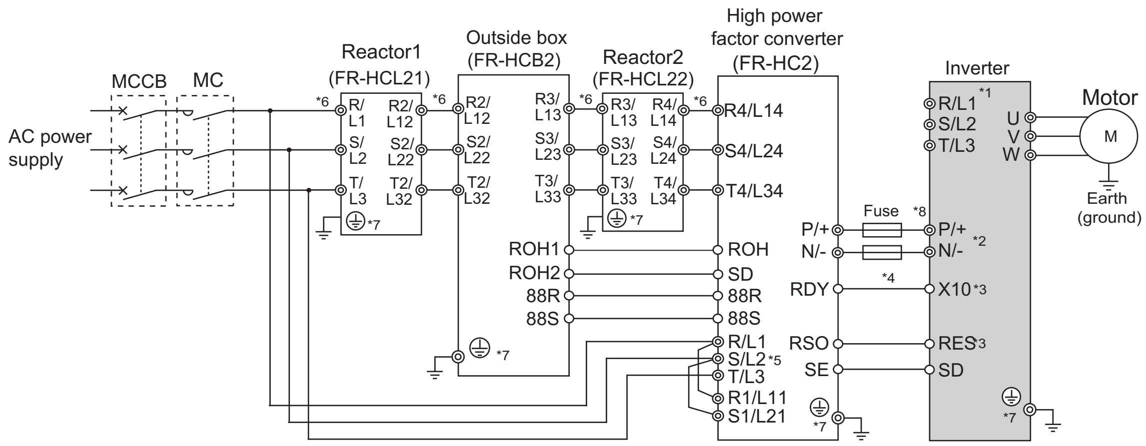
2.4.3 Connection of the high power factor converter (FR-HC2)

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

After making sure that the FR-HC2 is properly connected, set the following parameters.

Pr. 19 Base frequency voltage

Pr. 30 Regenerative function selection (Refer to page 131)



*1 Do not connect anything to the input terminals (R/L1, S/L2, T/L3). 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 and RES signals. *(Refer to page 134)*

*4 Be sure to connect terminal RDY of the FR-HC2 to the X10 signal or MRS signal assigned terminal of the inverter, and connect terminal SE of the FR-HC2 to terminal SD of the inverter. Without proper connecting, FR-HC2 will be damaged.

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

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

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

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

NOTE

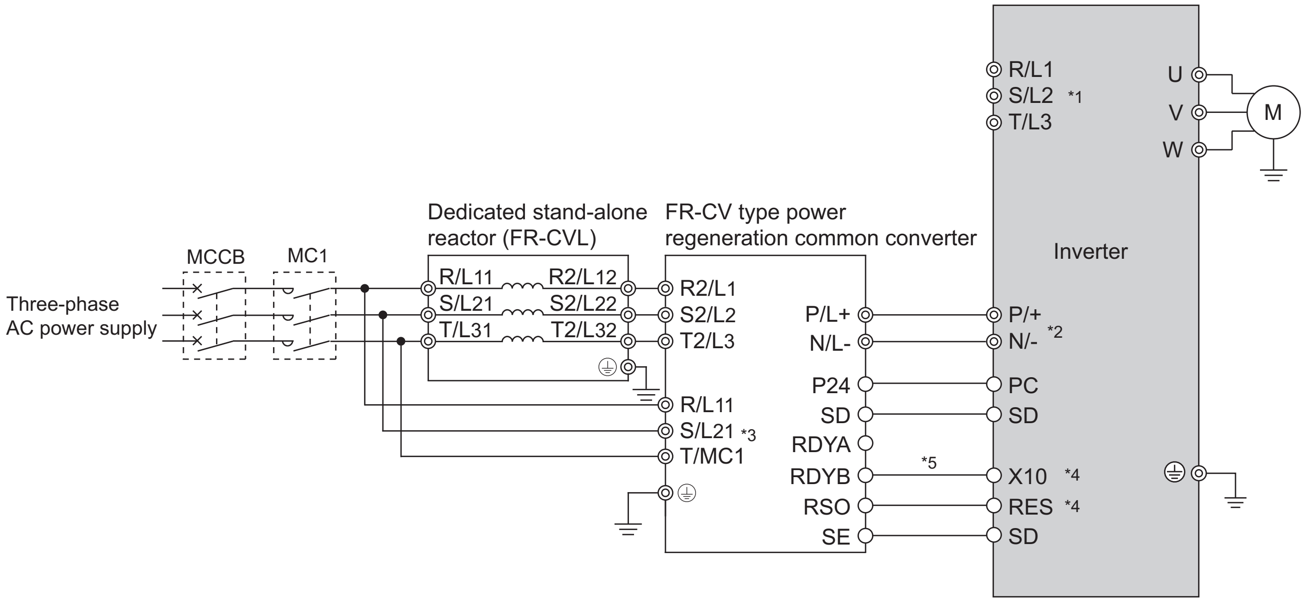
- **The voltage phases of terminals R/L1, S/L2, and T/L3 and terminals R4/L14, S4/L24, and T4/L34 must be matched.**
- **Match the control logic (sink logic/source logic) of the FR-HC2 and the inverter.** ***(Refer to page 27)***
- **Do not connect a DC reactor (FR-HEL) to the inverter when FR-HC2 is connected.**
- **Filterpack connection is not available when FR-HC2 is connected.**

Parameters referred to

Pr. 30 Regenerative function selection ☞ *Refer to page 131*

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 Do not connect anything to the input terminals (R/L1, S/L2, T/L3). 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 and RES signals. *(Refer to page 134)*
*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

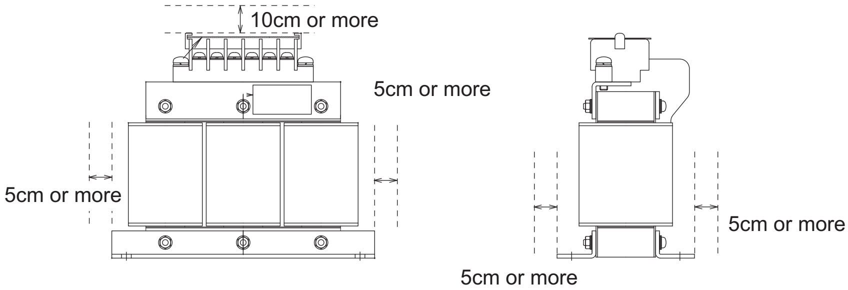
- **The voltage phases of the FR-CV terminals R/L11, S/L21, and T/MC1 and the voltage phases of the inverter terminals R2/L1, S2/L2, and T2/L3 must be matched.**
- **Use sink logic (initial setting) when the FR-CV is connected. The FR-CV cannot be connected when source logic is selected.**
- **Do not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

Parameters referred to

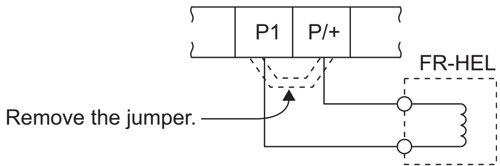
Pr. 30 Regenerative function selection *Refer to page 131*

2.4.5 Connection of a DC reactor (FR-HEL)

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



(2) When using the DC reactor (FR-HEL), connect it 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.



Since the DC reactor (FR-HEL) is electrically connected to the enclosure through mounting screws, the DC reactor is earthed (grounded) by being securely mounted to the enclosure. However, if the DC reactor is not earthed (grounded) securely enough, an earthing (grounding) cable may be used. When using an earthing (grounding) cable, wire the cable to the installation hole where varnish is removed. *(Refer to the Instruction Manual of FR-HEL.)*

NOTE

- **The wiring distance should be within 5m.**
- **As a reference, the cable gauge for the connection should be equal to or larger than that of the power supply cables (R/L1, S/L2, T/L3) and the earthing (grounding) cable.** *(Refer to page 17)*
- **DC reactor connection is not available when Filterpack is connected.**

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 42
3.2 Installation of power factor improving reactor 50
3.3 Power-OFF and magnetic contactor (MC) 51
3.4 Inverter-driven 400V class motor 52
3.5 Precautions for use of the inverter 53
3.6 Failsafe of the system which uses the inverter 55

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.

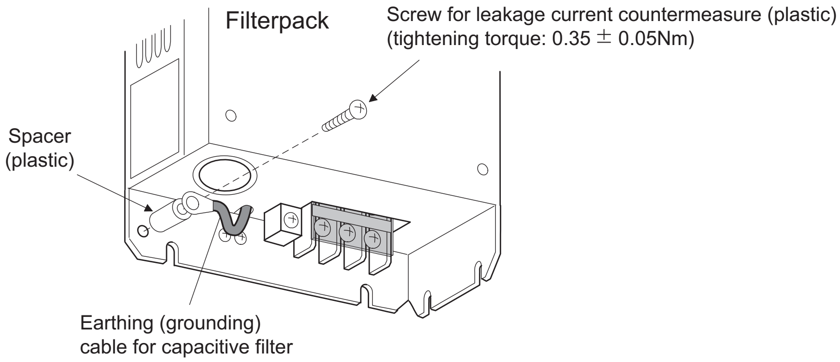
●Suppression technique

- 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).

REMARKS

When using Filterpack, the leakage current is about 4mA (8mA for the 400V class). (For one phase of the three-phase three wire ⅄ connection current)
In the operation with Filterpack, insulating the earthing (grounding) cable of the capacitive filter reduces leakage current. The earthing (grounding) cable can be insulated by connecting it to the enclosed plastic spacer and securing it using the enclosed plastic screw as a countermeasure against leakage current. However, the noise reduction effect of the capacitive filter will be lost. (Pull out the earthing (grounding) cable for the capacitive filter a little to wire.)

●Installation



NOTE

- **When the earthing (grounding) cable for the capacitive filter of Filterpack is removed, the cable is charged while the inverter power is ON and also shortly after the power OFF. Do not touch the earthing (grounding) cable as you may get an electric shock.**

(2) Line-to-line leakage currents

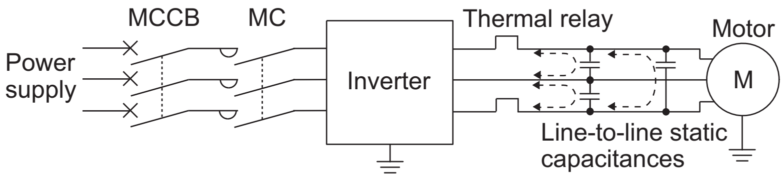
Harmonics of leakage currents flowing in static capacitances between the inverter output cables may operate the external thermal relay unnecessarily. When the wiring length is long (50m or more) for the 400V class small-capacity model (7.5kW or less), the external thermal relay is likely to operate unnecessarily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

●Line-to-line leakage current data example (400V class)

Motor Capacity (kW)	Rated Motor Current (A)	Leakage Current (mA) *	
		Wiring length 50m	Wiring length 100m
0.4	1.1	620	1000
0.75	1.9	680	1060
1.5	3.5	740	1120
2.2	4.1	800	1180
3.7	6.4	880	1260
5.5	9.7	980	1360
7.5	12.8	1070	1450

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

*The leakage current of the 200V class is about a half.



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.

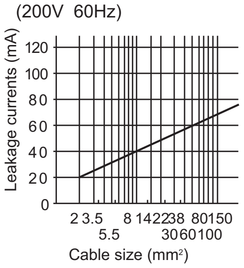
(3) Selection of rated sensitivity current of earth (ground) leakage current breaker

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

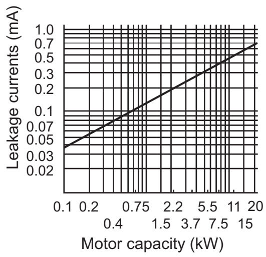
- Breaker designed for harmonic and surge suppression
  Rated sensitivity current:
  $I\Delta n \geq 10 \times (Ig1+Ign+Igi+Ig2+Igm)$
- Standard breaker
  Rated sensitivity current:
  $I\Delta n \geq 10 \times \{Ig1+Ign+Igi+3 \times (Ig2+Igm)\}$

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

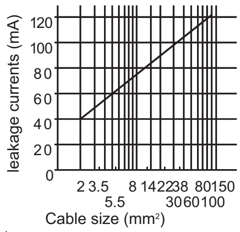
Example of leakage current of cable path per 1km during the commercial power supply operation when the CV cable is routed in metal conduit
(200V 60Hz)



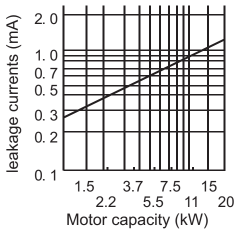
Example of leakage current of three-phase induction motor during the commercial power supply operation
(200V 60Hz)



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)

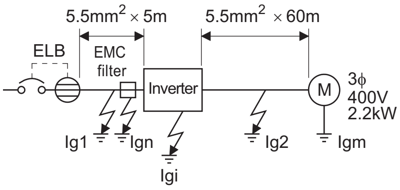


Example of leakage current of three-phase induction motor during the commercial power supply operation
(Totally-enclosed fan-cooled type motor 400V60Hz)



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)	$\frac{1}{3} \times 66 \times \frac{5\text{m}}{1000\text{m}} = 0.11$	
Leakage current Ign (mA)	0 (without EMC filter or Filterpack)	
Leakage current Igi (mA)	1	
Leakage current Ig2 (mA)	$\frac{1}{3} \times 66 \times \frac{60\text{m}}{1000\text{m}} = 1.32$	
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

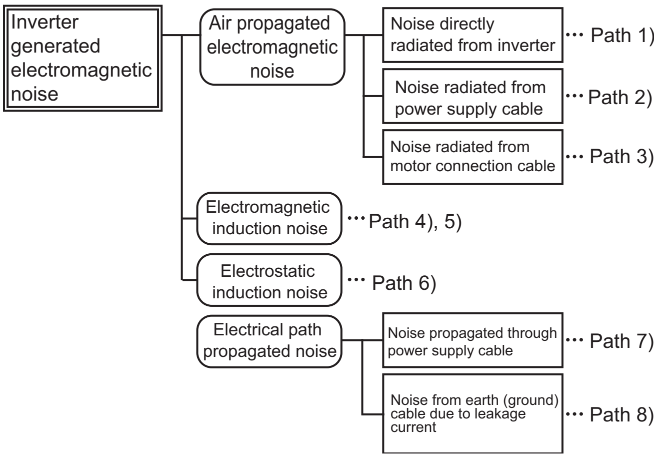
3.1.2 EMC measures

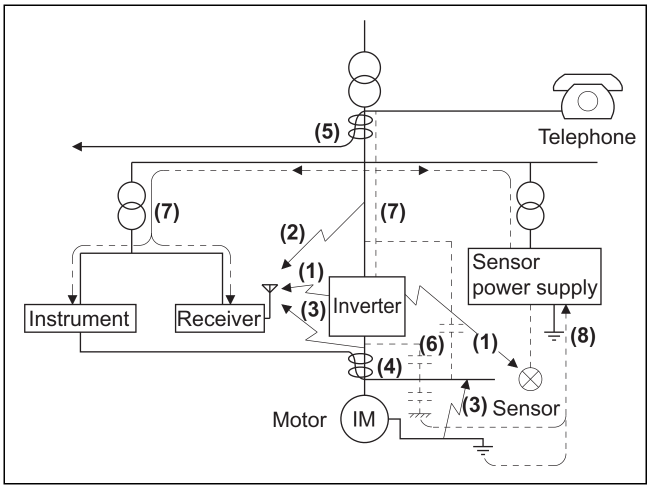
Some electromagnetic noises enter the inverter to malfunction it, and others are radiated by the inverter to malfunction peripheral devices. Though the inverter is designed to have high immunity performance, it handles low-level signals, so it requires the following basic techniques. Also, since the 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 46)* 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.





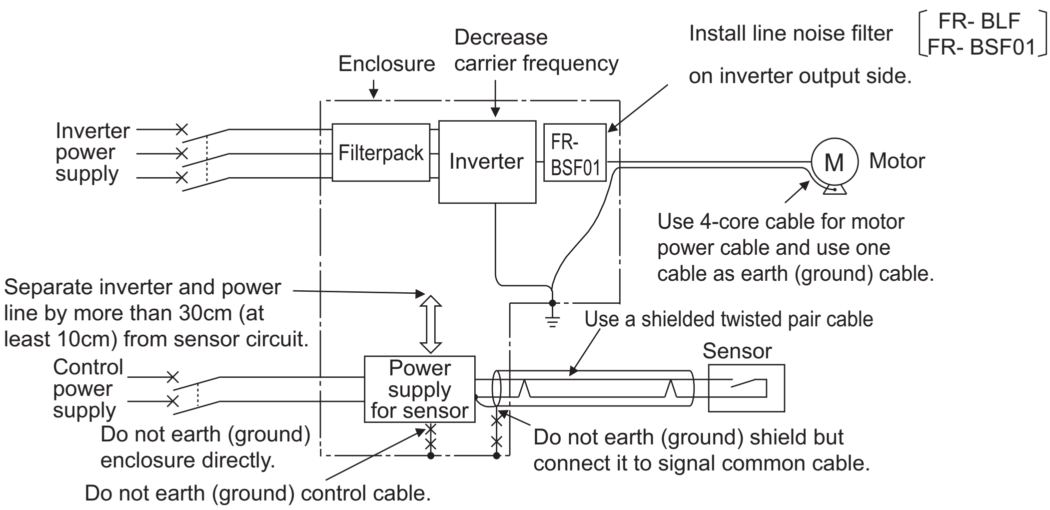
3
PRECAUTIONS FOR USE OF THE INVERTER

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 malfunction due to air-propagated electromagnetic noises. The following measures must be taken: • Install easily affected devices as far away as possible from the inverter. • Run easily affected signal cables as far away as possible from the inverter and its I/O cables. • Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. • Install Filterpack to the inverter, or install common mode filters to the I/O side and radio noise filters to the input side. These measures to suppress radiated noise from cables. • 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 which causes the devices to malfunction and the following measures must be taken: • Install easily affected devices as far away as possible from the inverter. • Run easily affected signal cables as far away as possible from the I/O cables of the inverter. • Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. • 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: • Install the line noise 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

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

●EMC measures



REMARKS

- Install common mode filters (FR-BLF, FR-BSF01) and radio noise filters (FR-BIF) to the input side of the inverter as an EMC measure for the inverter without Filterpack.
- For compliance with the EU, EMC Directive, *refer to the Instruction Manual (Basic).*

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.

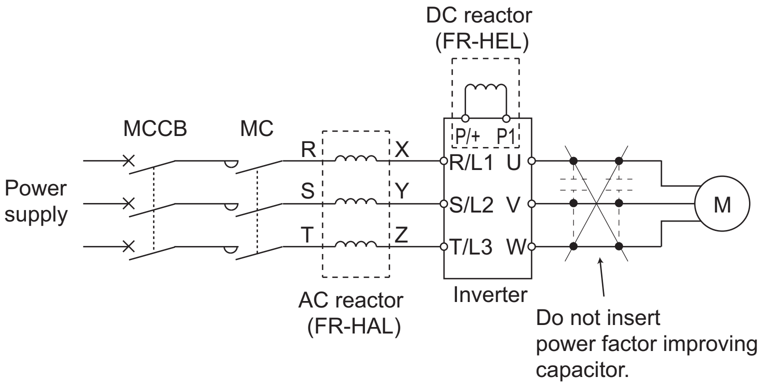
●The differences between harmonics and RF noises are indicated below:

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.

* The Filterpack (FR-BFP2) produces the same effect as when the DC reactor (FR-HEL) is connected.

●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 this should be calculated in the conditions under the rated load at the maximum operating frequency.



NOTE

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

3.1.4 Harmonic suppression guideline in Japan

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The Harmonic Suppression Guidelines were established to protect other consumers from these outgoing harmonic currents.
The three-phase 200V input specifications 3.7kW or less (single-phase 200V power input model 2.2kW or less, single-phase 100V power input model 0.75kW) are previously covered by "Harmonic Suppression Guidelines for Household Appliances and General-Purpose Products" and other models are covered by "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage". However, the transistorized inverter has been excluded from the target products covered by "Harmonic Suppression Guidelines for Household Appliances and General-Purpose Products" in January 2004 and "Harmonic Suppression Guidelines for Household Appliances and General-Purpose Products" was repealed on September 6, 2004.
All capacity and all models of general-purpose inverter used by specific consumers are covered by "Harmonic Suppression Guidelines for Consumers Who Receive High Voltage or Special High Voltage" (hereinafter referred to as "Specific Consumer Guidelines").
"Specific Consumer Guidelines"

This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or especially high-voltage consumer who will install, add or renew harmonic generating equipment. If any of the maximum values are exceeded, this guideline requires the consumer to take certain suppression measures.

Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW Contract Power

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

(1) Application for specific consumers

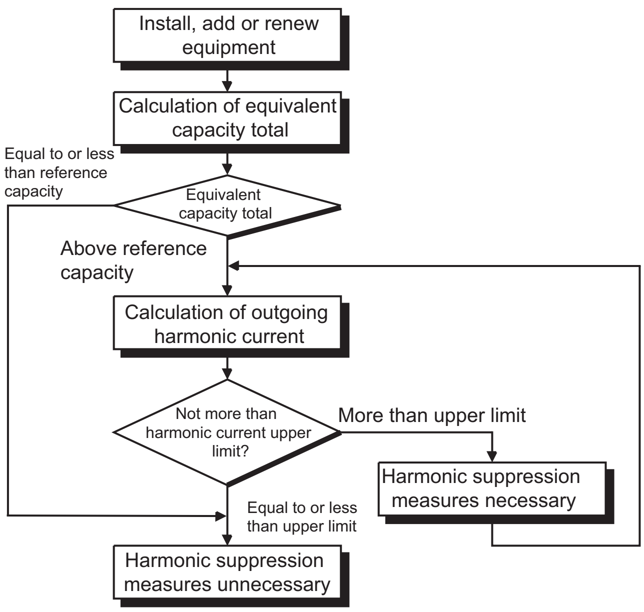


Table 2 Conversion Factors for FR-F700PJ Series

Class	Circuit Type		Conversion Factor (Ki)
3	Three-phase bridge (Capacitor smoothing)	Without reactor	K31= 3.4
		With reactor (AC side)	K32 = 1.8
		With reactor (DC side) or with Filterpack	K33 = 1.8
		With reactors (AC, DC sides)	K34 = 1.4
5	Self-excitation three-phase bridge	When high power factor converter is used	K5 = 0

Table 3 Equivalent Capacity Limits

Received Power Voltage	Reference Capacity
6.6kV	50kVA
22/33 kV	300kVA
66kV or more	2000kVA

Table 4 Harmonic Contents (Values at the fundamental current of 100%)

	Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Three-phase bridge (Capacitor smoothing)	Not used	65	41	8.5	7.7	4.3	3.1	2.6	1.8
	Used (AC side)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
	Used (DC side) or with Filterpack	30	13	8.4	5.0	4.7	3.2	3.0	2.2
	Used (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

1) Calculation of equivalent capacity (P0) of harmonic generating equipment

The "equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated with the following procedure:

$P0 = \Sigma(Ki \times Pi)$ [kVA]

Ki: Conversion factor (refer to Table 2)

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

i: Number indicating the conversion circuit type

* Rated capacity: Determined by the capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

2) Calculation of outgoing harmonic current

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

- Operation ratio: Operation ratio = actual load factor × operation time ratio during 30 minutes
- Harmonic content: Found in Table 4.

Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive

Applicable Motor (kW)	Rated Current [A]		Fundamental Wave Current Converted from 6.6kV (mA)	Rated Capacity (kVA)	Outgoing Harmonic Current Converted from 6.6kV(mA) (No reactor, 100% operation ratio)							
	200V	400V			5th	7th	11th	13th	17th	19th	23rd	25th
0.4	1.61	0.81	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882
0.75	2.74	1.37	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494
1.5	5.50	2.75	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2	7.93	3.96	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320
3.7	13.0	6.50	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092
5.5	19.1	9.55	579	6.77	376.1	237.4	49.22	44.58	24.90	17.95	15.05	10.42
7.5	25.6	12.8	776	9.07	504.4	318.2	65.96	59.75	33.37	24.06	20.18	13.97
11	36.9	18.5	1121	13.1	728.7	459.6	95.29	86.32	48.20	34.75	29.15	20.18
15	49.8	24.9	1509	17.6	980.9	618.7	128.3	116.2	64.89	46.78	39.24	27.16

3) Application of the Specific Consumer Guidelines

If the outgoing harmonic current is higher than the maximum value per 1kW contract power × contract power, a harmonic suppression technique is required.

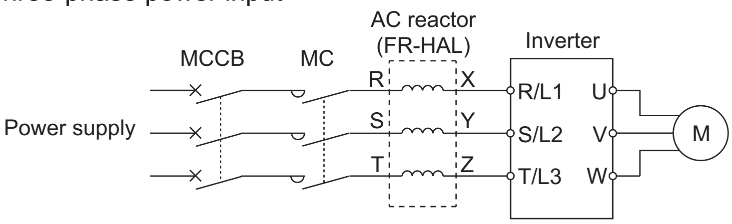
4) Harmonic suppression techniques

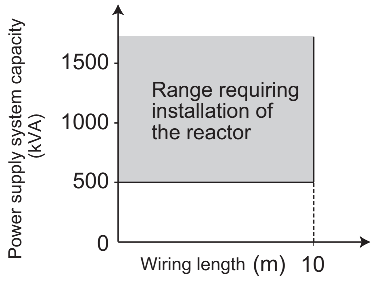
No.	Item	Description
1	Reactor installation (FR-HAL, FR-HEL)	Install an AC reactor (FR-HAL) on the AC side of the inverter or a DC reactor (FR-HEL) on its DC side or both to suppress outgoing harmonic currents. (A DC reactor is pre-installed for the inverter with Filterpack.)
2	High power factor converter (FR-HC2)	This converter trims the current waveform to be a sine waveform by switching in the rectifier circuit (converter module) with transistors. Doing so suppresses the generated harmonic amount significantly. Connect it to the DC area of an inverter. The high power factor converter (FR-HC2) is used with the standard accessory.
3	Installation of power factor improving capacitor	When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.
4	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° as in 人-Δ, Δ-Δ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
5	Passive filter (AC filter)	A capacitor and a reactor are used together to reduce impedances at specific frequencies, producing a great effect of absorbing harmonic currents.
6	Active filter (Active filter)	This filter detects the current of a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress a harmonic current at a detection point, providing a great effect of absorbing harmonic currents.

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 a Filterpack or an optional AC reactor (FR-HAL).

● Three-phase power input





3.3 Power-OFF and magnetic contactor (MC)

(1) Inverter input side magnetic contactor (MC)

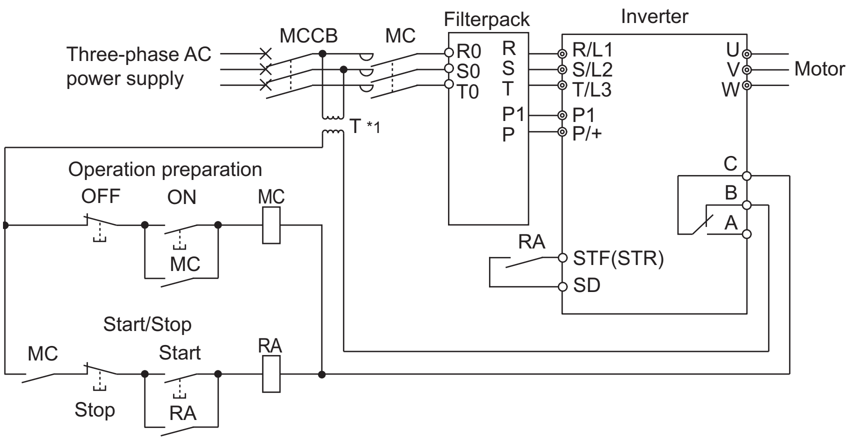
On the inverter input side, it is recommended to provide an MC for the following purposes.
(Refer to *page 5* for selection.)

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). For example, MC avoids overheat or burnout of the brake resistor when heat capacity of the resistor is insufficient or brake regenerative transistor is damaged with short while connecting an optional brake resistor.
2) To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure
3) To separate the inverter from the power supply to ensure safe maintenance and inspection work.

If using an MC for emergency stop during operation, select an MC regarding the inverter input side current as JEM1038-AC-3 class rated current.

REMARKS

Since repeated inrush currents at power ON will shorten the life of the converter circuit (switching life is about 1,000,000 times.), 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 (When using Filterpack)

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

*1 When the power supply is 400V class, install a stepdown 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. If an MC is provided to switch to the commercial power supply or for similar purposes under general-purpose motor control, switch the MC after the inverter and motor have stopped.

NOTE

IPM motor is a synchronous motor with high-performance magnets embedded in the rotor. Motor terminals hold high-voltage while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. When the motor is driven by the load in applications such as fan and blower, a low-voltage manual contactor must be connected at the inverter's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.

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

(Under general-purpose motor control)
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 or less	**50m to 100m**	**exceeding 100m**
Pr. 72 PWM frequency selection	15 (14.5kHz) or less	8 (8kHz) or less	4 (4kHz) or less

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

(Under IPM motor control)
When the wiring length is 30m or longer, use the inverter at the carrier frequency of 2.5kHz (*Pr. 72* = "0 to 4").

NOTE

- **For details of *Pr. 72 PWM frequency selection*, refer to page 181.**
- **For explanation of surge voltage suppression filter (FR-ASF-H/FR-BMF-H), refer to the manual of each option.**

3.5 Precautions for use of the inverter

The FR-F700PJ 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 (Filterpack).
Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter (Filterpack) clean.
When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the inverter (Filterpack).

(4) Use cables of the size to make a voltage drop 2% or less.
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 22* for the recommended wire sizes.

(5) The total wiring length should be within the prescribed length.
Especially for long distance wiring, the fast-response current limit function may decrease or the equipment connected to the output 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 24)*

(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. For an inverter without Filterpack, install the FR-BIF optional capacitor type filter (for use in the input side only), FR-BSF01 or FR-BLF line noise 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.

(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.

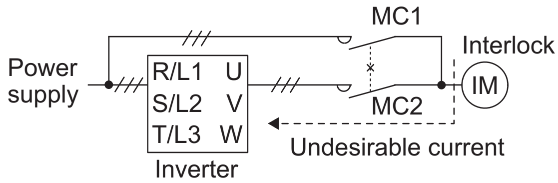
(9) A short circuit or earth (ground) fault on the inverter output side may damage the inverter modules.
- Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits caused by peripheral circuit inadequacy or an earth (ground) fault caused by wiring 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.
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.

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

(12) Do not apply a voltage higher than the permissible voltage to the inverter I/O signal circuits.
Application of a voltage higher than the permissible voltage to the inverter I/O signal circuits or opposite polarity may damage the I/O devices. Especially check the wiring to prevent the speed setting potentiometer from being connected incorrectly to short terminals 10 and 5.

(13) When driving a general-purpose motor, 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) Inverter input side magnetic contactor (MC)
On the inverter input side, connect a MC for the following purposes. (Refer to *page 5* for selection.)
1) To release the inverter from the power supply when a fault occurs or when the drive is not functioning (e.g. emergency stop operation). For example, MC avoids overheat or burnout of the brake resistor when heat capacity of the resistor is insufficient or brake regenerative transistor is damaged with short while connecting an optional brake resistor.
2) To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure
3) To separate the inverter from the power supply to ensure safe maintenance and inspection work.
If using an MC for emergency stop during operation, select an MC regarding the inverter input side current as JEM1038-AC-3 class rated current.

(16) 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. If an MC is provided to switch to the commercial power supply or for similar purposes under general-purpose motor control, switch the MC after the inverter and motor have stopped.

(17) Countermeasures against inverter-generated EMI
If electromagnetic noise generated from the inverter causes frequency setting signal to fluctuate and motor rotation speed to be unstable when changing motor speed with analog signal, the following countermeasures are effective.
- Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.
- Run signal cables as far away as possible from power cables (inverter I/O cables).
- Use shield cables as signal cables.
- Install a ferrite core on the signal cable (Example: ZCAT3035-1330 TDK).

(18) 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. A counter action for this is to raise the permissible current level by increasing the inverter capacity (up to 2 ranks) when using a general-purpose motor, and by increasing the inverter and IPM motor capacities when using an IPM motor.

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

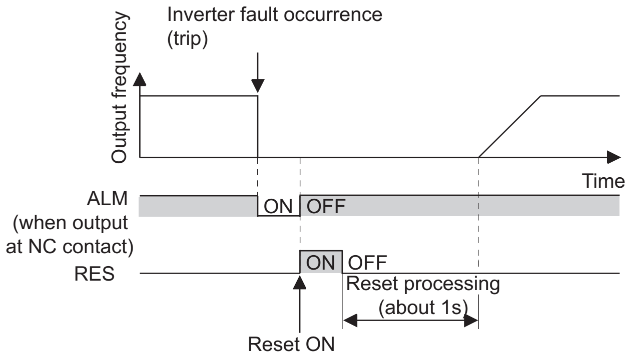
3.6 Failsafe of the system which uses the inverter

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.

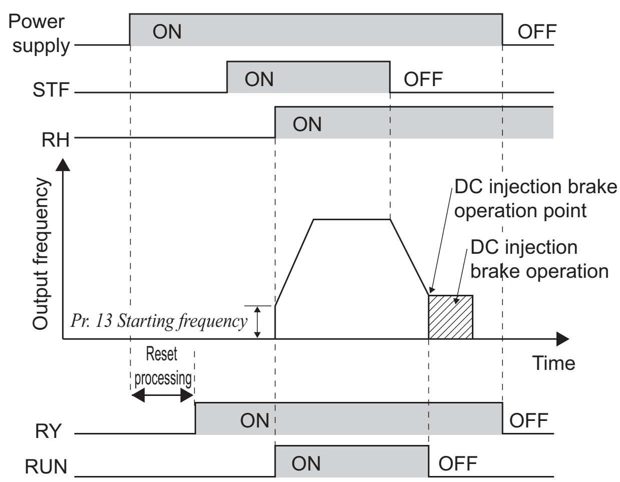
No.	Interlock Method	Check Method	Used Signals	Refer to Page
1)	Inverter protective function operation	Operation check of an alarm contact Circuit error detection by negative logic	Fault output signal (ALM signal)	*143*
2)	Inverter operating status	Operation ready signal check	Operation ready signal (RY signal)	*142*
3)	Inverter running status	Logic check of the start signal and running signal	Start signal (STF signal, STR signal) Running signal (RUN signal)	*138, 142*
4)	Inverter running status	Logic check of the start signal and output current	Start signal (STF signal, STR signal) Output current detection signal (Y12 signal)	*138, 146*

1)Check by the inverter fault output signal
When the inverter's protective function activates and the inverter trips, the fault output signal (ALM signal) is output. (ALM signal is assigned to terminal ABC in the initial setting).
With this signal, you can check if the inverter is operating 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.



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 120% of the rated inverter 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 the functions to *Pr.190 and Pr.192 (output terminal function selection)* referring to the table on the left.

NOTE

- **Changing the terminal assignment using *Pr. 190 and Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters 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.

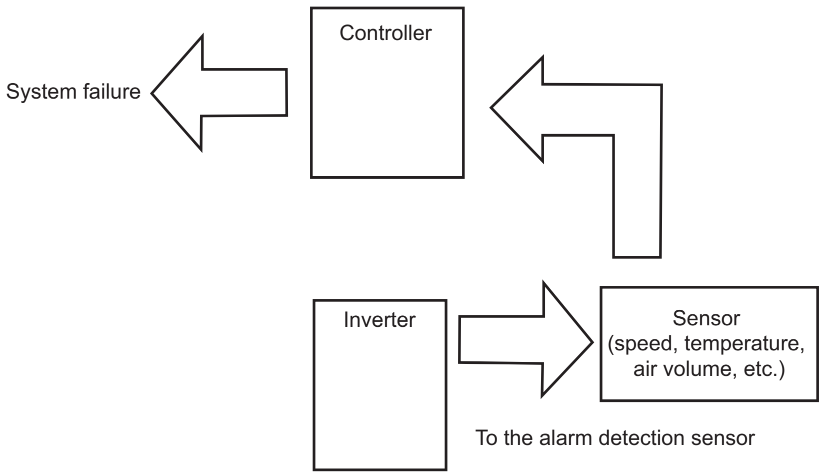
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as checking up as below according to the level of importance of the system.

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.



4 PARAMETERS

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

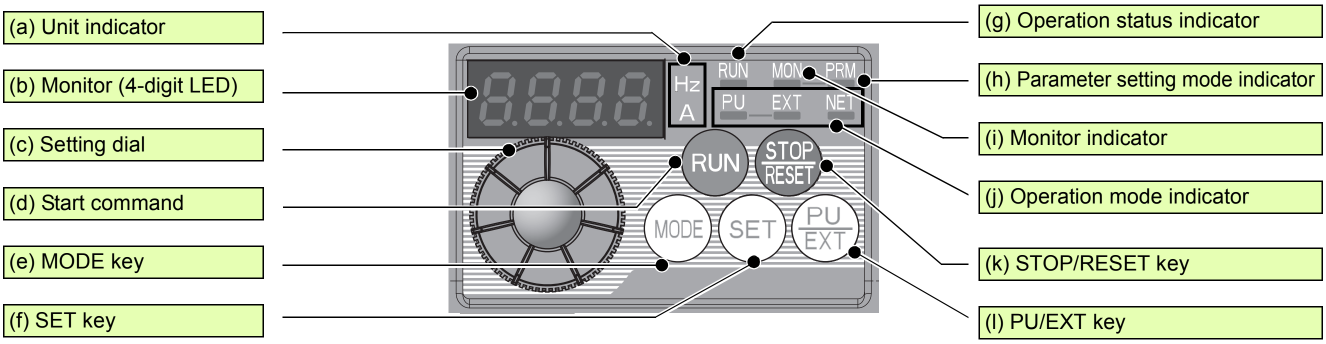
The following marks are used to indicate the controls as below. (Parameters without any mark are valid for all controls.)

Mark	Control method	Applied motor (control)
V/F	V/F control	Three-phase induction motor (general-purpose motor control)
GP MFVC	General-purpose magnetic flux vector control	
IPM	IPM motor control	Dedicated IPM motor (IPM motor control)

4.1 Operation panel

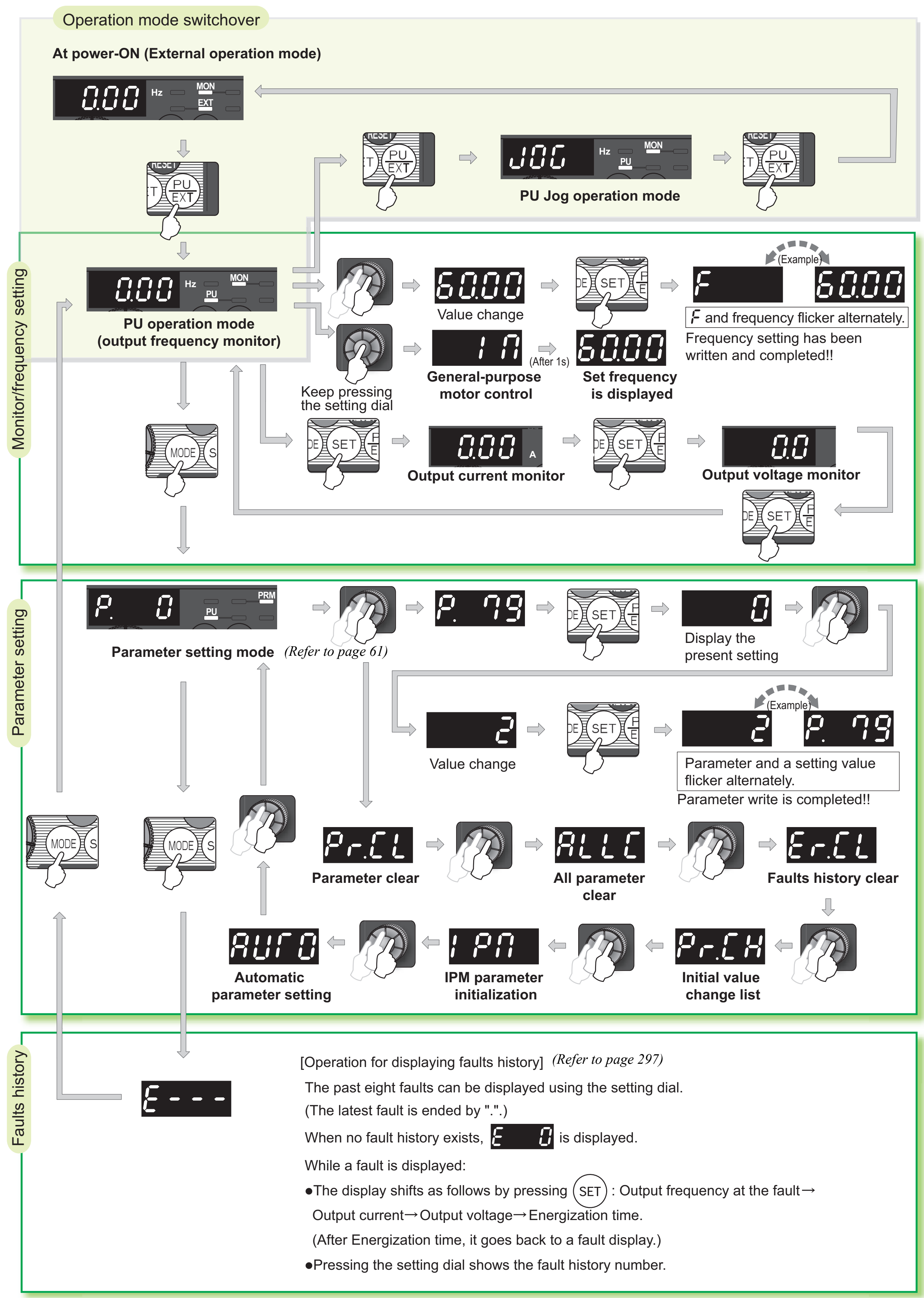
4.1.1 Names and functions of the operation panel

The operation panel cannot be removed from the inverter.



No.	Component	Name	Description
(a)	Hz A	Unit indicator	Hz: Lit to indicate frequency. (Flickers when the set frequency monitor is displayed.) A: Lit to indicate current. (Both "Hz" and "A" turns OFF to indicate a value other than frequency or current.)
(b)	8.8.8.8.	Monitor (4-digit LED)	Shows the frequency, parameter number, etc. (To monitor the output power, the set frequency and other items, set *Pr. 52*.)
(c)		Setting dial	The dial of the Mitsubishi inverters. The setting dial is used to change the frequency and parameter settings. Press the setting dial to perform the following operations: • To display a control method (general-purpose motor control or IPM motor control) during the monitor mode • To display the set frequency when pressed for 1s or longer under PU operation mode or External/PU combined operation mode (*Pr. 79* = "3") • To display the present setting during calibration • To display a fault history number in the faults history mode
(d)	RUN	Start command	Select the rotation direction in *Pr. 40*.
(e)	MODE	MODE key	Used to switch among different setting modes. Pressing PU/EXT simultaneously changes the operation mode. Holding this key for 2 seconds locks the operation. The key lock is invalid when *Pr. 161* = "0 (initial setting)." *(Refer to page 280)*
(f)	SET	SET key	Used to enter a setting. If pressed during the operation, monitored item changes as the following: Output frequency → Output current → Output voltage* (→ back to Output frequency) * Energy saving monitor is displayed when the energy saving monitor is set with *Pr. 52*.
(g)	RUN	Operation status indicator	Lit or flickers during inverter operation.* * Lit: When the forward rotation operation is being performed. Slow flickering (1.4s cycle): When the reverse rotation operation is being performed. Fast flickering (0.2s cycle): When RUN has been pressed or the start command has been given, but the operation cannot be made. • When the frequency command is less than the starting frequency. • When the MRS signal is being input.
(h)	PRM	Parameter setting mode indicator	Lit to indicate the parameter setting mode.
(i)	MON	Monitor indicator	Lit to indicate the monitor mode.
(j)	PU EXT NET	Operation mode indicator	PU: Lit to indicate the PU operation mode. EXT: Lit to indicate the External operation mode.(EXT is lit at power-ON in the initial setting.) NET: Lit to indicate the Network operation mode. PU and EXT: Lit to indicate EXT/PU combined operation mode 1 and 2 All of these indicators are OFF when the command source is not at the operation panel. *(Refer to page 214)*.
(k)	STOP RESET	STOP/RESET key	Used to stop operation commands. Used to reset a fault when the protective function (fault) is activated.
(l)	PU EXT	PU/EXT key	Used to switch between the PU and External operation modes. To use the External operation mode (operation using a separately connected frequency setting potentiometer and start signal), press this key to light up the EXT indicator. (Press MODE simultaneously (0.5s), or change the *Pr .79* setting *(refer to page 60)* to change to the combined operation mode.) PU: PU operation mode EXT: External operation mode Used to cancel the PU stop also.

4.1.2 Basic operation (factory setting)



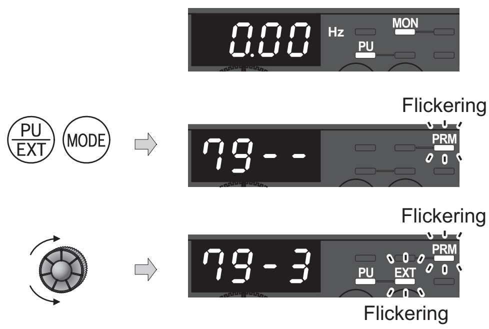
4.1.3 Easy operation mode setting (easy setting mode)

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 power-ON
   The monitor display appears.
2. Easy operation mode setting
   Press (PU/EXT) and (MODE) for 0.5s.
3. Operation mode selection
   Turn  until 79-3 appears.
   (refer to the table below for other settings)



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

4. Operation mode setting
   Press (SET) to set.

Flicker ··· Parameter setting complete!!
The monitor display appears after 3s.

REMARKS

? Er 1 is displayed ... Why?
☞ Parameter write is disabled with "1" set in *Pr. 77*.

? Er 2 is displayed ... Why?
☞ Setting cannot be made during operation. Turn the start switch (RUN, STF or STR) OFF.

- If (MODE) is pressed before pressing (SET), the easy setting mode is terminated and the display goes back to the monitor display. If the easy setting mode is terminated while *Pr.79* = "0 (initial setting)," the operation mode switches between the PU operation mode and the External operation mode. Check the 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".

4.1.4 Changing the parameter setting value

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

Operation / **Display**

1. Screen at power-ON

   The monitor display appears.

2. Changing the operation mode

   Press (PU/EXT) to choose the PU operation mode.

PU indicator is lit.

3. Parameter setting mode

   Press (MODE) to choose the parameter setting mode.

PRM indicator is lit.

(The parameter number read previously appears.)

4. Selecting the parameter number

   Turn (dial) until P. 1 *(Pr. 1)* appears.

5. Displaying the setting

   Press (SET) to read the present set value.

   " 120.0 "(120.0Hz (initial value)) appears.

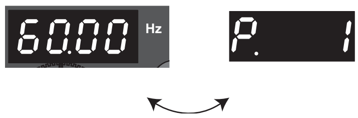
6. Changing the setting value

   Turn (dial) to change the set value to

   "60.00" (60.00Hz).

7. Parameter setting

   Press (SET) to 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

? Er1 to Er4 is displayed...Why?

Er1 appears.................... Write disable error

Er2 appears.................... Write error during operation

Er3 appears.................... Calibration error

Er4 appears.................... Mode designation error

(For details, *refer to page 298*.)

- 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 cannot 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.

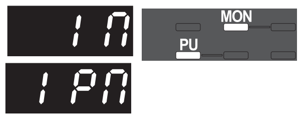
4

PARAMETERS

4.1.5 Displaying the control method and the set frequency

Press the setting dial () to display the present control method.

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

Operation	Display
1. Screen at power-ON The monitor display appears.	
2. Displaying the control method Press the setting dial to display the control method (general-purpose motor control or IPM motor control) that is currently selected. **3.** Displaying the set frequency While the control mode is displayed, press the setting dial to switch the display to the presently set frequency. The display switches after 1s. (Under the PU operation mode or External/PU combined operation mode 1 (*Pr. 79* = "3").)	 [Hz] and [A] indicators turn OFF. Under general-purpose motor control Under IPM motor control   Flicker
4. Monitor display Release the setting dial to return to the previous monitor display.	

MEMO

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. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel.
To use the inverter under IPM motor control, *refer to page 83*.

Parameter	Name	Initial Value	Setting Range	Remarks
160	**User group read selection**	9999	9999	Only the simple mode parameters can be displayed.
			0	Simple mode and extended mode parameters can be displayed.

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*.

Func-tion	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Basic functions	◎ 0	Torque boost	0 to 30%	0.1%	6/4/3/2% *1	*92*	
	◎ 1	Maximum frequency	0 to 120Hz	0.01Hz	120Hz	*101*	
	◎ 2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	*101*	
	◎ 3	Base frequency	0 to 400Hz	0.01Hz	60Hz	*103*	
	◎ 4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	*106*	
	◎ 5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	*106*	
	◎ 6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	*106*	
	◎ 7	Acceleration time	0 to 3600s	0.1s	5/15s *2	*113*	
	◎ 8	Deceleration time	0 to 3600s	0.1s	10/30s *3	*113*	
	◎ 9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated inverter current	*119*	
DC injection brake	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz	3Hz	*129*	
	11	DC injection brake operation time	0 to 10s	0.1s	0.5s	*129*	
	12	DC injection brake operation voltage	0 to 30%	0.1%	4/2% *4	*129*	
—	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	*116*	
—	14	Load pattern selection	0, 1	1	1	*105*	
JOG operation	15	Jog frequency	0 to 400Hz	0.01Hz	5Hz	*108*	
	16	Jog acceleration/deceleration time	0 to 3600s	0.1s	0.5s	*108*	
—	17	MRS input selection	0, 2, 4	1	0	*136*	
—	18	High speed maximum frequency	120 to 400Hz	0.01Hz	120Hz	*101*	
—	19	Base frequency voltage	0 to 1000V, 8888, 9999	0.1V	9999	*103*	
Acceleration/ deceleration time	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	*113*	
Stall prevention	22	Stall prevention operation level	0 to 150%	0.1%	120%	*96*	
	23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999	0.1%	9999	*96*	

- Symbol in the Remarks column
  Ver.UP ...Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.
- These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication.
  (*Refer to page 221* 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	IPM	Copy	Clear	All clear
◎ 0		00	80	0	○	×	×	○	○	○
◎ 1		01	81	0	○	○	○	○	○	○
◎ 2		02	82	0	○	○	○	○	○	○
◎ 3		03	83	0	○	○*10	×	○	○	○
◎ 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	○	○	×	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Multi-speed setting	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	106	
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	106	
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	106	
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	106	
—	29	Acceleration/deceleration pattern selection	0 to 2	1	0	118	
—	30	Regenerative function selection	0 to 2	1	0	131, 161	
Frequency jump	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	102	
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	102	
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	102	
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	102	
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	102	
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	102	
—	37	Speed display	0, 0.01 to 9998	0.001	0	150	
—	40	RUN key rotation direction selection	0, 1	1	0	277	
Frequency detection	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	144	
	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	144	
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	144	
Second functions	44	Second acceleration/deceleration time	0 to 3600s	0.1s	5/15s *2	113	
	45	Second deceleration time	0 to 3600s, 9999	0.1s	9999	113	
	46	Second torque boost	0 to 30%, 9999	0.1%	9999	92	
	47	Second V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	103	
	48	Second stall prevention operation current	0 to 150%, 9999	0.1%	9999	96	
	51	Second electronic thermal O/L relay	0 to 500A, 9999	0.01A	9999	119	
Monitor functions	52	DU/PU main display data selection	0, 5, 8 to 12, 14, 20, 23 to 25, 50 to 55, 61, 62, 64, 100	1	0	152	
	54	FM terminal function selection	1 to 3, 5, 8 to 12, 14, 21, 24, 50, 52, 53, 61, 62	1	1	152	
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60Hz	157	
	56	Current monitoring reference	0 to 500A	0.01A	Rated inverter current	157	
Automatic restart functions	57	Restart coasting time	0, 0.1 to 5s, 9999	0.1s	9999	161	
	58	Restart cushion time	0 to 60s	0.1s	1s	161	
—	59	Remote function selection	0 to 3	1	0	110	
—	60	Energy saving control selection	0, 9	1	0	174	
—	65	Retry selection	0 to 5	1	0	170	
—	66	Stall prevention operation reduction starting frequency	0 to 400Hz	0.01Hz	60Hz	96	
Retry	67	Number of retries at fault occurrence	0 to 10, 101 to 110	1	0	170	
	68	Retry waiting time	0.1 to 600s	0.1s	1s	170	
	69	Retry count display erase	0	1	0	170	
—	70	Special regenerative brake duty	0 to 30%	0.1%	0%	131	
—	71	Applied motor	0, 1, 3, 13, 23, 40, 43, 50, 53, 120, 210	1	0	93, 123, 125,	
—	72	PWM frequency selection	0 to 15	1	1	181	
—	73	Analog input selection	0, 1, 10, 11	1	1	183	
—	74	Input filter time constant	0 to 8	1	1	187	
—	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	193	
—	77	Parameter write selection	0 to 2	1	0	196	
—	78	Reverse rotation prevention selection	0 to 2	1	0	197	
—	◎ 79	Operation mode selection	0 to 4, 6, 7	1	0	200, 213	

Parameter	Remarks	Instruction Code			Control Mode-based Correspondence Table			Parameter		
		Read	Write	Extended	V/F	GP MFVC	IPM	Copy	Clear	All clear
24		18	98	0	○	○	○	○	○	○
25		19	99	0	○	○	○	○	○	○
26		1A	9A	0	○	○	○	○	○	○
27		1B	9B	0	○	○	○	○	○	○
29		1D	9D	0	○	○	○	○	○	○
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	○	○	○	○	○	○
54		36	B6	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	Ver.UP	47	C7	0	○	○	○	○	○	○
72		48	C8	0	○	○	○	○	○	○
73		49	C9	0	○	○	○	○	×	○
74		4A	CA	0	○	○	○	○	○	○
75		4B	CB	0	○	○	○	○	×	×
77		4D	CD *5	0	○	○	○	○	○	○
78		4E	CE	0	○	○	○	○	○	○
◎ 79		4F	CF *5	0	○	○	○	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Motor constants	80	Motor capacity	0.4 to 15kW, 9999	0.01kW	9999	93, 125	
	82	Motor excitation current	0 to 500A, 9999	0.01A	9999	125	
	83	Rated motor voltage	0 to 1000V	0.1V	200V/400V *5	125	
	84	Rated motor frequency	10 to 120Hz	0.01Hz	60Hz	125	
	90	Motor constant (R1)	0 to 50Ω , 9999	0.001Ω	9999	125	
	96	Auto tuning setting/status	0, 11, 21	1	0	161	
PU connector communication	117	PU communication station number	0 to 31 (0 to 247)	1	0	221, 238	
	118	PU communication speed	48, 96, 192, 384	1	192	221, 238	
	119	PU communication stop bit length	0, 1, 10, 11	1	1	221	
	120	PU communication parity check	0 to 2	1	2	221, 238	
	121	Number of PU communication retries	0 to 10, 9999	1	1	222	
	122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	0	222, 238	
	123	PU communication waiting time setting	0 to 150ms, 9999	1	9999	221	
	124	PU communication CR/LF selection	0 to 2	1	1	221	
—	◎ 125	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	188	
—	◎126	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	188	
PID operation	127	PID control automatic switchover frequency	0 to 400Hz, 9999	0.01Hz	9999	250	
	128	PID action selection	0, 20, 21	1	0	250, 221	
	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	250, 221	
	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	250, 221	
	131	PID upper limit	0 to 100%, 9999	0.1%	9999	250, 221	
	132	PID lower limit	0 to 100%, 9999	0.1%	9999	250, 221	
	133	PID action set point	0 to 100%, 9999	0.01%	9999	250, 221	
	134	PID differential time	0.01 to 10s, 9999	0.01s	9999	250, 221	
—	144	Speed setting switchover	2, 4, 6, 8, 10, 102, 104, 106, 108, 110	1	4	150	
PU	145	PU display language selection	0 to 7	1	0	277	
—	146 *7	Built-in potentiometer switching	0, 1	1	1	283	
Current detection	150	Output current detection level	0 to 150%	0.1%	120%	146	
	151	Output current detection signal delay time	0 to 10s	0.1s	0s	146	
	152	Zero current detection level	0 to 150%	0.1%	5%	146	
	153	Zero current detection time	0 to 1s	0.01s	0.5s	146	
—	154	Voltage reduction selection during stall prevention operation	1, 11	1	1	96	
—	156	Stall prevention operation selection	0 to 31, 100, 101	1	0	96	
—	157	OL signal output timer	0 to 25s, 9999	0.1s	0s	96	
—	◎ 160	Extended function display selection	0, 9999	1	9999	197	
—	161	Frequency setting/key lock operation selection	0, 1, 10, 11	1	0	278	
Automatic restart functions	162	Automatic restart after instantaneous power failure selection	0, 1, 10, 11	1	1	161	
	165	Stall prevention operation level for restart	0 to 150%	0.1%	120%	161	

Parameter list

Parameter	Remarks	Instruction Code			Control Mode-based Correspondence Table			Parameter		
		Read	Write	Extended	V/F	GP MFVC	IPM	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	○	○	○	○	○ *9	○ *9
118		12	92	1	○	○	○	○	○ *9	○ *9
119		13	93	1	○	○	○	○	○ *9	○ *9
120		14	94	1	○	○	○	○	○ *9	○ *9
121		15	95	1	○	○	○	○	○ *9	○ *9
122		16	96	1	○	○	○	○	○ *9	○ *9
123		17	97	1	○	○	○	○	○ *9	○ *9
124		18	98	1	○	○	○	○	○ *9	○ *9
◎ 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	○	○	○	○	○	○
144		2C	AC	1	○	○	○	○	○	○
145		2D	AD	1	○	○	○	○	×	×
146		2E	AE	1	○	○	○	○	×	×
150		32	B2	1	○	○	○	○	○	○
151		33	B3	1	○	○	○	○	○	○
152		34	B4	1	○	○	○	○	○	○
153		35	B5	1	○	○	○	○	○	○
154	Ver.UP	36	B6	1	○	○	×	○	○	○
156		38	B8	1	○	○	○	○	○	○
157		39	B9	1	○	○	○	○	○	○
◎ 160		00	80	2	○	○	○	○	○	○
161		01	81	2	○	○	○	○	×	○
162		02	82	2	○	○	○	○	○	○
165		05	85	2	○	○	○	○	○	○

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	146	
Current detection	167	Output current detection operation selection	0, 1	1	0	146	
—	168	Parameter for manufacturer setting. Do not set.					
—	169						
Cumulative monitor clear	170	Watt-hour meter clear	0, 10, 9999	1	9999	152	
Cumulative monitor clear	171	Operation hour meter clear	0, 9999	1	9999	152	
Input terminal function selection	178	STF terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 24, 25, 60, 62, 64 to 67, 72 9999	1	60	134	
Input terminal function selection	179	STR terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 24, 25, 61, 62, 64 to 67, 72, 9999	1	61	134	
Input terminal function selection	180	AU terminal function selection	0 to 5, 7, 8, 10, 12, 14, 16, 24, 25, 62, 64 to 67, 72, 9999	1	4	134	
Input terminal function selection	181	RM terminal function selection		1	1	134	
Input terminal function selection	182	RH terminal function selection		1	2	134	
Output terminal function selection	190	RUN terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46 to 48, 57, 64, 70, 79, 90 to 93, 95, 96, 98 to 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146 to 148, 157, 164, 170, 179, 190 to 193, 195, 196, 198, 199, 9999	1	0	140	
Output terminal function selection	192	A,B,C terminal function selection	0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46 to 48, 57, 64, 70, 79, 90, 91, 95, 96, 98 to 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146 to 148, 157, 164, 170, 179, 190, 191, 195, 196, 198, 199, 9999	1	99	140	
Multi-speed setting	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	106	
Multi-speed setting	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999	106	
Multi-speed setting	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999	106	
Multi-speed setting	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	106	
Multi-speed setting	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999	106	
Multi-speed setting	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz	9999	106	
Multi-speed setting	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999	106	
Multi-speed setting	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999	106	
—	240	Soft-PWM operation selection	0, 1	1	1	181	
—	241	Analog input display unit switchover	0, 1	1	0	188	
—	244	Cooling fan operation selection	0, 1	1	1	264	
Slip compensation	245	Rated slip	0 to 50%, 9999	0.01%	9999	95	
Slip compensation	246	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	95	
Slip compensation	247	Constant-power range slip compensation selection	0, 9999	1	9999	95	
—	249	Earth (ground) fault detection at start	0, 1	1	0	172	
—	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	0.1s	9999	133, 138	
—	251	Output phase loss protection selection	0, 1	1	1	172	

Parameter	Remarks	Instruction Code			Control Mode-based Correspondence Table			Parameter		
		Read	Write	Extended	V/F	GP MFVC	IPM	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	○	○	○	○	○	○

Func- tion	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	265	
	256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	265	
	257	Control circuit capacitor life display	(0 to 100%)	1%	100%	265	
	258	Main circuit capacitor life display	(0 to 100%)	1%	100%	265	
	259	Main circuit capacitor life measuring	0, 1 (2, 3, 8, 9)	1	0	265	
—	260	PWM frequency automatic switchover	0, 1	1	1	181	
Power failure stop	261	Power failure stop selection	0 to 2	1	0	168	
—	267	Terminal 4 input selection	0 to 2	1	0	183	
—	268	Monitor decimal digits selection	0, 1, 9999	1	9999	152	
—	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	281	
Password function	296	Password lock level	1 to 6, 101 to 106, 9999	1	9999	198	
	297	Password lock/unlock	1000 to 9998 (0 to 5, 9999)	1	9999	198	
—	298	Frequency search gain	0 to 32767, 9999	1	9999	161	
—	299	Rotation direction detection selection at restarting	0, 1, 9999	1	0	161	
RS-485 communication	338	Communication operation command source	0, 1	1	0	214	
	339	Communication speed command source	0 to 2	1	0	214	
	340	Communication startup mode selection	0, 1, 10	1	0	213	
	342	Communication EEPROM write selection	0, 1	1	0	225	
	343	Communication error count	—	1	0	238	
—	374	Overspeed detection level	0 to 400Hz, 9999	0.01Hz	9999	173	
Second motor constant	450	Second applied motor	0, 1, 9999	1	9999	123	
Remote Output	495	Remote output selection	0, 1, 10, 11	1	0	148	
	496	Remote output data 1	0 to 4095	1	0	148	
—	502	Stop mode selection at communication error	0 to 3	1	0	222, 238	
Maintenance	503	Maintenance timer	0 (1 to 9998)	1	0	268	
	504	Maintenance timer alarm output set time	0 to 9998, 9999	1	9999	268	
—	505	Speed setting reference	1 to 120Hz	0.01Hz	60Hz	150	
Communication	549	Protocol selection	0, 1	1	0	238	
	551	PU mode operation command source selection	2, 4, 9999	1	9999	214	
—	552	Frequency jump range	0 to 30Hz, 9999	0.01Hz	9999	102	
PID operation	553	PID deviation limit	0 to 100%, 9999	0.1%	9999	250	
	554	PID signal operation selection	0 to 3, 10 to 13	1	0	250	

Parameter list

Parameter	Remarks	Instruction Code			Control Mode-based Correspondence Table			Parameter		
		Read	Write	Extended	V/F	GP MFVC	IPM	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	○	○	○	○	○ *9	○ *9
339		27	A7	3	○	○	○	○	○ *9	○ *9
340		28	A8	3	○	○	○	○	○ *9	○ *9
342		2A	AA	3	○	○	○	○	○	○
343		2B	AB	3	○	○	○	×	×	×
374	Ver.UP	4A	CA	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	○	○	○	○	×	○
505		05	85	5	○	○	○	○	○	○
549		31	B1	5	○	○	○	○	○ *9	○ *9
551		33	B3	5	○	○	○	○	○ *9	○ *9
552	Ver.UP	34	B4	5	○	○	○	○	○	○
553		35	B5	5	○	○	○	○	○	○
554		36	B6	5	○	○	○	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Current average time monitor	555	Current average time	0.1 to 1s	0.1s	1s	269	
	556	Data output mask time	0 to 20s	0.1s	0s	269	
	557	Current average value monitor signal output reference current	0 to 500A	0.01A	Rated inverter current	269	
—	561	PTC thermistor protection level	0.5 to 30kΩ , 9999	0.01kΩ	9999	119	
—	563	Energization time carrying-over times	(0 to 65535)	1	0	152	
—	564	Operating time carrying-over times	(0 to 65535)	1	0	152	
—	571	Holding time at a start	0 to 10s, 9999	0.1s	9999	116	
PID operation	575	Output interruption detection time	0 to 3600s, 9999	0.1s	1s	250	
	576	Output interruption detection level	0 to 400Hz	0.01Hz	0Hz	250	
	577	Output interruption cancel level	900 to 1100%	0.1%	1000%	250	
—	611	Acceleration time at a restart	0 to 3600s, 9999	0.1s	9999	161	
—	653	Speed smoothing control	0 to 200%	0.1%	0%	182	
—	665	Regeneration avoidance frequency gain	0 to 200%	0.1%	100%	262	
—	779	Operation frequency during communication error	0 to 400Hz, 9999	0.01Hz	9999	222	
—	791	Acceleration time in low-speed range	0 to 3600s, 9999	0.1s	9999	113	
—	792	Deceleration time in low-speed range	0 to 3600s, 9999	0.1s	9999	113	
—	799	Pulse increment setting for output power	0.1kWh, 1kWh, 10kWh, 100kWh, 1000kWh	0.1kWh	1kWh	149	
—	800	Control method selection	9, 30	1	30	88	
Adjustment function	820	Speed control P gain 1	0 to 1000%	1%	25%	90	
	821	Speed control integral time 1	0 to 20s	0.001s	0.333s	90	
—	870	Speed detection hysteresis	0 to 5Hz	0.01Hz	0Hz	144	
Protective functions	872	Input phase loss protection selection	0, 1	1	0	172	
Regeneration avoidance function	882	Regeneration avoidance operation selection	0 to 2	1	0	262	
	883	Regeneration avoidance operation level	300 to 800V	0.1V	400/780V *6	262	
	885	Regeneration avoidance compensation frequency limit value	0 to 30Hz, 9999	0.01Hz	6Hz	262	
	886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	262	
Free parameter	888	Free parameter 1	0 to 9999	1	9999	271	
	889	Free parameter 2	0 to 9999	1	9999	271	
Energy saving monitor	891	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	152	
	892	Load factor	30 to 150%	0.1%	100%	175	
	893	Energy saving monitor reference (motor capacity)	0.4 to 15kW	0.01kW	Rated inverter capacity	175	
	894	Control selection during commercial power-supply operation	0 to 3	1	0	175	
	895	Power saving rate reference value	0, 1, 9999	1	9999	175	
	896	Power unit cost	0 to 500, 9999	0.01	9999	175	
	897	Power saving monitor average time	0, 1 to 1000h, 9999	1h	9999	175	
	898	Power saving cumulative monitor clear	0, 1, 10, 9999	1	9999	175	
	899	Operation time rate (estimated value)	0 to 100%, 9999	0.1%	9999	175	

Parameter	Remarks	Instruction Code			Control Mode-based Correspondence Table			Parameter		
		Read	Write	Extended	V/F	GP MFVC	IPM	Copy	Clear	All clear
555		37	B7	5	○	○	○	○	○	○
556		38	B8	5	○	○	○	○	○	○
557		39	B9	5	○	○	○	○	○	○
561		3D	BD	5	○	○	○	○	×	○
563		3F	BF	5	○	○	○	×	×	×
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	○	○	○	○	○	○
779		4F	CF	7	○	○	○	○	○	○
791		5B	DB	7	×	×	○	○	○	○
792		5C	DC	7	×	×	○	○	○	○
799		63	E3	7	○	○	○	○	○	○
800		00	80	8	×	×	○	○	○	○
820		14	94	8	×	×	○	○	○	○
821		15	95	8	×	×	○	○	○	○
870		46	C6	8	○	○	○	○	○	○
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	○	○	○	○	○	○
892		5C	DC	8	○	○	○	○	○	○
893		5D	DD	8	○	○	○	○	○	○
894		5E	DE	8	○	○	○	○	○	○
895		5F	DF	8	○	○	○	○	○	○
896		60	E0	8	○	○	○	○	○	○
897		61	E1	8	○	○	○	○	○	○
898		62	E2	8	○	○	○	○	×	○
899		63	E3	8	○	○	○	○	○	○

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Calibration parameters	C0 (900) *8	FM terminal calibration	—	—	—	158	
	C2 (902) *8	Terminal 2 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	188	
	C3 (902) *8	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	188	
	125 (903) *8	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	188	
	C4 (903) *8	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	188	
	C5 (904) *8	Terminal 4 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	188	
	C6 (904) *8	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	188	
	126 (905) *8	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	60Hz	188	
	C7 (905) *8	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	188	
	C22 (922) *7*8	Frequency setting voltage bias frequency (built-in potentiometer)	0 to 400Hz	0.01Hz	0Hz	284	
	C23 (922) *7*8	Frequency setting voltage bias (built-in potentiometer)	0 to 300%	0.1%	0%	284	
	C24 (923) *7*8	Frequency setting voltage gain frequency (built-in potentiometer)	0 to 400Hz	0.01Hz	60Hz	284	
	C25 (923) *7*8	Frequency setting voltage gain (built-in potentiometer)	0 to 300%	0.1%	100%	284	
PID operation	C42 (934) *8	PID display bias coefficient	0 to 500, 9999	0.01	9999	250	
	C43 (934) *8	PID display bias analog value	0 to 300%	0.1%	20%	250	
	C44 (935)*8	PID display gain coefficient	0 to 500, 9999	0.01	9999	250	
	C45 (935)*8	PID display gain analog value	0 to 300%	0.1%	100%	250	
PU	990	PU buzzer control	0, 1	1	1	282	
	991	PU contrast adjustment	0 to 63	1	58	282	
—	997	Fault initiation	16 to 18, 32 to 34, 48, 49, 64, 81, 82, 96, 97, 112, 128, 129, 144, 145, 176 to 178, 192, 196, 197, 199, 201, 208, 230, 245, 9999	1	9999	272	
—	◎ 998	IPM parameter initialization	0, 1, 12, 101, 112	1	0	85	
—	◎ 999	Automatic parameter setting	10, 20, 21, 9999	1	9999	273	

Parameter	Remarks	Instruction Code			Control Mode-based Correspondence Table			Parameter		
		Read	Write	Extended	V/F	GP MFVC	IPM	Copy	Clear	All clear
C0 (900)		5C	DC	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 (922)		16	96	9	○	○	○	○	×	○
C23 (922)		16	96	9	○	○	○	○	×	○
C24 (923)		17	97	9	○	○	○	○	×	○
C25 (923)		17	97	9	○	○	○	○	×	○
C42 (934)		22	A2	9	○	○	○	○	×	○
C43 (934)		22	A2	9	○	○	○	○	×	○
C44 (935)		23	A3	9	○	○	○	○	×	○
C45 (935)		23	A3	9	○	○	○	○	×	○
990		5A	DA	9	○	○	○	○	○	○
991		5B	DB	9	○	○	○	○	×	○
997	Ver.UP	61	E1	9	○	○	○	×	×	×
◎ 998	Ver.UP	62	E2	9	○	○	○	○	○	○
◎ 999		63	E3	9	○	○	○	×	×	×

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Clear parameters	Pr.CL	Parameter clear	0, 1	1	0	*290*	
	ALLC	All parameter clear	0, 1	1	0	*290*	
	Er.CL	Faults history clear	0, 1	1	0	*292*	
—	Pr.CH	Initial value change list	—	—	—	*291*	
—	◎ IPM	IPM parameter initialization	0, 1, 12	1	0	*83*	
—	◎ AUTO	Automatic parameter setting	—	—	—	*273*	

*1 Differ according to capacities.
6%: 0.75K or lower
4%: 1.5K to 3.7K
3%: 5.5K, 7.5K
2%: 11K, 15K

*2 Differ according to capacities.
5s: 7.5K or lower
15s: 11K or higher

*3 Differ according to capacities.
10s: 7.5K or lower
30s: 11K or higher

*4 Differ according to capacities.
4%: 7.5K or lower
2%: 11K or higher

*5 Write is disabled in the communication mode (Network operation mode) from the PU connector.

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

*7 Set this parameter when calibrating the operation panel built-in potentiometer for the FR-E500 series operation panel (PA02) connected with cable.

*8 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).

*9 These parameters are communication parameters that are not cleared when parameter clear (all clear) is executed from RS-485 communication. (*Refer to page 218* for RS-485 communication)

*10 This parameter is valid as an inflection point when the S-pattern acceleration/deceleration A is selected (*Pr. 29* = "1").

Parameter	Remarks	Instruction Code			Control Mode-based Correspondence Table			Parameter		
		Read	Write	Extended	V/F	GP MFVC	IPM	Copy	Clear	All clear
Pr.CL		—	FC	—	—	—	—	—	—	—
ALLC		—	FC	—	—	—	—	—	—	—
Er.CL		—	F4	—	—	—	—	—	—	—
Pr.CH		—	—	—	—	—	—	—	—	—
◎ IPM	Ver.UP	—	—	—	—	—	—	—	—	—
◎ AUTO		—	—	—	—	—	—	—	—	—

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4.3 IPM motor control

Purpose	Parameter that must be Set		Refer to Page
To perform IPM parameter initialization	IPM parameter initialization	Pr.998	*85*
To perform IPM motor test	Control method selection	Pr.800	*88*
To adjust the gain for IPM motor control	Adjusting the speed control gain	Pr.820, Pr.821	*90*

Highly efficient motor control and highly accurate motor speed control can be performed by using the inverter with an IPM motor.
The motor speed is detected by the output voltage and current of the inverter. It does not require a speed detector such as an encoder. The inverter drives the IPM motor with the least required current when a load is applied in order to achieve the highest motor efficiency.

POINT

The following conditions must be met to perform IPM motor control.
- For the motor model, dedicated IPM motor (MM-EF model (1800r/min)) must be used.
- The motor capacity must be equivalent to the inverter capacity.
- Single-motor operation (one motor run by one inverter) must be performed.
- The overall wiring length with the motor must be 100m or less. (50m or less for FR-F740PJ-0.4K)

4.3.1 *Setting procedure of IPM motor control*

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

Perform IPM parameter initialization by selecting the parameter setting mode (IPM) on the operation panel.* *(Refer to page 84)*

↓ Set "1" or "12" in IPM (IPM parameter initialization) to select IPM motor control. *Refer to page 84* for the setting method.
Setting value "1": MM-EF
Setting value "12": MM-EFS

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

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

Set the operation command. *(Refer to page 123)*

↓ Select the start command and speed command.

Test run

* IPM parameter initialization is performed by setting *Pr. 998 IPM parameter initialization* or by selecting IPM (IPM parameter initialization) on the operation panel.
To change to the IPM motor control, perform IPM parameter initialization at first. If parameter initialization is performed after setting other parameters, some of those parameters will be initialized too. (*Refer to page 85* for the parameters that are initialized.)

REMARKS

- IPM motor control can also be selected with *Pr.80 Motor capacity* and *Pr.998 IPM parameter initialization*. *(Refer to page 85)*
- To check the control method (general-purpose motor control/IPM motor control), simply press the setting dial while the monitor screen is displayed. *(Refer to page 62)*

NOTE

- The selectable carrier frequencies under IPM motor control are 2.5kHz, 5kHz, 10kHz, and 12.5kHz.
- Constant-speed operation cannot be performed in the low-speed range of 150r/min(MM-EFS 1500r/min specification) or less. Generally, speed control can be performed in the range that satisfies the ratio, 1:10.
- During IPM motor control, the RUN signal is output about 100ms after turning ON the start command (STF, STR). The delay is due to the magnetic pole detection.
- The following operations and controls are disabled during IPM motor control: power failure stop, Optimum excitation control, and speed smoothing control.
- The optional surge voltage suppression filter (FR-ASF-H/FR-BMF-H) cannot be used under IPM motor control, so do not connect it.
- When parameter copy is performed from an FR-F700PJ series inverter, which is set to use MM-EFS under IPM motor control, check that IPM motor control is selected on the operation panel after the copy. *(Refer to page 62)*
- When parameters are copied to an FR-F700PJ series inverter, which is not compatible with MM-EFS, from an FR-F700PJ series inverter, which is set to use MM-EFS under IPM motor control, General-purpose magnetic flux vector control is selected instead of IPM motor control.

(1) IPM motor control setting by the operation panel (parameter setting mode)

POINT

- The parameters required to drive an IPM motor are automatically changed as a batch. *(Refer to page 85)*

Operation example	Initialize the parameter setting for a premium high-efficiency IPM motor (MM-EFS 1500r/min specification) in the parameter setting mode.

Operation	Display
1. Screen at power-ON The monitor display appears.	0.00 Hz MON EXT
2. Parameter setting mode Press (MODE) to choose the parameter setting mode.	(MODE) ⇨ P. 0 The parameter number read previously appears.
3. Selecting the parameter Turn the setting dial until IPM (IPM parameter initialization) appears.	⇨ IPM
4. Displaying the setting Press (SET) to read the currently set value. "0" (initial value) appears.	(SET) ⇨ 0
5. Selecting the setting Turn the setting dial to change it to the set value "12".	⇨ 12
6. Parameter setting Press (SET) to set.	(SET) ⇨ 12 ⟷ IPM Flicker ... Parameter setting complete!!

· Turn the setting dial to read another parameter.

· Press (SET) to show the setting again.

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

Setting	Description
0	Parameter settings for a general-purpose motor
1	Parameter settings for a high-efficiency IPM motor MM-EF (rotations per minute)
12 Ver.UP	Parameter settings for a premium high-efficiency IPM motor MM-EFS (rotations per minute)

Ver.UP ......Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

REMARKS

- Performing IPM parameter initialization in the parameter setting mode of the operation panel automatically changes the *Pr.998 IPM parameter initialization* setting.
- To check the control method (general-purpose motor control/IPM motor control), simply press the setting dial while the monitor screen is displayed. *(Refer to page 62)*
- The IPM parameter setting is displayed as "1, 12" in the parameter setting mode even if *Pr.998 IPM parameter initialization* = "101, 112."

(2) IPM motor control signal

The IPM motor control signal (IPM) is output during IPM motor control.
For the terminal to output the IPM motor control signal, assign the function by setting "57 (positive logic)" or "157 (negative logic)" to *Pr.190 or Pr.192 (Output terminal function selection)*.

Parameters referred to

Pr.60 Energy saving control selection Refer to page 174
Pr.72 PWM frequency selection Refer to page 181
Pr.190 or Pr.192 (Output terminal function selection) Refer to page 140
Pr. 261 Power failure stop selection Refer to page 168
Pr.653 Speed smoothing control Refer to page 182
Pr.800 Control method selection Refer to page 88

4.3.2 Initializing the parameters required to drive an IPM motor (Pr.998) IPM

- By performing IPM parameter initialization, IPM motor control is selected and the parameters, which are required to drive an IPM motor, are changed. Initial settings and setting ranges of the parameters are adjusted automatically to drive an IPM motor.
- Initialization is performed by setting *Pr.998 IPM parameter initialization* or by choosing the mode on the operation panel.

Parameter Number	Name	Initial value	Setting range	Description	
998 Ver.UP	**IPM parameter initialization**	0	0	Parameter settings for a general-purpose motor (frequency)	Initial parameter settings required to drive a general-purpose motor are set.
			1	Parameter settings for a high-efficiency IPM motor MM-EF (rotations per minute)	Initial parameter settings required to drive an IPM motor are set.
			12	Parameter settings for a premium high-efficiency IPM motor MM-EFS (rotations per minute)	
			101	Parameter settings for a high-efficiency IPM motor MM-EF (frequency)	
			112	Parameter settings for a premium high-efficiency IPM motor MM-EFS (frequency)	

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

(1) *IPM parameter initialization (Pr.998)*

- By performing IPM parameter initialization, initial settings required to drive an IPM motor can be set in parameters.
- When *Pr. 998* = "1, or 12" the monitor is displayed and the frequency is set using the motor rotations per minute. To use frequency to display or set, set *Pr. 998* = "101 or 112."
- Set *Pr. 998* = "0" to change the parameter settings from the settings required to drive an IPM motor to the settings required to drive a general-purpose motor.

Pr.998 Setting	Description	Operation in the parameter setting mode of the operation panel
0	Parameter settings for a general-purpose motor (frequency)	"IPM (IPM)" ⇒ Write "0"
1	Parameter settings for a high-efficiency IPM motor MM-EF (rotations per minute)	"IPM (IPM)" ⇒ Write "1"
12	Parameter settings for a premium high-efficiency IPM motor MM-EFS (rotations per minute)	"IPM (IPM)" ⇒ Write "12"
101	Parameter settings for a high-efficiency IPM motor MM-EF (frequency)	Invalid
112	Parameter settings for a premium high-efficiency IPM motor MM-EFS (frequency)	Invalid

REMARKS

- Make sure to set *Pr.998* before setting other parameters. If the *Pr.998* setting is changed after setting other parameters, some of those parameters will be initialized too. (Refer to "(2) IPM parameter initialization list" for the parameters that are initialized.)
- To change back to the parameter settings required to drive a general-purpose motor, perform parameter clear or all parameter clear.
- If the setting of *Pr.998 IPM parameter initialization* is changed from "1, 12 (rotations per minute)" to "101, 112 (frequency)," or from "101, 112" to "1, 12," all the target parameters are initialized.
  The purpose of *Pr.998* is not to change the display units. Use *Pr.144 Speed setting switchover* to change the display units between rotations per minute and frequency. *Pr.144* enables switching of display units between rotations per minute and frequency without initializing the parameter settings.
  Example) Changing the *Pr.144* setting between "6" and "106" switches the display units between frequency and rotations per minute.

(2) IPM parameter initialization list

By selecting IPM motor control from the parameter setting mode or with *Pr.998 IPM parameter initialization*, the parameter settings in the following table change to the settings required to drive an IPM motor. The changed settings differ according to the IPM motor specification (capacity). Refer to the IPM motor specification list shown below.
Performing parameter clear or all parameter clear sets back the parameter settings to the settings required to drive a general-purpose motor.

Pr.	Name	Setting: General-purpose motor	Setting: IPM motor (rotations per minute)	Setting: IPM motor (frequency)	Increment	
	Pr.998	0 (Initial setting)	1(MM-EF), 12(MM-EFS)	101(MM-EF), 112(MM-EFS)	1,12	0,101, 112
1	Maximum frequency	120Hz	Maximum motor rotations per minute	Maximum motor frequency	1r/min	0.01Hz
4	Multi-speed setting (high speed)	60Hz	Rated motor rotations per minute	Rated motor frequency	1r/min	0.01Hz
9	Electronic thermal O/L relay	Rated inverter current	Rated motor current		0.01A	
13	Starting frequency	0.5Hz	Minimum rotations per minute	Minimum frequency	1r/min	0.01Hz
15	Jog frequency	5Hz	Minimum rotations per minute	Minimum frequency	1r/min	0.01Hz
18	High speed maximum frequency	120Hz	Maximum motor rotations per minute	Maximum motor frequency	1r/min	0.01Hz
20	Acceleration/deceleration reference frequency	60Hz	Rated motor rotations per minute	Rated motor frequency	1r/min	0.01Hz
22	Stall prevention operation level	120%	120% (Short-time motor torque)		0.1%	
37	Speed display	0	0		1	
55	Frequency monitoring reference	60Hz	Rated motor rotations per minute	Rated motor frequency	1r/min	0.01Hz
56	Current monitoring reference	Rated inverter current	Rated motor current		0.01A	
71 Ver.UP	Applied motor	0	*Pr.998* = 1,101 : 120 *Pr.998* = 12,112 : 210		1	
80	Motor capacity	9999	Inverter capacity *		0.01kW	
125 (903)	Terminal 2 frequency setting gain frequency	60Hz	Rated motor rotations per minute	Rated motor frequency	1r/min	0.01Hz
126 (905)	Terminal 4 frequency setting gain frequency	60Hz	Rated motor rotations per minute	Rated motor frequency	1r/min	0.01Hz
144	Speed setting switchover	4	106 (Number of motor poles + 100)	6 (Number of motor poles)	1	
240	Soft-PWM operation selection	1	0		1	
260	PWM frequency automatic switchover	1	1		1	
374 Ver.UP	Overspeed detection level	9999	Maximum motor rotations per minute × 105%	Maximum motor frequency × 105%	1 r/min	0.01Hz
505	Speed setting reference	60Hz	Rated motor frequency		0.01Hz	

Pr.	Name	Setting			Increment	
		General-purpose motor	IPM motor (rotations per minute)	IPM motor (frequency)		
	Pr.998	0 (Initial setting)	1(MM-EF), 12(MM-EFS)	101(MM-EF), 112(MM-EFS)	1,12	0,101, 112
557	Current average value monitor signal output reference current	Rated inverter current	Rated motor current		0.01A	
870	Speed detection hysteresis	0Hz	10r/min (Speed detection hysteresis rotations per minute)	0.5Hz (Speed detection hysteresis frequency)	1r/min	0.01Hz
885	Regeneration avoidance compensation frequency limit value	6Hz	Minimum rotations per minute	Minimum frequency	1r/min	0.01Hz
893	Energy saving monitor reference (motor capacity)	Rated inverter capacity	Motor capacity *(Pr.80)*		0.01kW	
C24 (923)	Frequency setting voltage gain frequency (built-in potentiometer)	60Hz	Rated motor rotations per minute	Rated motor frequency	1r/min	0.01Hz

* When *Pr.80 Motor capacity* ≠ "9999," the *Pr.80 Motor capacity* setting is not changed by IPM parameter initialization. IPM parameter initialization is performed by setting *Pr.998 IPM parameter initialization* or the parameter setting mode on the operation panel.

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

REMARKS

- When initialization of the IPM driving parameters is performed using rotations per minute (*Pr. 998* = "1 or 12"), increments of the other parameters, which are not listed in the above table, also change to rotations per minute. In addition, the increments of monitor displays change from frequency to rotations per minute for all monitored items.
- The *Pr. 998* setting automatically changes the *Pr. 71* setting but does not change *Pr. 0 Torque boost* and *Pr. 12 DC injection brake operation voltage* settings. (*Refer to page 123*)

[IPM motor specification list]

	MM-EF	MM-EFS
Rated motor frequency (rotations per minute)	90Hz (1800r/min)	75Hz (1500r/min)
Maximum motor frequency (rotations per minute)	135Hz (2700r/min)	112.5Hz (2250r/min)
Minimum frequency (rotations per minute)	9Hz (180r/min)	7.5Hz (150r/min)

(3) IPM motor control dedicated parameter

The following parameters are activated only under IPM motor control.
See the reference pages for details.

Parameter number	Name	Description	Refer to Page
791	Acceleration time in low-speed range	Acceleration time in the low-speed range ("rated motor frequency/10" or lower) is set.	*113*
792	Deceleration time in low-speed range	Deceleration time in the low-speed range ("rated motor frequency/10" or lower) is set.	*113*
800	Control method selection	IPM motor test operation is selected.	*88*
820	Speed control P gain 1	The proportional gain during speed control is set. (Setting this parameter higher improves the trackability for speed command changes. It also reduces the speed fluctuation due to a load fluctuation.)	*90*
821	Speed control integral time 1	The integral time during speed control is set. (Setting this parameter shortens the return time to the original speed when the speed fluctuates due to a load fluctuation.)	*90*

Parameters referred to

Pr. 0 Torque boost *Refer to page 92*
Pr. 12 DC injection brake operation voltage *Refer to page 129*

4.3.3 IPM motor test operation (Pr.800) IPM

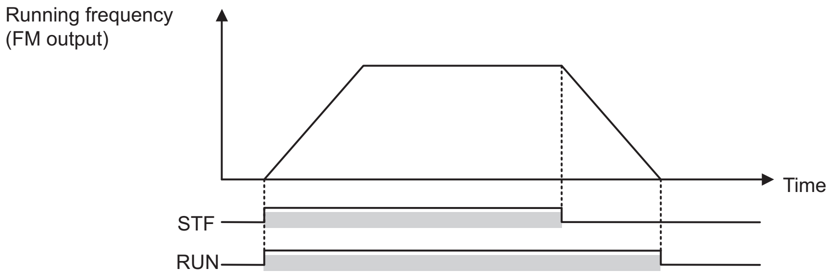
- Without connecting an IPM motor, the frequency movement can be checked by the monitor or analog signal output.
- Two types of operation can be selected using this parameter: an actual operation by connecting an IPM motor, or a test operation without connecting an IPM motor to simulate a virtual operation.

Parameter Number	Name	Initial value	Setting range	Operation
800	**Control method selection**	30	9	IPM motor test operation (Motor is not driven even if it is connected.)
			30	Normal operation (Motor can be driven.)

The above parameters can be set when *Pr.160 User group read selection* = "0." *(Refer to page 197)*

(1) Test operation

- To activate the IPM motor test operation, set *Pr.998 IPM parameter initialization*, change the control to IPM motor control, then set *Pr.800 Control method selection* = "9."
  Perform a test operation by giving a frequency and a start command under each of PU/External/Network operation mode.



REMARKS

- In the test operation, current is not detected and voltage is not output. Related monitor displays of the output current and voltage show "0."

(2) Valid/invalid statuses of I/O terminal functions during the test operation

1)*Input terminal function selection (Pr.178 to Pr.182)*

All assignable functions are valid.

2)*Output terminal function selection (Pr. 190 and Pr. 192)*

Some functions have restrictions. For details, refer to the table below.

○: Valid, ×: invalid

Signal name	Function	
RUN	Inverter running	○
SU	Up to frequency	○
OL	Overload alarm	×
FU	Output frequency detection	○
RBP	Regenerative brake pre-alarm	○
THP	Electronic thermal O/L relay pre-alarm	×
RY	Inverter operation ready	○
Y12	Output current detection	○
Y13	Zero current detection	○
FDN	PID lower limit	○
FUP	PID upper limit	○
RL	PID forward/reverse rotation output	○
FAN	Fan fault output	○
FIN	Heatsink overheat pre-alarm	○
PID	During PID control activated	○
Y48	PID deviation limit	○
IPM	IPM motor control	○
Y64	During retry	○
SLEEP	PID output interruption	○
Y79	Pulse train output of output power	×
Y90	Life alarm	○
Y91	Fault output 3 (power-off signal)	○
Y92	Energy saving average value updated timing	○
Y93	Current average value monitor signal	○
Y95	Maintenance timer signal	○
REM	Remote output	○
LF	Alarm output	○
ALM	Fault output	○
9999	No function	—

(3) Valid/invalid statuses of monitor outputs during the test operation

○: Valid, ×: Invalid (always displays 0)

△: Displays accumulated value before the test, —: Not monitored

Monitoring items	Operation panel/PU monitor display	FM output
Output frequency	○	○
Output current	×	×
Output voltage	×	×
Fault display	○	—
Frequency setting value	○	○
Converter output voltage	○	○
Regenerative brake duty	○	○
Electronic thermal relay load factor	× *2	× *2
Output current peak value	× *2	× *2
Converter output voltage peak value	○	○
Output power	×	×
Cumulative energization time	○	—
Reference voltage output	—	○
Actual operation time	○	—
Motor load factor	×	×
Cumulative power	△	—
Energy saving effect	×	×
Cumulative saving energy	△	—
PID set point	○	○
PID measured value	○	○
PID deviation	○	—
Input terminal status	—/○	—
Output terminal status	—/○	—
Inverter I/O terminal monitor	○/—	—
Motor thermal load factor	× *2	× *2
Inverter thermal load factor	× *2	× *2
PTC thermistor resistance	○	—

*1 Monitor output is valid or invalid depending on the monitor type (operation panel display, parameter unit display, or terminal FM). For details, *Refer to page 152*.

*2 When the operation is switched to the test operation, "0" is displayed. When IPM motor control is selected again after a test operation, the following monitored items from the last operation are displayed: output current peak value, motor thermal load factor, inverter thermal load factor, and the electronic thermal relay load factor.

Parameters referred to

Pr. 52 DU/PU main display data selection *Refer to page 152*

Pr. 190, Pr. 192 (Output terminal function selection) *Refer to page 140*

4 PARAMETERS

4.3.4 Adjusting the speed control gain (Pr.820, Pr.821) IPM

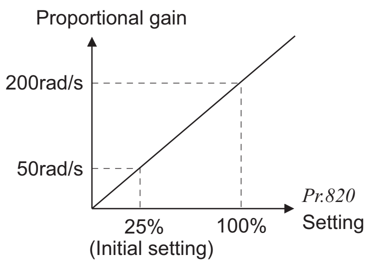
Manual adjustment of gain is useful to exhibit the optimum performance of the machine or to improve unfavorable conditions such as vibration and acoustic noise during the operation with high load inertia or gear backlashes.

Parameter Number	Name	Initial value	Setting range	Operation
820	**Speed control P gain 1**	25%	0 to 1000%	The proportional gain during speed control is set. (Setting this parameter higher improves the trackability for speed command changes. It also reduces the speed fluctuation due to a load fluctuation.)
821	**Speed control integral time 1**	0.333s	0 to 20s	The integral time during speed control is set. (Setting this parameter lower shortens the return time to the original speed when the speed fluctuates due to a load fluctuation.)

The above parameters can be set when *Pr.160 User group read selection* = "0." *(Refer to page 197)*

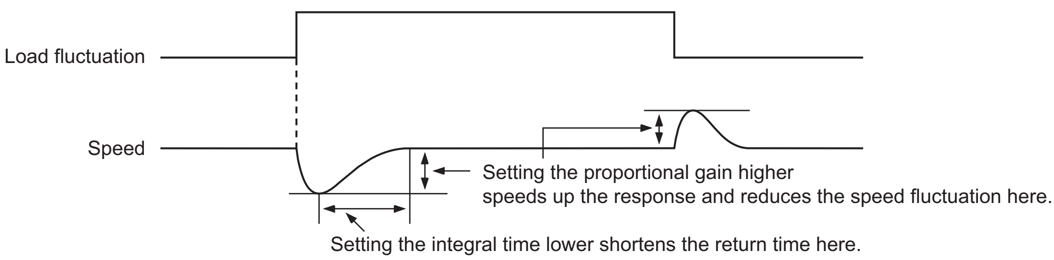
(1) Adjusting the speed control gain manually

- The speed control gain can be adjusted for the conditions such as abnormal machine vibration, acoustic noise, slow response, and overshoot.



- *Pr.820 Speed control P gain 1* = "25% (initial setting)" is equivalent to 50rad/s (speed response of a single motor). Setting this parameter higher speeds up the response, but setting this too high causes vibration and acoustic noise.
- Setting *Pr.821 Speed control integral time 1* lower shortens the return time to the original speed at a speed fluctuation, but setting it too low causes overshoot.

- Actual speed gain is calculated as below when load inertia is applied.



Actual speed gain = Speed gain of a single motor × $\frac{JM}{JM+JL}$

JM: Motor inertia
JL: Load inertia converted as the motor axis inertia

- Adjust in the following procedure:
  1) Change the *Pr.820* setting while checking the conditions.
  2) If it can not be adjusted well, change *Pr.821* setting, and perform 1) again.

No.	Movement · condition	Adjustment method	
1	Load inertia is too high.	Set *Pr.820 and Pr.821* higher.	
		Pr.820	If acceleration is slow, raise the setting by 10%s and set a value that satisfies the following condition: The setting immediately before vibration/noise starts occurring × 0.8 to 0.9
		Pr.821	If overshoots occur, raise the setting by double the setting and set a value that satisfies the following condition: The setting where overshoots stop occurring × 0.8 to 0.9
2	Vibration or acoustic noise are generated from machines.	Set *Pr.820* lower and *Pr.821* higher.	
		Pr.820	Lower the setting by 10%s and set a value that satisfies the following condition: The setting immediately before vibration/noise starts occurring × 0.8 to 0.9
		Pr.821	If overshoots occur, raise the setting by double the setting and set a value that satisfies the following condition: The setting where overshoots stop occurring × 0.8 to 0.9
3	Response is slow.	Set *Pr.820* higher.	
		Pr.820	If acceleration is slow, raise the setting by 5%s and set a value that satisfies the following condition: The setting immediately before vibration/noise starts occurring × 0.8 to 0.9
4	Return time (response time) is long.	Set *Pr.821* lower.	
		Lower *Pr.821* by half the current setting and set a value that satisfies the following condition: The setting immediately before overshoots or unstable movements stop occurring × 0.8 to 0.9	
5	Overshoots or unstable movements occur.	Set *Pr.821* higher.	
		Raise *Pr.821* by double the current setting and set a value that satisfies the following condition: The setting immediately before overshoots or unstable movements stop occurring × 0.8 to 0.9	

(2) Troubleshooting

	Condition	Possible cause	Countermeasure
1	Motor does not run at the correct speed. (Command speed and actual speed differ.)	(1) Speed command from the controller is different from the actual speed. The speed command is affected by noise. (2) The command speed and the speed recognized by the inverter are different.	(1) Check that the speed command sent from the controller is correct. Lower *Pr. 72 PWM frequency selection*. (2) Adjust bias and gain *(Pr.125, Pr.126, C2 to C7)* of the speed command again.
2	The speed does not accelerate to the command speed.	(1) Torque shortage Stall prevention operation is activated. (2) Only P (proportion) control is performed. (3) Speed control gain is too low.	(1) -1 Raise the stall prevention operation level. *(Refer to page 96.)* (1) -2 Capacity shortage (2) Speed deviation occurs under P (proportional) control when the load is heavy. Select PI control. (3) Set *Pr. 820* higher.
3	Motor speed fluctuates.	(1) Speed command varies. (2) Torque shortage (3) Speed control gain is not suitable for the machine. (Resonance occurs.)	(1) -1 Check that the speed command sent from the controller is correct. (Take EMC measures.) (1) -2 Lower *Pr.72 PWM frequency selection*. (2) Raise the stall prevention operation level. *(Refer to page 96.)* (3) Adjust *Pr. 820 and Pr. 821 (Refer to page 90.)*
4	Hunting (vibration or acoustic noise) occurs in the motor or the machine.	(1) Speed control gain is too high. (2) Motor wiring is incorrect.	(1) Set *Pr. 820* lower and *Pr. 821* higher. (2) Check the wiring.
5	Acceleration/deceleration time is different from the setting.	(1) Torque shortage (2) Load inertia is too high.	(1) Raise the stall prevention operation level. *(Refer to page 96.)* (2) Set acceleration/deceleration time suitable for the load.
6	Machine movement is unstable.	(1) Speed control gain is not suitable for the machine. (2) Response is slow because of the inverter's acceleration/ deceleration time setting.	(1) Adjust *Pr. 820 and Pr. 821 (Refer to page 90.)* (2) Set the optimum acceleration/deceleration time.
7	Rotation ripple occurs during the low-speed operation.	(1) High carrier frequency is affecting the motor rotation. (2) Speed control gain is too low.	(1) Lower *Pr. 72 PWM frequency selection*. (2) Raise *Pr. 820 Speed control P gain 1*.

4.4 Adjustment of 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	92
Automatically control output current according to load	General-purpose magnetic flux vector control	Pr. 71, Pr. 80	93
Compensate for motor slip to secure low-speed torque	Slip compensation	Pr. 245 to Pr. 247	95
Limit output current to prevent inverter trip	Stall prevention operation	Pr. 22, Pr. 23, Pr. 66, Pr. 154, Pr. 156, Pr. 157	96

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

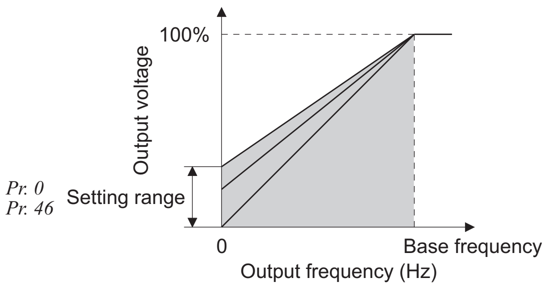
Motor torque reduction in the low-speed range can be improved by compensating a voltage drop in the low-frequency range.
●Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
●Two kinds of start torque boosts can be changed by switching between terminals.

Parameter Number	Name	Initial Value		Setting Range	Description
0	Torque boost	0.75K or lower	6%	0 to 30%	Set the output voltage at 0Hz as %.
		1.5K to 3.7K	4%		
		5.5K, 7.5K	3%		
		11K, 15K	2%		
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 197)*

(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 137)*

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 296*.)
- **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 5.5K, 7.5K, 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. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 3 Base frequency, Pr. 19 Base frequency voltage ☞ *Refer to page 103*
Pr. 71 Applied motor ☞ *Refer to page 123*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*

4.4.2 Acquiring large starting torque and low speed torque (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.

Parameter Number	Name	Initial Value	Setting Range	Description
71 Ver.UP	**Applied motor**	0	0, 1, 3, 13, 23, 40, 43 50, 53, 120, 210	By selecting a standard motor or constant-torque motor, thermal characteristic and motor constants of each motor are set.
80	**Motor capacity**	9999	0.4 to 15kW	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 197)*

Ver.UP ....Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

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.
- Motor to be used is any of Mitsubishi standard motor (SF-JR 0.4kW or higher), high efficiency motor (SF-HR 0.4kW or higher) or Mitsubishi constant-torque motor (SF-JRCA 4P, SF-HRCA 0.4kW to 15kW). 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. (Perform offline auto tuning in the state where wiring work is performed when the wiring length exceeds 30m.)
  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 the General-purpose magnetic flux control are available to drive general-purpose motors (three-phase induction motors) with this inverter.
  IPM motor control is available to drive an IPM motor. (*Refer to page 83*)
- 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.

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

Perform secure wiring.
(Refer to page 18)

↓

Display the extended function parameters.
(Pr. 160) (Refer to page 197)

↓ 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 Mitsubishi high efficiency motor	SF-JR	0 (initial value)	
	SF-HR	40	
	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 123* for other settings of *Pr. 71*.
∗2 *Refer to page 125* for offline auto tuning.

↓

Set the motor overheat protection.
(Pr. 9) (Refer to page 119)

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

Set the motor capacity.
(Pr. 80) (Refer to page 93)

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

Set the rated motor voltage and the rated motor frequency.
(Pr. 83, Pr. 84) (Refer to page 125)

↓

Set the operation command. *(Refer to page 200)*

↓ Select the start command and speed command.

Test run

As required

- Perform offline auto tuning. *(Pr. 96) (Refer to page 125)*
- Set motor excitation current. *(Pr. 82) (Refer to page 125)*
- Set slip compensation. *(Pr. 245, Pr. 246, Pr. 247) (Refer to page 95)*

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.**

4.4.3 Slip compensation (Pr. 245 to Pr. 247) V/F GP MFVC

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 197)*

- Slip compensation is enabled when the rated motor 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 101*
Pr. 3 Base frequency ☞ *Refer to page 103*

4.4.4 Stall prevention operation (Pr. 22, Pr. 23, Pr. 48, Pr. 66, Pr. 154, Pr. 156, Pr. 157)

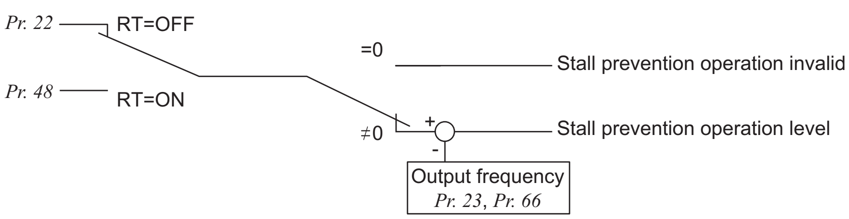
This function monitors the output current and automatically changes the output frequency to prevent the inverter from coming to trip due to overcurrent, overvoltage, etc.
It can also limit stall prevention and fast-response current limit operation during acceleration/deceleration, driving or regeneration.

- 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.

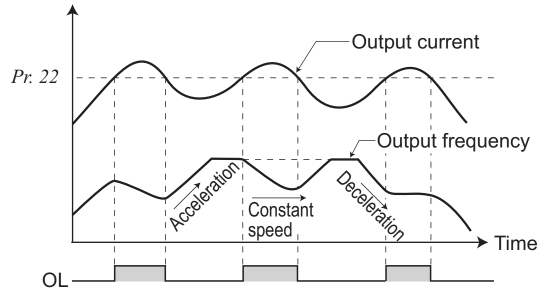
Parameter Number	Name	Initial Value	Setting Range	Description
22	**Stall prevention operation level**	120% *1	0	Stall prevention operation invalid
			0.1 to 150%	Set the current value to start the stall prevention operation.
23 V/F GP MFVC	**Stall prevention operation level compensation factor at double 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 150%	Second stall prevention operation level
			9999	Same level as *Pr. 22*.
66 V/F GP MFVC	**Stall prevention operation reduction starting frequency**	60Hz	0 to 400Hz	Set the frequency at which the stall operation level starts being reduced.
154 V/F GP MFVC Ver.UP	**Voltage reduction selection during stall prevention operation**	1	1	Does not suppress the overvoltage protective function
			11	Suppresses the overvoltage protective function
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 197*)
*1 Performing IPM parameter initialization changes the settings. (*Refer to page 85*)
Ver.UP .... Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

(1) Block diagram



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



Stall prevention operation example

- For *Pr. 22*, set the output current level where the stall prevention is activated. Set the output current level in ratio to the rated inverter current (rated IPM motor current under IPM motor control). Normally set 120% (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.

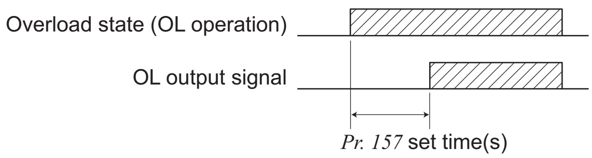
NOTE

- **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 the function 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 and Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

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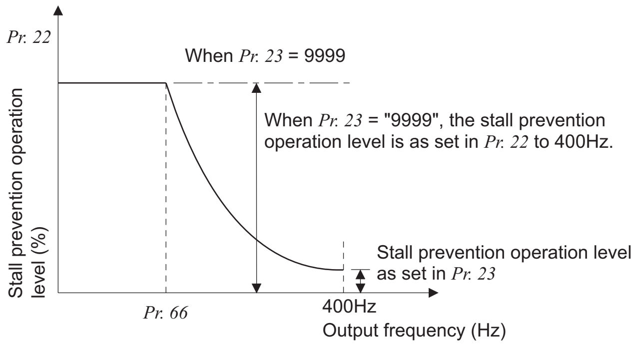
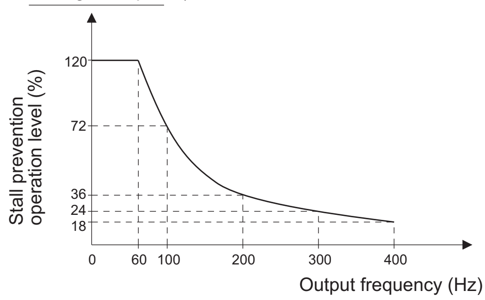
PARAMETERS

(4) Setting of stall prevention operation in high frequency range *(Pr. 22, Pr. 23, Pr. 66)* V/F GP MFVC





- 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

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

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

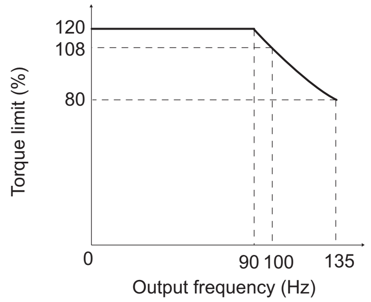
- By setting "9999" (initial value) in *Pr. 23 Stall prevention operation level compensation factor at double speed*, the stall prevention operation level is constant at the *Pr. 22* setting up to 400Hz.

(5) Torque limit in the high frequency range *(Pr. 22)* IPM

The following diagram shows the torque limit in the high frequency range (rated motor frequency or higher) under the IPM motor control.

- Calculation formula for the torque limit in the rated output range under the IPM motor control.

$$\text{Torque limit (\%)} = \frac{\text{Rated frequency (Hz)} \times Pr.\,22\ (\%)}{\text{Output frequency (Hz)}}$$



(6) 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. Set parameters after confirming the function of each terminal.**
- **The RT signal acts as the second function selection signal and makes the other second functions valid.**
  (Refer to page 137)

(7) To further prevent a trip *(Pr.154)*

- Set *Pr.154* = "11" when the overvoltage protective function (E.OV□) activates during stall prevention operation in an application with large load inertia. Note that turning OFF the start signal (STF/STR) or varying the frequency signal during stall prevention operation may delay the acceleration/deceleration start.

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

Pr. 156 Setting		Fast-Response Current Limit	Acceleration	Constant speed	Deceleration	OL Signal Output
100 *3	Power driving	○	○	○	○	○
	Regeneration	●	●	●	●	— *2
101 *3	Power driving	●	○	○	○	○
	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.
*4 OL signal is not output at fast-response current limit operation.
*5 The fast-response current limit operation is disabled under IPM motor control.

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.**

4

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⚠ 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 103*
- *Pr. 178 to Pr. 182 (input terminal function selection)* ☞ *Refer to page 134*
- *Pr. 190, Pr. 192 (output terminal function selection)* ☞ *Refer to page 140*

4.5 Limiting the output frequency

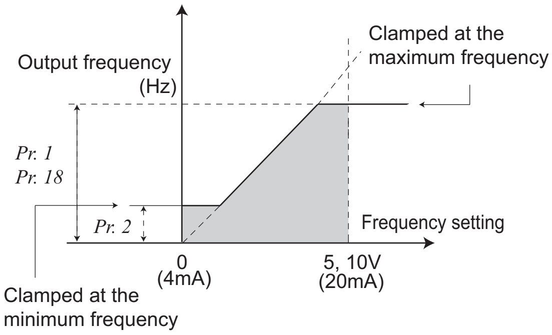
Purpose	Parameter that should be Set		Refer to Page
Set upper limit and lower limit of output frequency	**Maximum/minimum frequency**	**Pr. 1, Pr. 2, Pr. 18**	*101*
Perform operation by avoiding mechanical resonance points	**Frequency jump**	**Pr. 31 to Pr. 36, Pr. 552**	*102*

4.5.1 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 ∗2	0 to 120Hz	Upper limit of the output frequency.
2	**Minimum frequency**	0Hz	0 to 120Hz	Lower limit of the output frequency.
18 ∗1	**High speed maximum frequency**	120Hz ∗2	120 to 400Hz ∗3	Set when performing the operation at 120Hz or more.

∗1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 197)*
∗2 Performing IPM parameter initialization changes the settings. *(Refer to page 85)*
∗3 Even if a value higher than the maximum motor frequency *(Refer to page 86)* is set in *Pr. 18* under IPM motor control, the high speed maximum frequency is limited to the maximum motor frequency



(1) Set maximum frequency

- Use *Pr. 1 Maximum frequency* to set the maximum frequency. If the value of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.
- To operate with a frequency higher than 120Hz under V/F control or General-purpose magnetic flux vector control, set the upper limit for the output frequency in *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

- To operate with a frequency higher than 60Hz (rated IPM motor frequency under IPM motor control *(Refer to page 86)*) using frequency-setting analog signals, change the *Pr. 125 (Pr. 126)* (frequency setting gain) setting. Changing only *Pr.1* and *Pr.18* does not allow the operation with a frequency higher than 60Hz (rated IPM motor frequency under IPM motor control. *(Refer to page 86)*
- Under IPM motor control, the estimated output frequency (rotations per minute) is used to limit the frequency. Therefore, a value equal to or higher than the upper limit frequency may be displayed in the monitor.

(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.
- Under IPM motor control, the estimated output frequency (rotations per minute) is used to limit the frequency. Therefore, the value displayed in the monitor may reach the lower limit frequency or lower.

⚠ 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 116*
Pr. 15 Jog frequency ☞ *Refer to page 108*
Pr. 125 Terminal 2 frequency setting gain frequency, Pr. 126 Terminal 4 frequency setting gain frequency ☞ *Refer to page 188*

4.5.2 Avoiding mechanical resonance points (frequency jumps) (Pr. 31 to Pr. 36, Pr. 552)

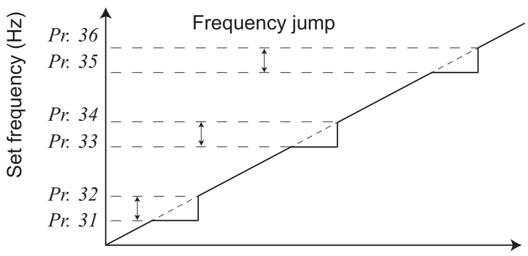
When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped.

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 (3-point jump) 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	
552 Ver.UP	**Frequency jump range**	9999	0 to 30Hz, 9999	Jump range for the frequency jump (6-point jump). 9999: 3-point jump

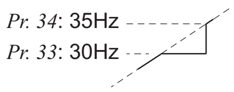
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

Ver.UP .... Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

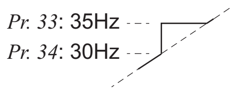
(1) Frequency jump (3-point jump) *(Pr.31 to Pr.36)*



- 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.

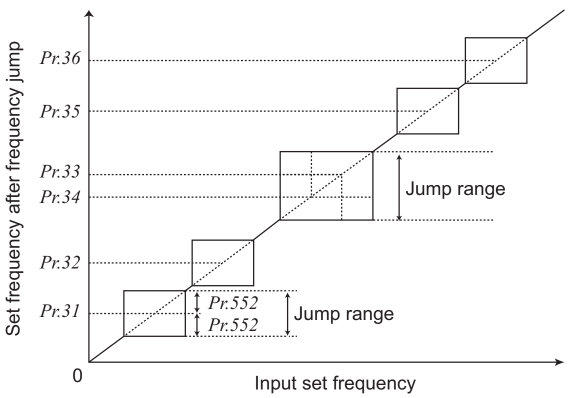


Example 1 To fix the frequency to 30Hz in the range of 30Hz to 35Hz, set 35Hz in *Pr. 34* and 30Hz in *Pr. 33*.



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*.

(2) Frequency jump (6-point jump) *(Pr.552)*



- The total of six jump areas can be set by setting the common jump range for the frequencies set in *Pr.31* to *Pr.36*.
- When frequency jump ranges overlap, the lower limit of the lower jump range and the upper limit of the upper jump range are used.
- When a frequency is set to a point within a jump range, the set frequency is lowered or increased to the jump range limits, according to the following frequency input condition.

Frequency input condition	Set frequency after frequency jump
When accelerating	The setting frequency is decreased to the lower limit of the jump range.
When decelerating	The setting frequency is increased to the upper limit of the jump range.

REMARKS

- During acceleration/deceleration, the running frequency within the set area is valid.
- If the setting ranges of individual groups (1A and 1B, 2A and 2B, 3A and 3B) overlap, Er1 (write disable error) will occur.
- Setting *Pr.552* = "0" disables frequency jumps.

4.6 V/F pattern

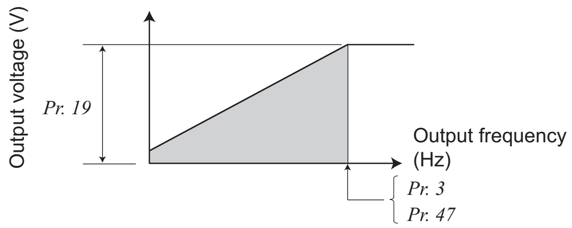
Purpose	Parameter that should be Set		Refer to Page
Set motor ratings	**Base frequency, Base frequency voltage**	**Pr. 3, Pr. 19, Pr. 47**	*103*
Select a V/F pattern according to applications.	**Load pattern selection**	**Pr. 14**	*105*

4.6.1 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 197)*



(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 137)*

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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

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

Parameters referred to

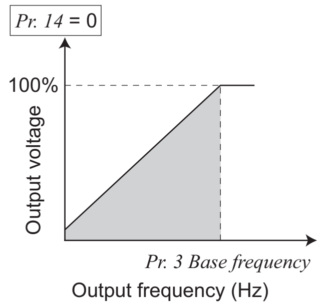
Pr. 14 Load pattern selection ☞ *Refer to page 105*
Pr. 29 Acceleration/deceleration pattern selection ☞ *Refer to page 118*
Pr. 83 Rated motor voltage, Pr. 84 Rated motor frequency ☞ *Refer to page 125*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*
General-purpose magnetic flux vector control ☞ *Refer to page 93*

4.6.2 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**	1	0	For constant-torque load
			1	For variable-torque load

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

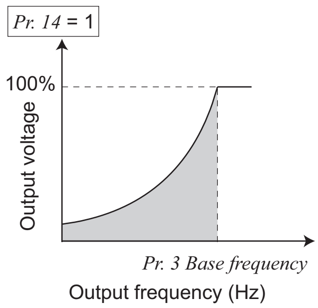


(1) Constant-torque load application (setting "0")

- 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", initial value)

- 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.

REMARKS

- When the RT signal is ON, the other second functions are also valid.

NOTE

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

Parameters referred to

Pr. 3 Base frequency *Refer to page 103*
Pr. 178 to Pr. 182 (input terminal function selection) *Refer to page 134*

4.7 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	*106*
Perform Jog operation	Jog operation	Pr. 15, Pr. 16	*108*
Infinitely variable speed setting by terminals	Remote setting function	Pr. 59	*110*

4.7.1 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 ∗2	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 ∗1	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. 9999: not selected
25 ∗1	Multi-speed setting (speed 5)	9999	0 to 400Hz, 9999	
26 ∗1	Multi-speed setting (speed 6)	9999	0 to 400Hz, 9999	
27 ∗1	Multi-speed setting (speed 7)	9999	0 to 400Hz, 9999	
232 ∗1	Multi-speed setting (speed 8)	9999	0 to 400Hz, 9999	
233 ∗1	Multi-speed setting (speed 9)	9999	0 to 400Hz, 9999	
234 ∗1	Multi-speed setting (speed 10)	9999	0 to 400Hz, 9999	
235 ∗1	Multi-speed setting (speed 11)	9999	0 to 400Hz, 9999	
236 ∗1	Multi-speed setting (speed 12)	9999	0 to 400Hz, 9999	
237 ∗1	Multi-speed setting (speed 13)	9999	0 to 400Hz, 9999	
238 ∗1	Multi-speed setting (speed 14)	9999	0 to 400Hz, 9999	
239 ∗1	Multi-speed setting (speed 15)	9999	0 to 400Hz, 9999	

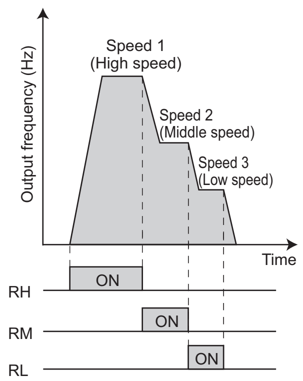
The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

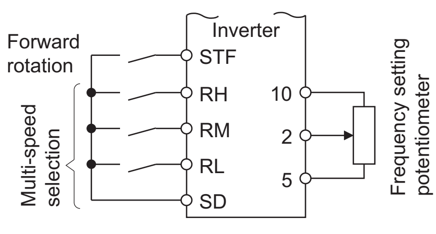
∗1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

∗2 Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

(1) Multi-speed setting for 3 speeds *(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.
- For the RL signal, set "0" in any of *Pr.178 to Pr.182 (input terminal function selection)* to assign the function to a terminal.





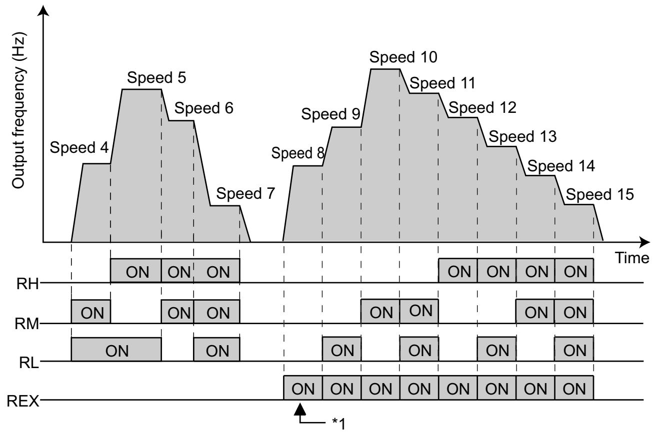
Multi-Speed Operation Connection Example

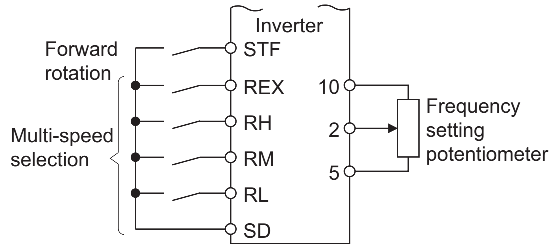
REMARKS

- 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 and RM signals are assigned to the terminals RH and RM in the initial setting. By setting "1 (RM)" or "2 (RH)" in any of *Pr. 178 to Pr. 182 (input terminal function selection)*, you can assign the signals to other terminals.

(2) Multi-speed setting for 4 or more speeds *(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 RL and REX signals, set "0 (RL)" and "8 (REX)" in any of *Pr.178 to Pr.182 (input terminal function selection)* to assign the functions to terminals.





Multi-speed operation connection example

*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.

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 188* 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. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 15 Jog frequency ☞ *Refer to page 108*
Pr. 59 Remote function selection ☞ *Refer to page 110*
Pr. 79 Operation mode selection ☞ *Refer to page 200*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*

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4.7.2 Jog operation (Pr. 15, Pr. 16)

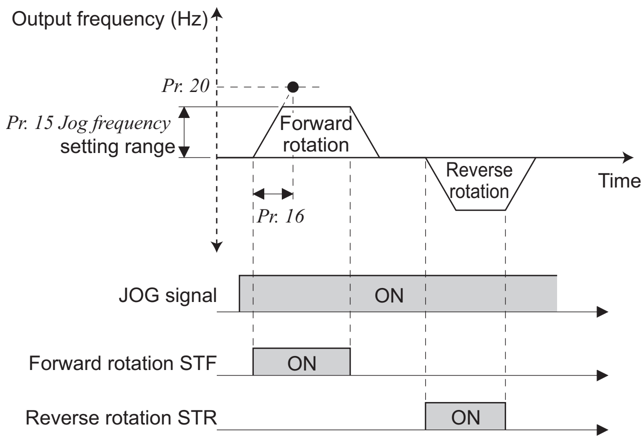
The frequency and acceleration/deceleration time for Jog operation can be set. Jog operation can be performed in either of the external and the PU operation mode.
This operation can be used for conveyor positioning, test operation, etc.

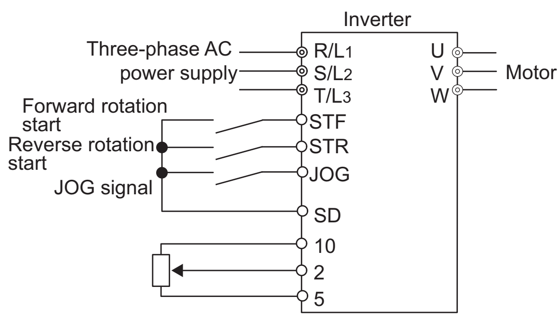
Parameter Number	Name	Initial Value	Setting Range	Description
15	**Jog frequency**	5Hz *	0 to 400Hz	Frequency for Jog operation.
16	**Jog acceleration/ deceleration time**	0.5s	0 to 3600s	Acceleration/deceleration time for Jog operation. Acceleration/ deceleration time is the time taken to reach the 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 197)*
* Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

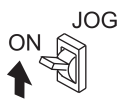
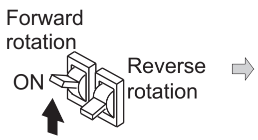
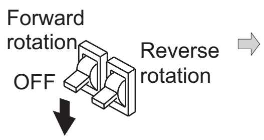
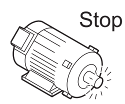
(1) Jog operation from outside

- 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

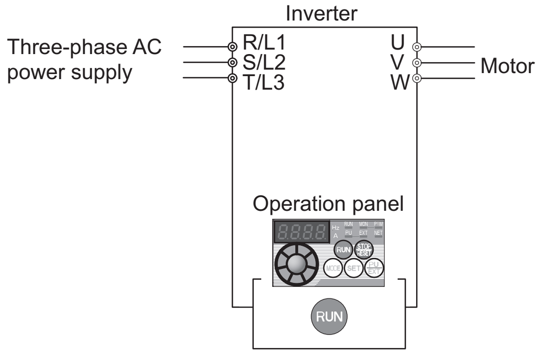
Operation	Display
1. Screen at power-ON ● Confirm that the External operation mode is selected. ([EXT] lit) If not displayed, press (PU/EXT) to change to the External (EXT) operation mode. If the operation mode still does not change, set *Pr. 79* to change to the External operation mode.	
2. Turn ON 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*)	  Rotates while ON
4. Turn the start switch (STF or STR) OFF.	  Stop

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.

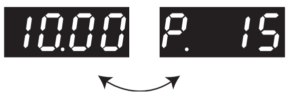
(2) Jog operation from PU

•Select 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 operation status indicator and operation mode indicator ● The monitor mode should have been selected. ● The inverter should be at a stop.		
2. Press (PU/EXT) to choose the PU Jog operation mode.	(PU/EXT)	
3. Press (RUN) . ● While (RUN) is pressed, the motor rotates. ● 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]

Operation		Display
5. Press (MODE) to choose the parameter setting mode.	(MODE)	PRM indicator 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.
The motor rotates at 10Hz.

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NOTE

- **The** ***Pr. 15*** **setting should be equal to or higher than the** ***Pr. 13 Starting frequency.***
- **Changing the terminal assignment using** ***Pr.178 to Pr.182 (input terminal function selection)*** **may affect other functions. Set parameters 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 137)*****)**
- **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

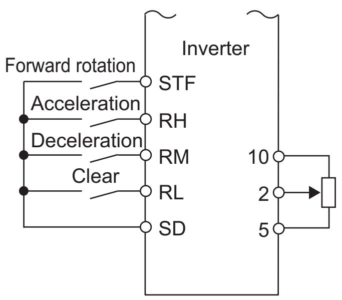
- *Pr. 13 Starting frequency* *Refer to page 116*
- *Pr. 20 Acceleration/deceleration reference frequency, Pr. 21 Acceleration/deceleration time increments* *Refer to page 113*
- *Pr. 79 Operation mode selection* *Refer to page 200*
- *Pr. 178 to Pr. 182 (input terminal function selection)* *Refer to page 134*

4.7.3 Remote setting function (Pr. 59)

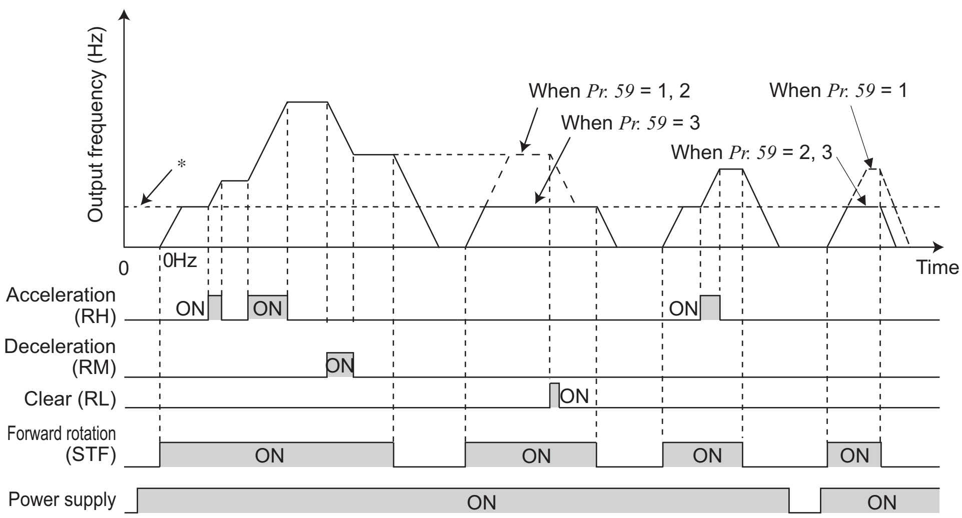
- Even if the operation panel is located away from the enclosure, you can use contact signals to perform continuous variable-speed operation, without using analog signals.
- By merely setting this parameter, you can use the acceleration, deceleration and setting clear functions of the remote speed setter (FR-FK).

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

(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
  For the RL signal, set "0" in any of *Pr.178 to Pr.182 (Input terminal function selection)* to assign the function to a terminal.

(2) Frequency setting storage

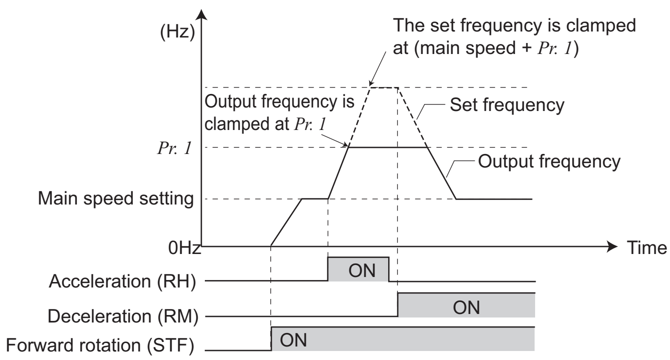
- The frequency setting storage function stores the remotely-set frequency (frequency set by RH/RM operation) into the memory (EEPROM). When power is switched OFF once, then ON, operation is resumed with that output frequency value. (*Pr. 59* = 1)

<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 RL 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.**
- **Changing the terminal assignment using *Pr.178 to Pr.182 (input terminal function selection)* may affect other functions. Set parameters after confirming the function of each terminal.**
- **Also available for the Network operation mode.**

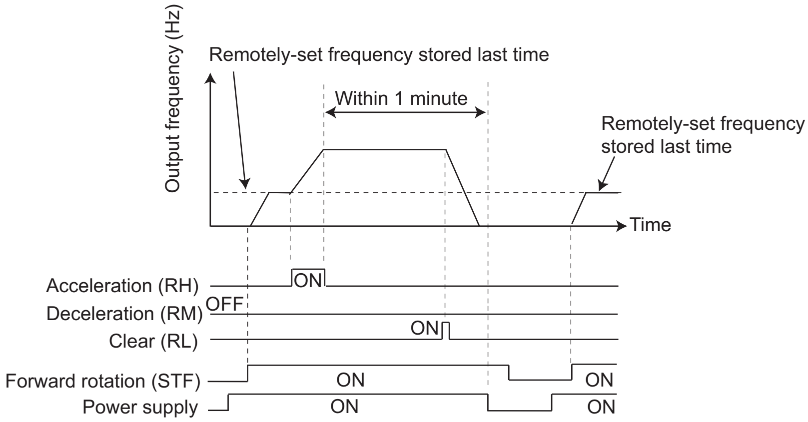
4
PARAMETERS

REMARKS

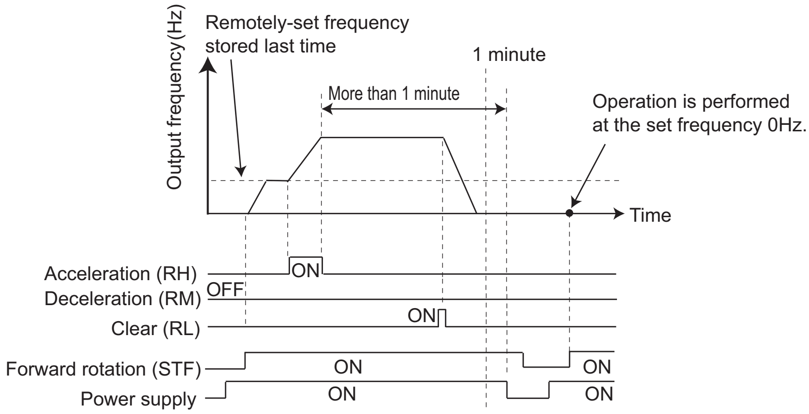
The RH and RM signals are assigned to the terminals RH and RM in the initial setting. By setting "1 (RM)" or "2 (RH)" in any of *Pr. 178 to Pr. 182 (input terminal function selection)*, you can assign the signals to other terminals.
During Jog operation or PID control operation, the remote setting function 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 101*
Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 44 Second acceleration/deceleration time, Pr. 45 Second deceleration time ☞ *Refer to page 113*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*

4.8 Setting of acceleration/deceleration time and acceleration/ deceleration pattern

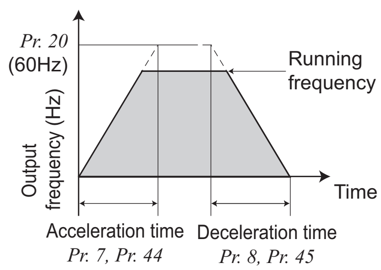
Purpose	Parameter that should be Set		Refer to Page
Motor acceleration/deceleration time setting	**Acceleration/deceleration times**	**Pr. 7, Pr. 8, Pr. 20, Pr. 44, Pr. 45, Pr. 791, Pr. 792**	*113*
Starting frequency	**Starting frequency and start-time hold**	**Pr. 13, Pr. 571**	*116*
Minimum motor speed frequency	**Starting frequency**	**Pr. 13**	*117*
Set acceleration/deceleration pattern suitable for application	**Acceleration/deceleration pattern**	**Pr. 29**	*118*

4.8.1 *Setting of the acceleration and deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 44, Pr. 45, Pr. 791, Pr. 792)*

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 161).*

Parameter Number	Name	Initial Value		Setting Range	Description
7	**Acceleration time**	7.5K or lower	5s	0 to 3600s	Motor acceleration time.
		11K or higher	15s		
8	**Deceleration time**	7.5K or lower	10s	0 to 3600s	Motor deceleration time.
		11K or higher	30s		
20 *1	**Acceleration/ deceleration reference frequency**	60Hz *2		1 to 400Hz	Frequency that will be the basis of acceleration/deceleration time. As acceleration/deceleration time, set the frequency change time from stop to *Pr. 20*.
44 *1	**Second acceleration/ deceleration time**	7.5K or lower	5s	0 to 3600s	Acceleration/deceleration time when the RT signal is ON.
		11K or higher	15s		
45 *1	**Second deceleration time**	9999		0 to 3600s	Deceleration time when the RT signal is ON.
				9999	Acceleration time = deceleration time
791 IPM	**Acceleration time in low-speed range**	9999		0 to 3600s	Acceleration time in the low-speed range (slower than 10% of the rated motor frequency) is set.
				9999	The acceleration time set in *Pr.7* is applied. (When the second function is enabled, the setting is applied.)
792 IPM	**Deceleration time in low-speed range**	9999		0 to 3600s	Deceleration time in the low-speed range (slower than 10% of the rated motor frequency) is set.
				9999	The deceleration time set in *Pr.8* is applied. (When the second function is enabled, the setting is applied.)

*1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
*2 Performing IPM parameter initialization changes the settings. *(Refer to page 85)*



(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.

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

* The output starts at 0Hz under IPM motor control. Calculate with 0Hz.

Example) How to find the setting value for *Pr.7* when increasing the output frequency to the maximum frequency of 50Hz in 10s with *Pr.20*=60Hz (initial setting) and *Pr.13*=0.5Hz.

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

(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.

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

* DC injection brake is not applied until the frequency drops to 0Hz regardless of the *Pr.10* setting under IPM motor control. Under IPM motor control, calculate as *Pr.10* ="0."

Example) How to find the setting value for *Pr.8* when decreasing the output frequency from the maximum frequency of 50Hz in 10s with *Pr.20*=120Hz and *Pr.10*=3Hz.

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

(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 118)*****, the acceleration/deceleration time is the time required to reach** ***Pr. 3 Base frequency*****. When the S-pattern acceleration/deceleration A is set under IPM motor control, acceleration/deceleration time is the time to reach the rated motor frequency (*****Refer to page 86*****).**
- **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)

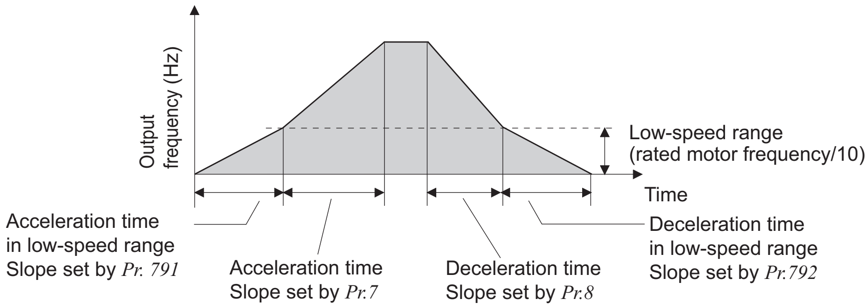
- **Guideline for acceleration/deceleration time at the** ***Pr. 3 Base frequency*** **of 60Hz (0Hz to set frequency)**

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. Set parameters after confirming the function of each terminal.**

(4) Setting the acceleration/deceleration time in the low-speed range *(Pr.791, Pr.792)* IPM

If torque is required in the low-speed range (rated motor frequency/10), set the *Pr.791 Acceleration time in low-speed range* and *Pr.792 Deceleration time in low-speed range* settings higher than the *Pr.7 Acceleration time* and *Pr.8 Deceleration time* (When the second function is enabled, the setting is applied.) settings so that the slow acceleration/deceleration is performed in the low-speed range.
(*Refer to page 85* for the rated motor frequency.)



REMARKS

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 137)*
- 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.
- Set *Pr.791* higher than *Pr.7*, and *Pr.792* higher than *Pr.8*. If set as *Pr.791* < *Pr.7*, the operation is performed as *Pr.791* = *Pr.7*. If set as *Pr.792* < *Pr.8*, the operation is performed as *Pr.792* = *Pr.8*.
- 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

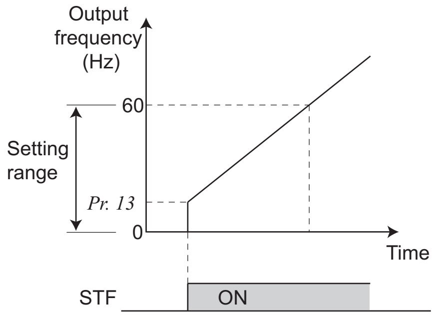
Pr. 3 Base frequency Refer to page 103
Pr. 10 DC injection brake operation frequency Refer to page 129
Pr. 29 Acceleration/deceleration pattern selection Refer to page 118
Pr. 125, Pr. 126 (frequency setting gain frequency) Refer to page 188
Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 134

4.8.2 Starting frequency and start-time hold function (Pr. 13, Pr. 571) V/F GP MFVC

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. Starting frequency at which the start signal is turned ON.
571 V/F GP MFVC	**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 197)*

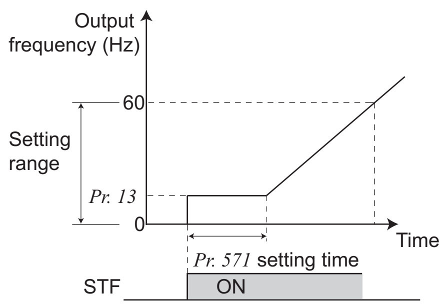


(1) Starting frequency setting *(Pr. 13)*

- 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 function 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

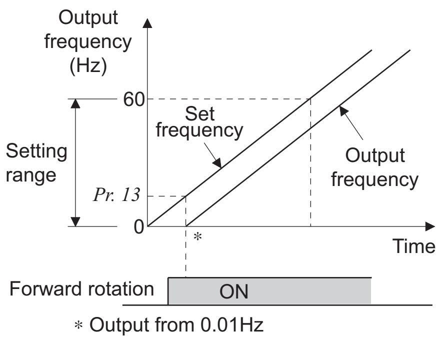
Pr. 2 Minimum frequency *Refer to page 101*

4.8.3 Minimum motor rotation frequency (Pr.13) IPM

Set the frequency where the motor starts running.
Set the deadband in the low-speed range to eliminate noise and offset deviation when setting a frequency with analog input.

Parameter Number	Name	Initial value	Setting range	Description
13	**Starting frequency**	Minimum frequency (180r/min) *	0 to 60Hz	The frequency where the motor starts running can be set in the range of 0 to 60Hz.

The above parameters can be set when *Pr.160 Extended function display selection* = "0." *(Refer to page 197)*
* The value after the IPM parameter initialization. *(Refer to page 85)*



· The frequency where the IPM motor starts running can be set in the range of 0 to 60Hz.
· While the frequency command is less than the *Pr. 13 Starting frequency* setting, the IPM motor is stopped.
When the frequency command reaches the set frequency or higher, the IPM motor accelerates according to the *Pr. 7 Acceleration time setting.*

REMARKS

- Under general-purpose motor control (under V/F control and Simple magnetic flux vector control), the inverter starts output at the frequency set in *Pr.13* at start, but in IPM motor control, the inverter always starts output from 0.01Hz.

NOTE

The inverter output does not start when the frequency-setting signal is less than *Pr.13*.
For example, while *Pr.13* = 20Hz, the inverter output starts when the frequency setting signal reaches 20Hz.

⚠ CAUTION

Note that when *Pr. 13* is set to any value 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

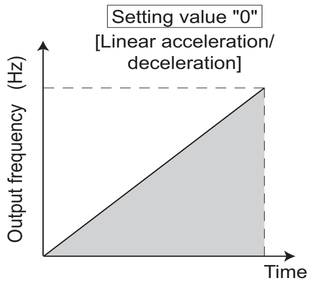
Pr. 2 Minimum frequency ☞ *Refer to page 101*
Pr.7 Acceleration time ☞ *Refer to page 113*
IPM motor control ☞ *Refer to page 83*

4.8.4 Acceleration/deceleration pattern (Pr. 29)

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

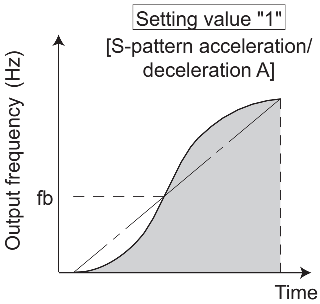
Parameter Number	Name	Initial Value	Setting Range	Description
29	**Acceleration/deceleration pattern selection**	0	0	Linear acceleration/ deceleration
			1	S-pattern acceleration/deceleration A
			2	S-pattern acceleration/deceleration B

The above parameters can be set when *Pr. 160 Extended function display selection* ="0". *(Refer to page 197)*



(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.



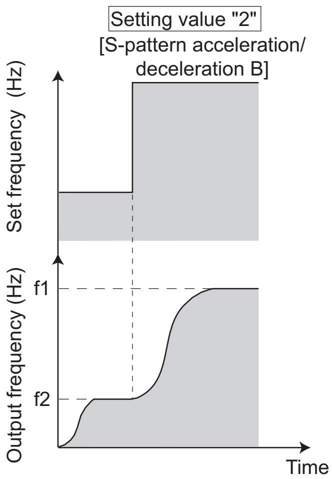
(2) S-pattern acceleration/deceleration A (*Pr. 29* = "1")

- 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.

∗ Rated motor frequency under IPM motor control *(Refer to page 86)*

NOTE

- **For the acceleration/deceleration time of the S-pattern acceleration/deceleration A, set the time to reach *Pr.3 Base frequency* (rated IPM motor frequency under IPM motor control *(Refer to page 86)*) but not the time to reach *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 103*
Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 20 Acceleration/deceleration reference frequency ☞ *Refer to page 113*

4.9 Selection and protection of a motor

Purpose	Parameter that should be Set		Refer to Page
Motor protection from overheat	**Electronic thermal O/L relay PTC thermistor protection**	**Pr. 9, Pr. 51, Pr. 561**	*119*
Use the constant-torque motor	**Applied motor**	**Pr. 71**	*123*
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**	*125*

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

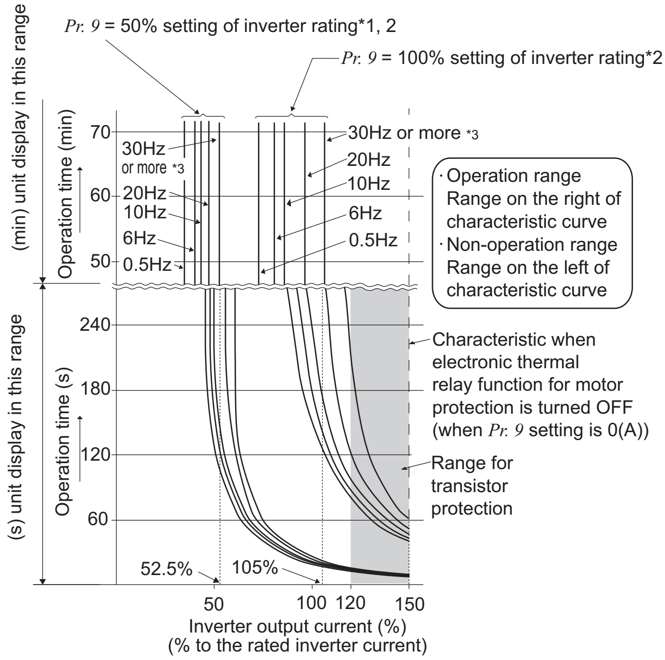
Set the current of the electronic thermal relay function to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

Parameter Number	Name	Initial Value	Setting Range	Description
9	**Electronic thermal O/L relay**	Rated inverter current *2	0 to 500A	Set the rated motor current.
51*1 V/F GP MFVC	**Second electronic thermal O/L relay** *3	9999	0 to 500A	Valid when the RT signal is ON. 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 197)*
*2 Performing IPM parameter initialization automatically sets the rated current of the IPM motor. *(Refer to page 85)*
*3 When parameter is read using the FR-PU04, a parameter name different from an actual parameter is displayed.

(1) Electronic thermal O/L relay operation under general-purpose motor control *(Pr. 9)* V/F GP MFVC

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 rated inverter output current (current value) is set to *Pr. 9*
*2 The % value denotes the percentage to the rated inverter output current. It is not the percentage to the rated motor 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. (*Refer to page 123* for the operation characteristic.)

NOTE

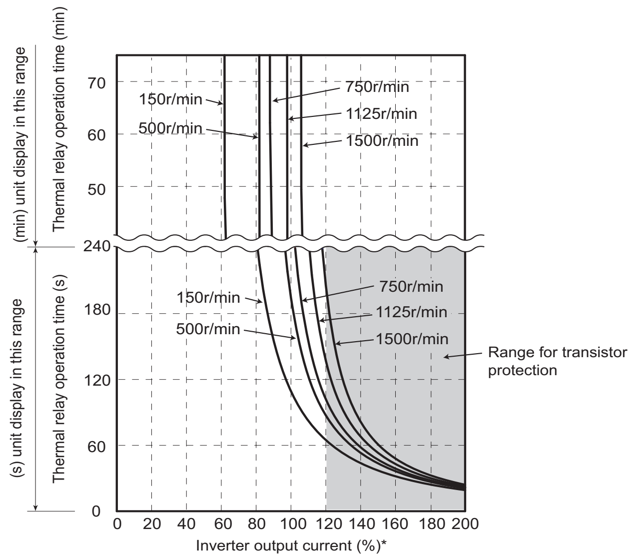
- **Internal accumulated heat value of the electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.**
- **When multiple motors are operated by a single inverter, protection cannot be provided by the electronic thermal function. 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.**

(2) Electronic thermal O/L relay operation under IPM motor control *(Pr.9)* IPM

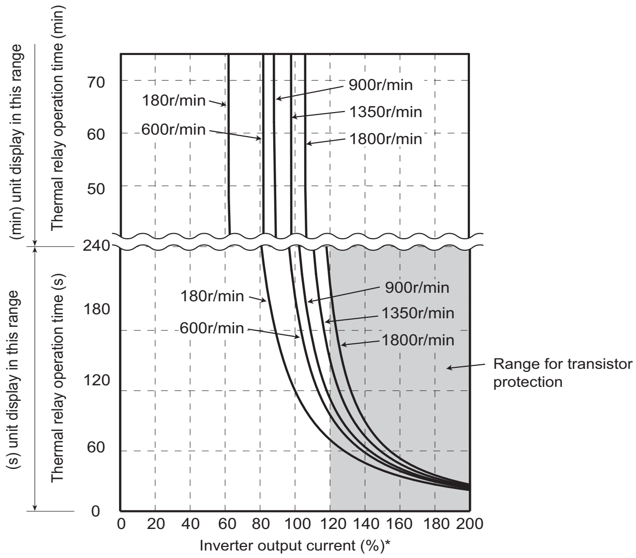
This function detects the overload (overheat) of the motor and trips the inverter by stopping the operation of the transistor at the inverter output side. (The operation characteristic is shown below.)

- Set the rated current (A) of the motor in *Pr.9*.
  Performing IPM parameter initialization automatically sets the rated current of the IPM motor. *(Refer to page 86)*
- Set "0" in *Pr.9* when you do not want to activate the electronic thermal relay function. An example for this case is when using an external thermal relay for the motor. (Note that the output transistor protection of the motor is activated. (E.THT))

•MM-EFS



•MM-EF



*The % value denotes the percentage to the rated motor current.

- Operation range: Range on the right of characteristic curve
- Non-operation range: Range on the left of characteristic curve

NOTE

- **Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-OFF.**

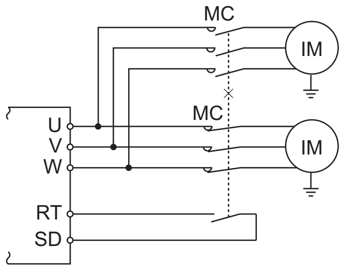
(3) Set two different electronic thermal O/L relays *(Pr. 51)* V/F GP MFVC

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	×	O
9999	Other than 0	9999	O	×	O	×
		0	O	×	Δ	×
		0.01 to 500	O	Δ	Δ	O
Other than 9999	0	9999	×	×	×	×
		0	×	×	×	×
		0.01 to 500	×	Δ	×	O
Other than 9999	Other than 0	9999	O	Δ	Δ	O
		0	O	×	Δ	×
		0.01 to 500	O	Δ	Δ	O

O... 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.

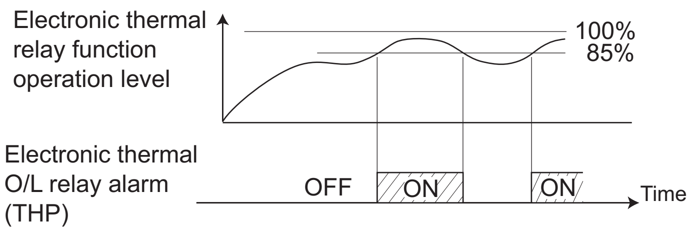


REMARKS

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 137)*

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

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

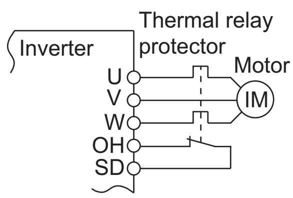


- The alarm signal (THP) is output and electronic thermal relay function prealarm (TH) is displayed when the electronic thermal O/L relay cumulative value reaches 85% of the level set in *Pr. 9 or Pr. 51*. If it reaches 100% of the *Pr. 9 Electronic thermal O/L relay* setting electronic-thermal relay 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 and Pr.192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(5) External thermal relay input (OH signal)



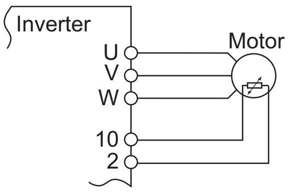
External thermal relay input connection example

- 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)* .

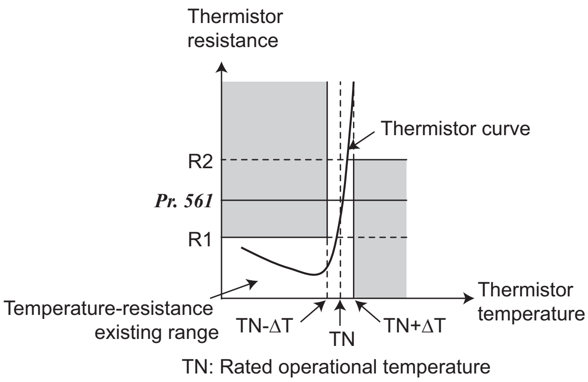
NOTE

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

(6) 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 152)*, or RS-485 communication *(Refer to page 218)* 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, terminal 2 is not available for analog frequency command when using terminal 2 for PID control. When PID 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 123*
Pr. 72 PWM frequency selection ☞ *Refer to page 181*
Pr. 79 Operation mode selection ☞ *Refer to page 200*
Pr. 128 PID action selection ☞ *Refer to page 250*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*

4.9.2 Applied motor (Pr. 71, Pr. 450)

Setting of the used motor selects the thermal characteristic appropriate for the motor.
Setting is required when using a constant-torque motor or IPM 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 Ver.UP	**Applied motor**	0∗	0, 1, 3, 13, 23, 40, 43, 50, 53, 120, 210	Selecting the standard motor, constant-torque motor, or IPM motor sets the corresponding motor thermal characteristic.
450 V/F GP MFVC	**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 197)*
∗ Performing IPM parameter initialization changes the settings. *(Refer to page 85)*
Ver.UP ....Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

(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		Used motor		Thermal Characteristic of the Electronic Thermal Relay Function		
Pr. 71	*Pr. 450*			Standard	Constant-torque	IPM
0 (*Pr. 71* initial value)		Standard motor (such as SF-JR)		○		
1		Mitsubishi constant-torque motor (such as SF-JRCA)			○	
40	—	Mitsubishi high-efficiency motor (SF-HR)		○		
50	—	Mitsubishi constant-torque motor (SF-HRCA)			○	
3	—	Standard motor	Select "offline auto tuning setting"	○		
13	—	Constant-torque motor			○	
23	—	Mitsubishi standard motor(SF-JR 4P 1.5kW or less)			○	
43	—	Mitsubishi high-efficiency motor (SF-HR)		○		
53	—	Mitsubishi constant-torque motor(SF-HRCA)			○	
120 ∗	—	High-efficiency IPM motor (MM-EF)				○
210 ∗	—	Premium high-efficiency IPM motor MM-EFS				○
—	9999 (initial value)	Without second applied motor				

∗ Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

REMARKS

- When performing offline auto tuning, set any of "3, 13, 23, 43, 53" in *Pr. 71*.
  (Refer to *page 125* for offline auto tuning.)
- For the 5.5K and 7.5K, 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. (These are not automatically changed by the *Pr.998 IPM parameter initialization* setting.)

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, 120, 210
∗2 *Pr. 71* setting: 1, 13, 50, 53

NOTE

- **Set the electronic thermal relay function to the thermal characteristic for the constant-torque motor when using a geared motor (GM-S, GM-D, GM-SY, GM-HY2 series) to perform General-purpose magnetic flux vector control.**

4 PARAMETERS

(2) To use two types of motors *(Pr. 450)* V/F GP MFVC

- 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.
- The setting is invalid under the IPM motor control.

REMARKS

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 137)*

NOTE

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

⚠ CAUTION

⚠ **Make sure to set this parameter correctly according to the motor used.**
Incorrect setting may cause the motor to overheat and burn.

Parameters referred to

Pr. 0 Torque boost ☞ *Refer to page 92*
Pr. 12 DC injection brake operation voltage ☞ *Refer to page 129*
Pr. 80 Motor capacity ☞ *Refer to page 125*
IPM motor control ☞ *Refer to page 83*

4.9.3 Exhibiting the best performance for the motor (offline auto tuning) (Pr. 71, Pr. 80, Pr. 82 to Pr. 84, Pr. 90, Pr. 96) GP MFVC

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 Ver.UP	**Applied motor**	0*		0, 1, 3, 13, 23, 40, 43, 50, 53, 120, 210	By selecting a standard motor or constant-torque motor, thermal characteristic and motor constants of each motor are set.
80	**Motor capacity**	9999		0.4 to 15kW	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	0 to 1000V	Rated motor voltage (V).
		400V class	400V		
84	**Rated motor frequency**	60Hz		10 to 120Hz	Rated motor frequency (Hz).
90	**Motor constant (R1)**	9999		0 to 50Ω, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 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 Offline auto tuning is performed without motor running. (motor constant (R1) only)
				21	Offline auto tuning for V/F control (automatic restart after instantaneous power failure (with frequency search)) *(Refer to page 163)*

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

* Performing IPM parameter initialization automatically sets the rated current of the IPM motor. *(Refer to page 85)*

Ver.UP ...Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

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 (SF-JR 0.4kW or higher), high efficiency motor (SF-HR 0.4kW or higher), and Mitsubishi constant-torque motor (SF-JRCA 4P, SF-HRCA 0.4kW to 15kW) are used or the wiring length is long (30m or more as a reference), 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.

(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.
- A general-purpose motor (three-phase induction 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.
- The maximum frequency is 120Hz.
- A high-slip motor, high-speed motor and special motor cannot be tuned. (Do not tune an IPM 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.
- 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 93*).
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 119*)
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 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

(3) Execution of tuning

POINT

Before tuning, check the monitor display of the operation panel or parameter unit (FR-PU04/FR-PU07) to confirm that the inverter is in the suitable condition for tuning. (Refer to 2) below.) Turning ON the start command in a tuning-disabled status starts the motor running.

1) To perform tuning for PU operation, press RUN on the operation panel or FWD or REV on 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.)

REMARKS

- Satisfy the required inverter start conditions to start offline auto tuning. For example, stop the input of MRS signal.
- To force tuning to end, use the MRS or RES signal or press STOP/RESET of the operation panel. (Turning the start signal (STF signal or STR signal) OFF also ends tuning.)
- During offline auto tuning, only the following I/O signals are valid: (initial value)
  - Input terminal <valid signal> STF, STR
  - Output terminal RUN, FM, A, B, C

  Note that the progress status of offline auto tuning is output in five steps from FM when speed and output frequency are selected.
- Do not perform ON/OFF switching of the second function selection signal (RT) during execution of offline auto tuning. Auto tuning is not executed properly.

NOTE

- **Since the RUN signal turns ON when tuning is started, caution is required especially when a sequence which releases a mechanical brake by the RUN signal has been designed.**
- **When executing offline auto tuning, input the run command after switching ON the main circuit power (R/L1, S/L2, T/L3) of the inverter.**
- **When *Pr.79* = "7," turn ON the X12 signal, and tune in the PU operation mode.**

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 11 - - - STOP PU	
(2)Tuning in progress	TUNE 12 STF FWD PU	
(3)Normal end	TUNE 13 COMPETION STF STOP PU	Flickering 
(4)Error end (when inverter protective function operation is activated)	TUNE 9 ERROR STF STOP PU	

REMARKS

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

4 PARAMETERS

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.)

REMARKS

- The motor constants measured once in the offline auto tuning are stored as parameters, and their data are held until the offline auto tuning is performed again.
- Changing *Pr. 96* setting ("3 or 13") after tuning completion will disable the tuning data. In such case, tune again.

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

Error Display	Error Cause	Remedy
8	Forced end	Set "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 A motor is not connected.	Check the motor wiring and make setting again. 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 properly. (The motor constants have not been set.)
Perform an inverter reset and restart tuning.
6) When using the motor corresponding to the following specifications and conditions, reset *Pr.9 Electronic thermal O/L relay* as below after tuning is completed.
   a) When the rated power specifications of the motor is 200/220V (400/440V) 60Hz, set 1.1 times rated motor current value in *Pr.9*.
   b) When performing motor protection from overheat using a PTC thermistor or motor with temperature detector such as Klixon, set "0" (motor overheat protection by the inverter is invalid) in *Pr. 9*.
7) When you know motor excitation current (no load current), set the value in *Pr. 82 Motor excitation current*.

NOTE

- **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 119*
Pr. 71 Applied motor ☞ *Refer to page 119*
Pr. 80 Motor capacity ☞ *Refer to page 93*
Pr. 156 Stall prevention operation selection ☞ *Refer to page 96*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*

4.10 Motor brake and stop operation

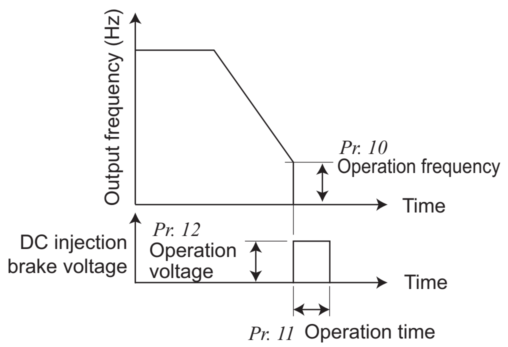
Purpose	Parameter that should be Set		Refer to Page
Motor braking torque adjustment	**DC Injection brake of general-purpose motor control**	**Pr. 10 to Pr. 12**	*129*
	DC injection brake of IPM motor control	**Pr. 10, Pr. 11**	*130*
Improve the motor braking torque with an option	**Selection of a regenerative brake**	**Pr. 30, Pr. 70**	*131*
Coast the motor to a stop	**Selection of motor stopping method**	**Pr. 250**	*133*

4.10.1 DC injection brake of general-purpose motor control (Pr. 10 to Pr. 12) V/F GP MFVC

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 V/F GP MFVC	**DC injection brake operation voltage**	0.4K to 7.5K	4%	0 to 30%	DC injection brake voltage (torque). When "0" is set, DC injection brake is disabled.
		11K, 15K	2%		

The above parameters can be set when *Pr. 160 Extended function display selection* ="0". *(Refer to page 197)*



(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:
  3.7K or lower...4%, 5.5K or higher...2%
  SF-HR, SF-HRCA:
  3.7K or lower...4%, 5.5K and 7.5K...3%, 11K and 15K...2%

REMARKS

- For the 5.5K and 7.5K, 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, 120) 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, 120).
- 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

⚠ **Install a mechanical brake to make an emergency stop or to stay stopped for a long time.**

Parameters referred to

Pr. 13 Starting frequency ☞ *Refer to page 116*
Pr. 71 Applied motor ☞ *Refer to page 123*

4.10.2 DC injection brake of IPM motor control (Pr.10, Pr.11) IPM

At a motor stop, DC injection brake operates to apply braking torque to the motor.

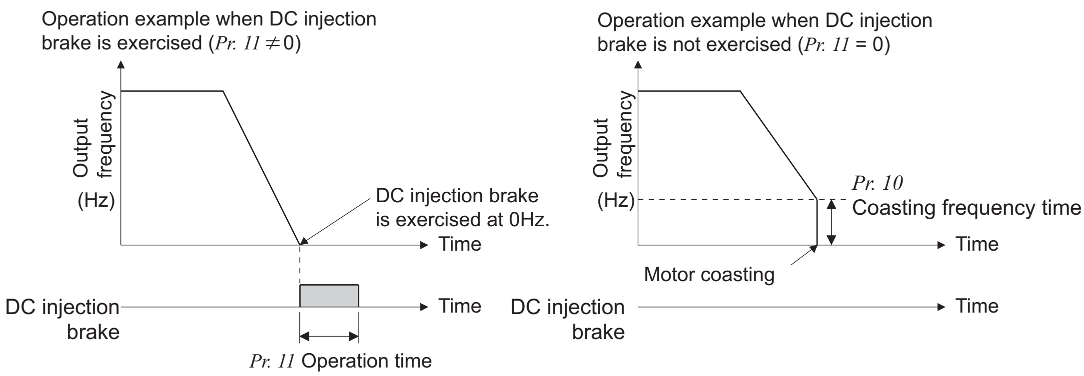
Parameter Number	Name	Initial Value	Setting Range	Description
10	DC injection brake operation frequency	3Hz	0 to 120Hz	Set the frequency at which the motor coasts.
11	DC injection brake operation time	0.5s	0	DC injection brake disabled
			0.1 to 10s	Set the operation time of the DC injection brake.

(1) Coasting frequency setting *(Pr.10)*

- When frequency at which coasting starts is set in *Pr.10*, output is shutoff when this frequency is reached during deceleration and motor starts coasting. (This function is valid when *Pr. 11* = "0s")
- When *Pr. 11* ≠ "0," *Pr. 10* is always set to 0Hz.

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

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



⚠ CAUTION

⚠ **Install a mechanical brake to make an emergency stop or to stay stopped for a long time.**

⚠ **An IPM motor is a motor with interior permanent magnets. High voltage is generated at motor terminals while the motor is running. Do not touch motor terminals and other parts until the motor stops to prevent an electric shock.**

Parameters referred to

Pr. 13 Starting frequency ☞ *Refer to page 116*
Pr. 71 Applied motor ☞ *Refer to page 123*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 134*
IPM motor control ☞ *Refer to page 83*

4.10.3 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-HC2) 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	Inverter without regenerative function, Brake resistor (MRS type, MYS type), Brake unit (FR-BU2), Power regeneration common converter (FR-CV), High power factor converter (FR-HC2)
			1	Brake resistor (MYS type) used at 100% torque/6%ED, High-duty brake resistor (FR-ABR)
			2	High power factor converter (FR-HC2) 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 197)*

(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-HC2)

•Set *Pr. 30* to "0" (initial value). The *Pr. 70* setting is invalid.
At this time, the regenerative brake duty is as follows.

Type	Regenerative brake duty
FR-F720PJ-0.4K to 3.7K	3%
FR-F720PJ-5.5K or higher FR-F740PJ-0.4K or higher	2%

•Assign the inverter operation enable signal (X10) to the contact input terminal. To make protective coordination with the FR-HC2 and FR-CV, use the inverter operation enable signal to shut off the inverter output.
Input the RDY signal of the FR-HC2 (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-F720PJ-3.7K only)

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

(3) When using the high-duty brake resistor (FR-ABR)

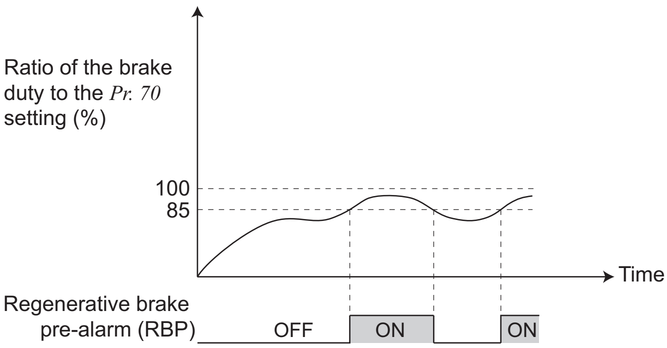
•Set "1" in *Pr. 30*.
•Set *Pr. 70* as follows.
7.5K or lower............10%
11K, 15K...................6%

(4) When a high power factor converter (FR-HC2) is used and automatic restart after instantaneous power failure function is valid

- When automatic restart after instantaneous power failure function of both the FR-HC2 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-HC2 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 136)*
- Refer to *page 34* to *39* for connecting the brake resistor (MRS type, MYS type), high-duty brake resistor (FR-ABR), brake unit (FR-BU2), high power factor converter (FR-HC2), and power regeneration common converter (FR-CV).

NOTE

- **When terminal assignment is changed using *Pr. 178 to Pr. 182 (input terminal function selection), Pr. 190, and Pr. 192 (output terminal function selection)*, the other functions may be affected. Set parameters after confirming the function of each terminal.** *(Refer to page 134)*

⚠ 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

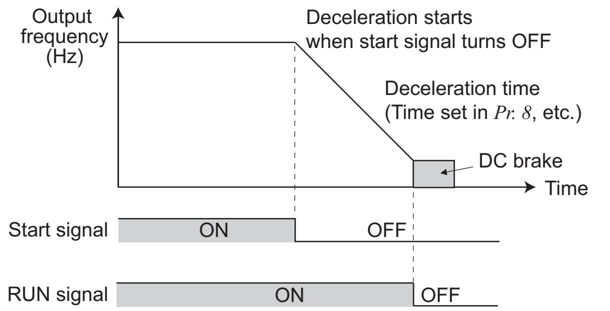
Pr. 57 Restart coasting time ☞ *Refer to page 161*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*

4.10.4 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 138* for start signal selection)

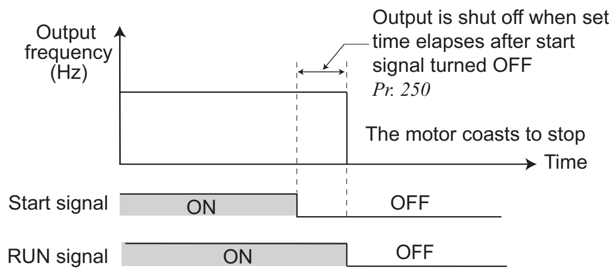
Parameter Number	Name	Initial Value	Setting Range	Description: Start signal (STF/STR) *(Refer to page 138)*	Description: Stop operation
250	**Stop selection**	9999	0 to 100s	STF signal: Forward rotation start STR signal: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after the start signal is turned OFF.
			1000s to 1100s	STF signal: Start signal 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 STR signal: Reverse rotation start	When the start signal is turned OFF, the motor decelerates to stop.
			8888	STF signal: Start signal STR signal: Forward/reverse signal	

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*



(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 shut off.

NOTE

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

CAUTION

⚠ An IPM motor is a motor with interior permanent magnets. High voltage is generated at motor terminals while the motor is running. Do not touch motor terminals and other parts until the motor stops to prevent an electric shock.

Parameters referred to

Pr. 7 Acceleration time, Pr. 8 Deceleration time ☞ *Refer to page 113*
Pr. 13 Starting frequency ☞ *Refer to page 116*

4.11 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**	*134*
Set MRS signal (output shutoff) to NC contact specification	**MRS input selection**	**Pr. 17**	*136*
Assign start signal and forward/ reverse command to other signals	**Start signal (STF/STR) operation selection**	**Pr. 250**	*138*
Assign function to output terminal	**Output terminal function selection**	**Pr. 190, Pr. 192**	*140*
Detect output frequency	**Up-to-frequency sensitivity** **Output frequency detection** **Speed detection hysteresis**	**Pr. 41 to Pr. 43, Pr. 870**	*144*
Detect output current	**Output current detection** **Zero current detection**	**Pr. 150 to Pr. 153, Pr. 166, Pr. 167**	*146*
Remote output function	**Remote output**	**Pr. 495, Pr. 496**	*148*
Detect specified output power	**Pulse train output of output power**	**Pr. 799**	*149*

4.11.1 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, 24, 25, 60*1, 61*2, 62, 64 to 67, 72, 9999
179	**STR terminal function selection**	61	STR (reverse rotation command)	
180	**AU terminal function selection**	4	AU (terminal 4 input selection)	
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 197)*

*1 The setting value "60" is only available for *Pr.178*.

*2 The setting value "61" is only available for *Pr.179*.

(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	*106*
		Pr. 59 ≠ 0 ∗1	Remote setting (setting clear)	Pr. 59	*110*
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	*106*
		Pr. 59 ≠ 0 ∗1	Remote setting (deceleration)	Pr. 59	*110*
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	*106*
		Pr. 59 ≠ 0 ∗1	Remote setting (acceleration)	Pr. 59	*110*
3	RT	Second function selection		Pr. 44 to Pr. 51	*137*
4	AU	Terminal 4 input selection		Pr. 267	*183*
5	JOG	Jog operation selection		Pr. 15, Pr. 16	*108*
7	OH	External thermal relay input ∗2		Pr. 9	*119*
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	*106*
10	X10	Inverter run enable signal (FR-HC2, FR-CV connection)		Pr. 30, Pr. 70	*131*
12	X12	PU operation external interlock		Pr. 79	*200*
14	X14	PID control valid terminal		Pr. 127 to Pr. 134	*250*
16	X16	PU/External operation switchover (turning ON X16 selects External operation)		Pr. 79, Pr. 340	*207*
24	MRS	Output stop		Pr. 17	*136*
25	STOP	Start self-holding selection		—	*138*
60	STF	Forward rotation command (assigned to STF terminal *(Pr. 178)* only)		—	*138*
61	STR	Reverse rotation command (assigned to STR terminal *(Pr. 179)* only)		—	*138*
62	RES	Inverter reset		—	—
64	X64	Starting frequency for elevator mode		Pr. 127 to Pr. 134	*250*
65	X65	PU/NET operation switchover (turning ON X65 selects PU operation)		Pr. 79, Pr. 340	*208*
66	X66	External/NET operation switchover (turning ON X66 selects NET operation)		Pr. 79, Pr. 340	*208*
67	X67	Command source switchover (turning ON X67 makes *Pr. 338 and Pr. 339* commands valid)		Pr. 338, Pr. 339	*214*
72	X72	PWM frequency selection		Pr. 127 to Pr. 134, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45	*250*
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. Set parameters after confirming the function of each terminal.**
- **Same function can be assigned to two or more terminals. In this case, the logic of terminal input is OR.**
- **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-HC2, 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 (7 speeds) and remote setting. These cannot be set individually.**
  (Same signal is used since multi-speed (7 speeds) setting and remote setting are not used to set speed at the same time.)
- **Turning the AU signal ON makes terminal 2 (voltage input) invalid.**

(2) Response time of each signal

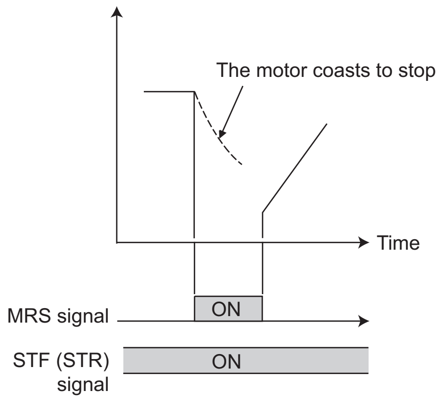
- The response time of the X10 signal and MRS signal is within 2ms.
  The response time of other signals is within 20ms.

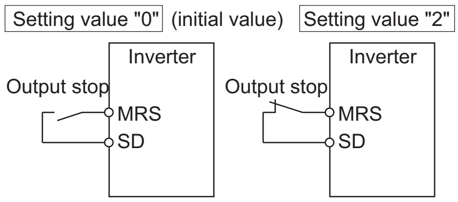
4.11.2 Inverter output shutoff signal (MRS signal, Pr. 17)

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 197*)





(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

- When using an external terminal to input the MRS signal, the MRS signal shuts off the output in any of the operation modes.

NOTE

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

CAUTION

An IPM motor is a motor with interior permanent magnets. High voltage is generated at motor terminals while the motor is running. Do not touch motor terminals and other parts until the motor stops to prevent an electric shock.

Parameters referred to

Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 134

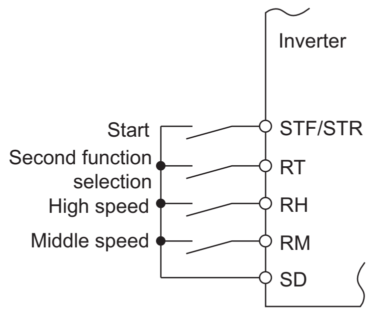
4.11.3 Condition selection of function validity by second function selection signal (RT)

You can select the second function using the RT signal.

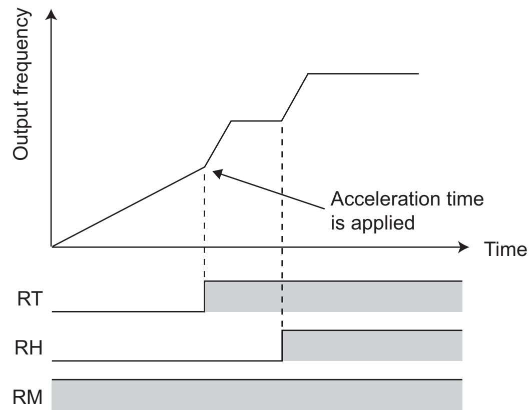
- When the RT signal turns ON, the second function becomes valid.
- For the RT signal, set "3" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.
- The second function has the following applications.

(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



When the RT signal is ON, the following functions are selected at the same time.

Function	First Function Parameter Number	Second Function Parameter Number	Applied control mode (○: Valid, —: Invalid)			Refer to Page
			V/F	GP MFVC	IPM	
Torque boost	Pr. 0	Pr. 46	○	—	—	*92*
Base frequency	Pr. 3	Pr. 47	○	○	—	*103*
Acceleration time	Pr. 7	Pr. 44	○	○	○	*113*
Deceleration time	Pr. 8	Pr. 44, Pr. 45	○	○	○	*113*
Electronic thermal O/L relay	Pr. 9	Pr. 51	○	○	— (*Pr. 9* is enabled.)	*119*
Stall prevention	Pr. 22	Pr. 48	○	○	○	*96*
Applied motor	Pr. 71	Pr. 450	○	○	— (*Pr. 71* is enabled.)	*123*

NOTE

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

Parameters referred to

Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*

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

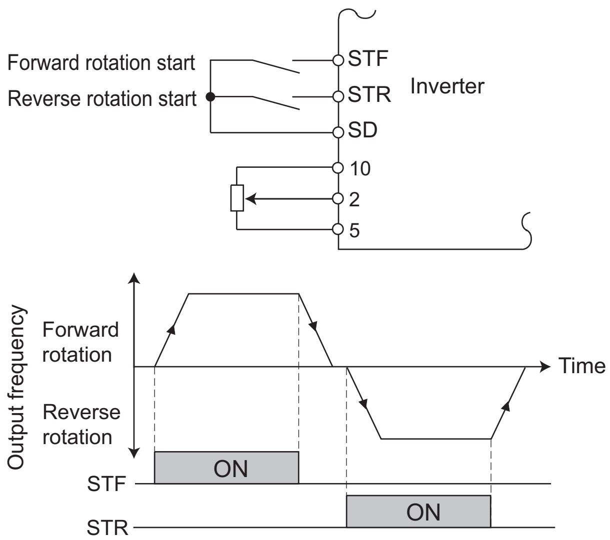
You can select the operation of the start signal (STF/STR).
Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns OFF.
Used to stop the motor with a mechanical brake, etc. together with switching OFF of the start signal.
(Refer to *page 133* for stop selection)

Parameter Number	Name	Initial Value	Setting Range	Description: Start signal (STF/STR)	Description: Stop operation *Refer to page 133*
250	**Stop selection**	9999	0 to 100s	STF signal: Forward rotation start 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 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 STR signal: Reverse rotation start	When the start signal is turned OFF, the motor decelerates to stop.
			8888	STF signal: Start signal STR signal: Forward/reverse signal	

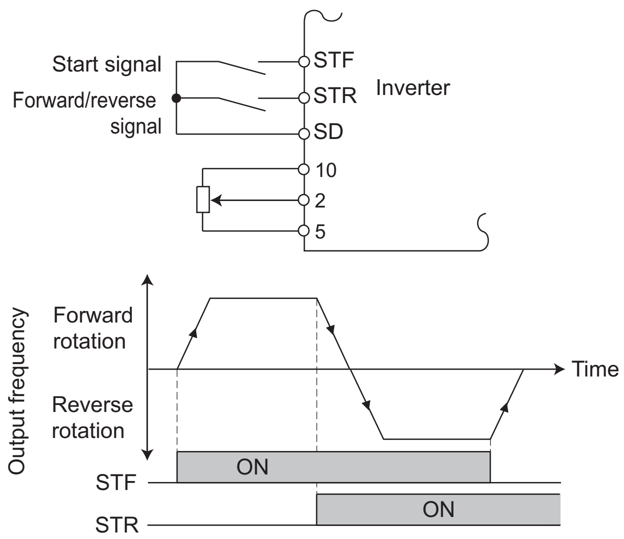
The above parameter can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 197)*

(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 motor 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 106*.)
- 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")



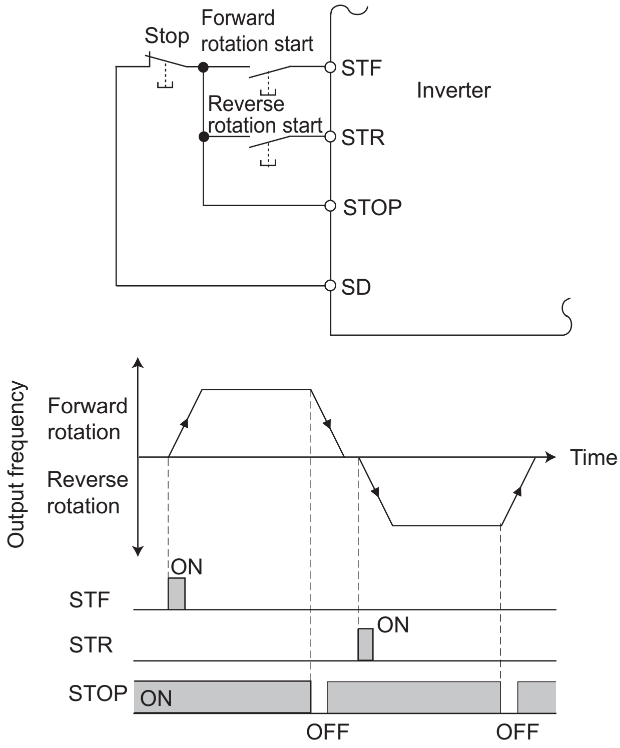
2-wire connection example (*Pr. 250* = "8888")

REMARKS

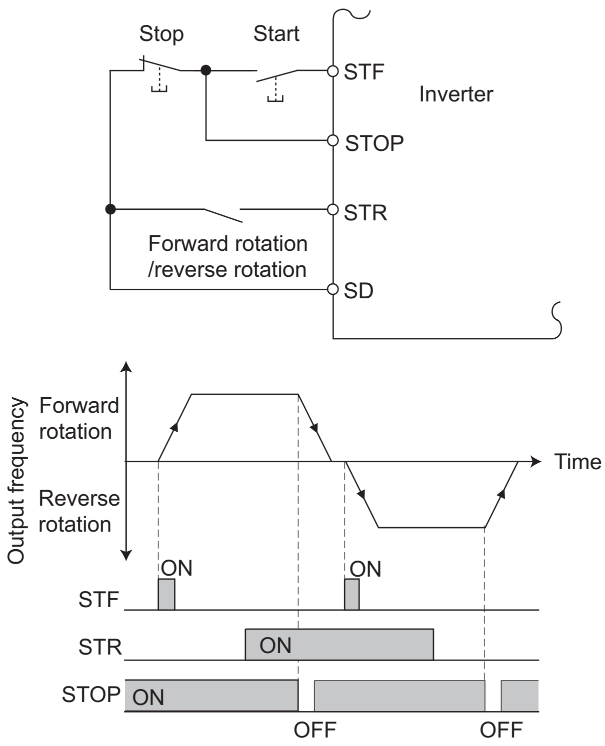
- When *Pr. 250* is set to any of "0 to 100, 1000 to 1100", turning OFF the start command coasts the inverter to a stop. *(Refer to page 133)*
- The STF and STR signals are assigned to the STF and STR terminals in the initial setting. The STF signal can be assigned to *Pr. 178 STF terminal function selection*, and the STR signal to *Pr. 179 STR terminal function selection* only.

(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 106*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*

4.11.5 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 to 48, 64, 70, 79, 90 to 93 *, 95, 96, 98 to 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146 to 148, 164, 170, 179, 190 to 193 *, 195, 196, 198, 199, 9999
192	**A,B,C terminal function selection**	**Relay output terminal**	99	ALM (fault output)	

*1 The setting values "92", "93", "192", and "193" cannot be set in *Pr. 192*.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

(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* (0.01Hz under IPM motor control).	—	*142*
1	101	SU	Up to frequency *1	Output when the output frequency is reached to the set frequency.	Pr. 41	*144*
3	103	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66	*96*
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	*144*
7	107	RBP	Regenerative brake pre-alarm	Output when 85% of the regenerative brake duty set in *Pr. 70* is reached.	Pr. 70	*131*
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	*119*
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.	—	*142*
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	*146*
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	*146*
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	*250*
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	*264*
26	126	FIN	Heatsink overheat pre-alarm	Output when the heatsink temperature reaches about 85% of the heatsink overheat protection providing temperature.	—	*304*
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	*168*
47	147	PID	During PID control activated	Output during PID control.	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	*250*
48	148	Y48	PID deviation limit	Output when the absolute value of deviation exceeds the limit value.	Pr. 127 to Pr. 134, Pr. 241, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45	*250*

Setting		Signal	Function	Operation	Related Parameter	Refer to Page
Positive logic	Negative logic					
57	157	IPM	IPM motor control	Output during IPM motor control.	Pr. 71, Pr. 80, Pr. 998	*83*
64	164	Y64	During retry	Output during retry processing.	Pr. 65 to Pr. 69	*170*
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	*250*
79	179	Y79	Pulse train output of output power	Output in pulses every time the accumulated output power of the inverter reaches the *Pr.799* setting.	Pr. 799	*149*
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	*265*
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.	—	*143*
92	192	Y92	Energy saving average value updated timing	Turned ON and OFF alternately every time the average power saving is updated when the power saving monitor is used. Cannot be set to *Pr. 192* (relay output terminal).	Pr. 52, Pr. 54, Pr. 158, Pr. 891 to Pr. 899	*176*
93	193	Y93	Current average value monitor signal	Average current value and maintenance timer value are output as pulses. The signal cannot be set in *Pr. 192 A,B,C terminal function selection* .	Pr. 555 to Pr. 557	*269*
95	195	Y95	Maintenance timer signal	Output when *Pr. 503* rises to or above the *Pr. 504* setting.	Pr. 503, Pr. 504	*268*
96	196	REM	Remote output	Output to the terminal when a value is set to the parameter.	Pr. 495, Pr. 496	*148*
98	198	LF	Alarm output	Output when an alarm (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244	*221, 264*
99	199	ALM	Fault output	Output when a fault occurs. The signal output is stopped when the fault is reset.	—	*143*
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".)

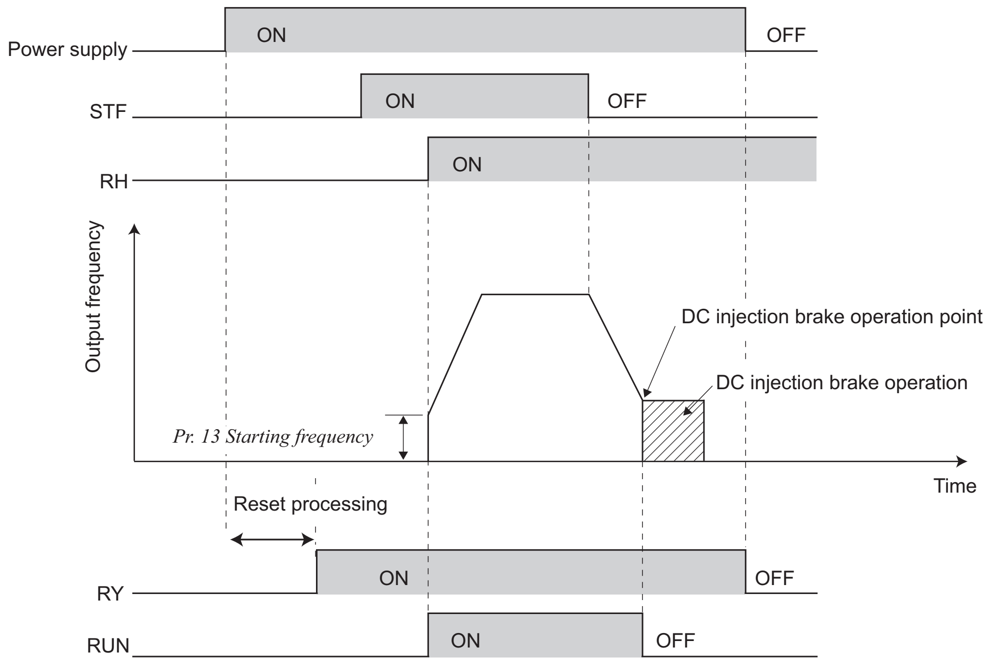
REMARKS

- 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 and Pr.192 (output terminal function selection)* may affect the other functions. Set parameters 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.**
- **The common terminal for terminal RUN is terminal SE.**

(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 inverter's output frequency reaches *Pr. 13 Starting frequency* (0.01Hz under IPM motor control) or higher, the inverter running signal (RUN) is output. 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* and *Pr. 192* Setting	
	Positive logic	Negative logic
RY	11	111
RUN	0	100

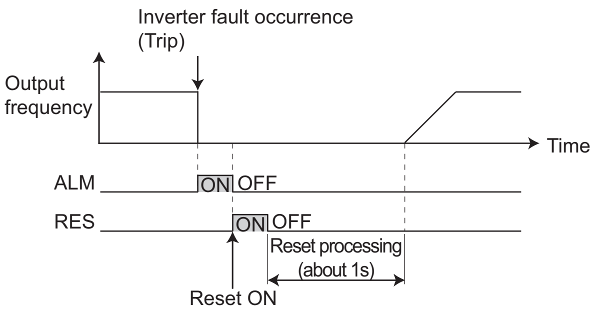
Inverter Status / Output signal	Start Signal OFF (during stop)	Start Signal ON (during stop)	Start Signal ON (during operation)	Under DC Injection Brake	Output Shutoff *2	Automatic Restart after Instantaneous Power Failure		
						Coasting		Restarting
						Start signal ON	Start signal OFF	
RY	ON	ON	ON	ON	OFF	ON *1		ON
RUN	OFF	OFF	ON	OFF	OFF	OFF		ON

*1 This signal turns OFF during power failure or undervoltage.
*2 Output is shutoff in conditions like a fault and when the MRS signal is ON.

REMARKS

- The RUN signal (positive logic) is assigned to the terminal RUN in the initial setting.
- During IPM motor control, the RUN signal is output about 100ms after turning ON the start command (STF, STR). The delay is due to the magnetic pole detection.

(3) Fault output signal (ALM signal)



- If the inverter trips, 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 298* 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 297* 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.IOH	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 116*

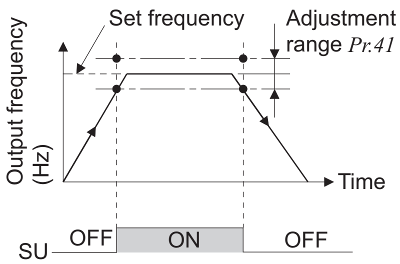
4.11.6 Detection of output frequency (SU, FU signal, Pr. 41 to Pr. 43, Pr. 870)

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
870	**Speed detection hysteresis**	0Hz*	0 to 5Hz	Set the hysteresis width for the detected frequency.

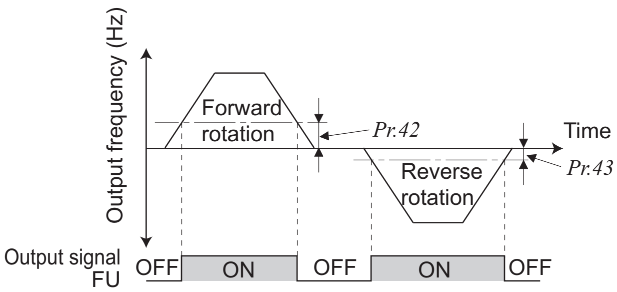
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

* Performing IPM parameter initialization changes the settings. *(Refer to page 85)*



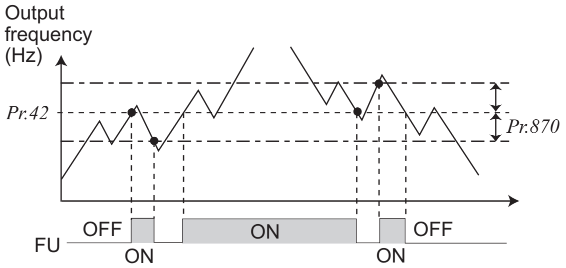
(1) Up-to-frequency sensitivity (SU signal, *Pr. 41*)

- 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 the reverse operation 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.



Example of output frequency detection signal (FU)

(3) Speed detection hysteresis *(Pr.870)*

- This function prevents chattering of the speed detection signals.
  When an output frequency fluctuates, the up to frequency signal (SU) and output frequency detection signals (FU) may repeat ON/OFF (chatters). Setting hysteresis to the detected frequency prevents chattering of these signals.

REMARKS

- Setting a higher value to this parameter slows the response of frequency detection signals (SU and FU).

REMARKS

- All signals are OFF during DC injection brake.
- The output frequency compared with the set frequency changes depending on the control method.

Control Method	Compared Output Frequency
V/F control	Output frequency
General-purpose magnetic flux vector control	Output frequency before slip compensation
IPM motor control	Estimated frequency (actual motor rotation per minute)

NOTE

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

Parameters referred to

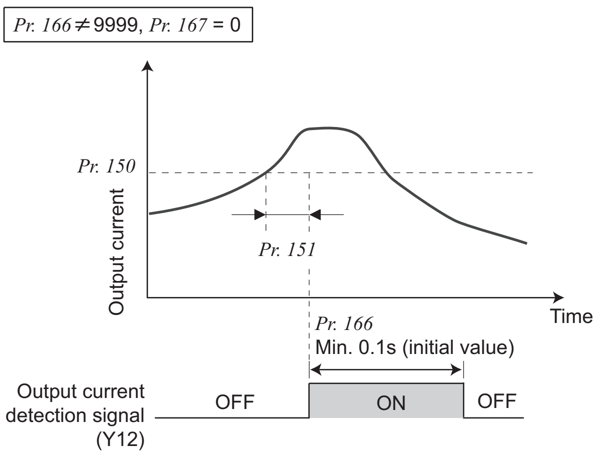
Pr. 190, Pr. 192 (output terminal function selection) ☞ *(Refer to page 140)*

4.11.7 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.

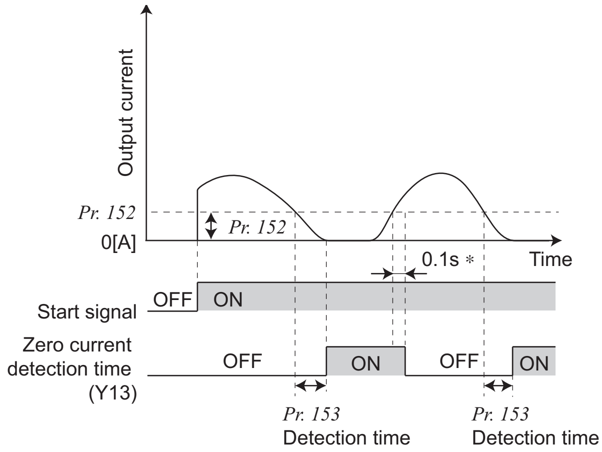
Parameter Number	Name	Initial Value	Setting Range	Description
150	**Output current detection level**	120%	0 to 150%	100% is the rated inverter current.
151	**Output current detection signal delay time**	0s	0 to 10s	Output current detection period. The time from when the output current has risen above the setting until the output current detection signal (Y12) is output.
152	**Zero current detection level**	5%	0 to 150%	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 197)*



(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.



* 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 and Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

⚠ CAUTION

⚠ **The zero current detection level setting should not be too low, 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 125*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*

4.11.8 Remote output selection (REM signal, Pr. 495, Pr. 496)

You can utilize the ON/OFF of the inverter's output signals instead of the remote output terminal of the programmable logic controller.

Parameter Number	Name	Initial Value	Setting Range	Description	
495	**Remote output selection**	0	0	Remote output data clear at powering OFF	Remote output data is cleared during an inverter reset
			1	Remote output data retention at powering OFF	
			10	Remote output data clear at powering OFF	Remote output data is retained during an inverter reset
			11	Remote output data retention at powering OFF	
496*	**Remote output data 1**	0	0 to 4095	Refer to the following diagram.	

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

* 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*.

<**Remote output data**>

Pr. 496

b11 ... b0

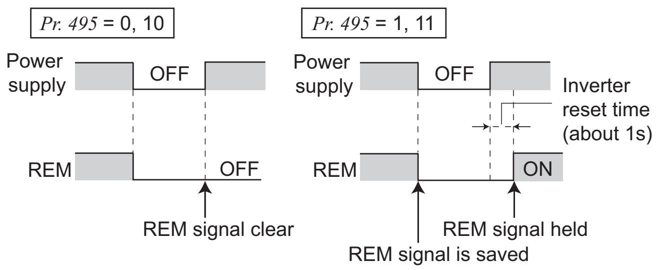
*	*	*	*	*	*	ABC	*	*	*	*	RUN

* Any

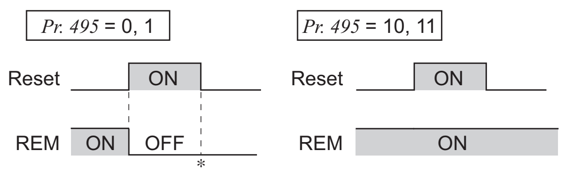
- The output terminal can be turned ON/OFF depending on the *Pr. 496* setting. The remote output selection can be controlled ON/OFF by computer link communication from the PU connector.
- Set "96 (positive logic) or 196 (negative logic)" to *Pr.190 or Pr.192 (output terminal function selection)*, and assign the remote output (REM) signal to the terminal used for remote output.
- When you refer to the diagram on the left and set 1 to the terminal bit (terminal where the REM signal has been assigned) of *Pr. 496*, the output terminal turns ON (OFF for negative logic). By setting 0, the output terminal turns OFF (ON for negative logic).

Example: When "96 (positive logic)" is set in *Pr. 190 RUN terminal function selection* and "1" (H01) is set in *Pr. 496*, the terminal RUN turns ON.

ON/OFF example for positive logic



Signal condition during a reset



* When *Pr. 495* = "1," the signal condition saved in EEPROM (condition of the last power OFF) is applied.

- When *Pr. 495* = "0 (initial value) or 10", performing a power ON reset (including a power failure) clears the REM signal output. (The ON/OFF status of the terminals are as set in *Pr. 190 and Pr. 192*) The *Pr. 496* setting becomes also "0".
  When *Pr. 495* = "1, 11", the remote output data before power OFF is stored into the EEPROM, so the signal output at power recovery is the same as before power OFF. However, it is not stored when the inverter is reset (terminal reset, reset request through communication).
  (See the chart on the left.)
- When *Pr. 495* = "10 or 11," the signal before the reset is held even during an inverter reset.

REMARKS

- The output terminal where the REM signal is not assigned using *Pr.190, Pr.192* does not turn ON/OFF if 0/1 is set to the terminal bit of *Pr. 496*. (It turns ON/OFF with the assigned function.)

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 140*

4.11.9 Pulse train output of output power (Y79 signal, Pr. 799)

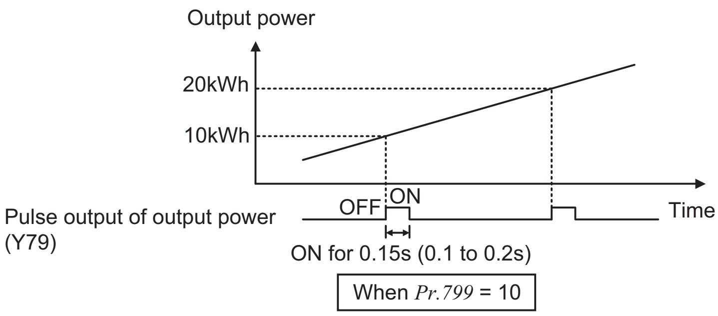
After power ON or inverter reset, output signal (Y79 signal) is output in pulses every time accumulated output power, which is counted after the *Pr.799 Pulse increment setting for output power* is set, reaches the specified value (or its integral multiples).

Parameter Number	Name	Initial Value	Setting Range	Description
799	**Pulse increment setting for output power**	1kWh	0.1kWh, 1kWh, 10kWh, 100kWh, 1000kWh	Output signal is output in pulses at every output power (kWh) that is specified.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0".

(1) Pulse increment setting for output power (Y79 signal, *Pr.799*)

- After power ON or inverter reset, output signal (Y79 signal) is output in pulses every time accumulated output power of the inverter exceeds *Pr.799 Pulse increment setting for output power*.
- The inverter continues to count the output power at retry function or when automatic restart after instantaneous power failure function works without power OFF of output power (power failure that is too short to cause an inverter reset), and it does not reset the count.
- If power failure occurs, output power is counted from 0kWh again.
- Assign pulse output of output power (Y79: setting value 79 (positive logic), 179 (negative logic)) to *Pr.190 or Pr.192 (Output terminal function selection)*.



NOTE

- Because the accumulated data in the inverter is cleared when control power is lost by power failure or at an inverter reset, the value on the monitor cannot be used to charge electricity bill.
- Changing the terminal assignment using *Pr. 190 and Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal. *(Refer to page 140)*

REMARKS

- When parameter copy is performed, *Pr.799* = "9999" might be set. However, the inverter operates as *Pr.799* were at "1kWh" (initial value) in such case.

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*

4.12 Monitor display and monitor output signal

Purpose	Parameter that should be Set		Refer to Page
Display motor speed Set speed	Speed display and speed setting	Pr. 37, Pr. 144, Pr. 505	150
Change PU monitor display data	Monitor display/PU main display data selection Cumulative monitor clear	Pr. 52, Pr. 54, Pr. 170, Pr. 171, Pr. 268, Pr. 563, Pr. 564, Pr. 891	152
Change the monitor output from terminal FM	Terminal FM function selection	Pr. 54	152
Set the reference of the monitor output from terminal FM	Terminal FM standard setting	Pr. 55, Pr. 56	157
Adjust terminal FM outputs	Terminal FM calibration	Pr. 900	158

4.12.1 Speed display and speed setting (Pr. 37, Pr. 144, Pr. 505)

The monitor display and frequency setting of the PU (FR-PU04/FR-PU07) can be changed to the machine speed.

Parameter Number	Name	Initial Value	Setting Range	Description
37	Speed display	0*1	0	Frequency display, setting
			0.01 to 9998*3, *4	Set the machine speed at *Pr.505.*
144	Speed setting switchover	4 *2	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	Set the number of motor poles when displaying the motor speed.
505	Speed setting reference	60Hz *2	1 to 120Hz	Set the reference speed for *Pr. 37*.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

*1 Performing IPM parameter initialization sets back the settings to the initial settings. (*Refer to page 85*)

*2 Performing IPM parameter initialization changes the settings. (*Refer to page 85*)

*3 The maximum value of the setting range differs according to the *Pr. 1 Maximum frequency (Pr. 18 High speed maximum frequency)*, and it can be calculated from the following formula.

$$\text{Maximum setting value of } Pr.\ 37 < \frac{16777.215 \times 60\ (\text{Hz})}{\text{Setting value of } Pr.\ 1\ (Pr.\ 18)\ (\text{Hz})}$$

Note that the maximum setting value of *Pr. 37* is 9998 if the result of the above formula exceeds 9998.

*4 If *Pr. 999 Automatic parameter setting* setting is set to "20" or "21" while the machine speed is displayed (*Pr.37* ≠ 0), calculate the rotations per minute based on the changed *Pr.505* setting, and set *Pr.37* again. *(Refer to page 273)*

- To display a machine speed, set *Pr.37* to the machine speed at the frequency set in *Pr. 505*, and set *Pr. 144* to the number of motor poles (2, 4, 6, 8, 10).
  For example, when *Pr. 505* = "60Hz" and *Pr. 37* = "1000", "1000" is displayed on the machine speed monitor at the running frequency of 60Hz. When running frequency is 30Hz, "500" is displayed.
- When displaying the motor speed, set the number of motor poles + 100 (102, 104, 106, 108, 110) to *Pr. 144*.
- When both *Pr. 37* and *Pr. 144* have been set, their priorities are as given below.
  Pr. 144, 102 to 110 > *Pr. 37*, 1 to 9998 > *Pr. 144*, 2 to 10
- A combination of the *Pr.37* and *Pr. 144* settings determines the monitored item and the setting increment as shown in the table below. (Initial settings are outlined with bold borders)

Pr. 37 Setting	*Pr. 144* Setting	Output Frequency Monitor	Set Frequency Monitor	Running Speed Monitor	Parameter Setting
0 (initial value)	2 to 10	0.01 Hz	0.01 Hz	0.01 Hz *1	0.01 Hz
	102 to 110	1 r/min *1	1 r/min *1	1 r/min *1	1 r/min *1
0.01 to 9998	2 to 10	0.001 (Machine speed *1)	0.001 (Machine speed *1)	0.001 (Machine speed *1)	0.01 Hz
	102 to 110	0.01 Hz	0.01 Hz	0.01 Hz	0.01 Hz

*1 Motor speed r/min conversion formula............ frequency × 120/number of motor poles (*Pr. 144*)
Machine speed conversion formula.................. *Pr. 37* × frequency/*Pr. 505* setting (Hz)
For *Pr. 144* in the above formula, the value is "*Pr. 144*-100" when "102 to 110" is set in *Pr. 144* and the value is "4" when *Pr. 37* = 0 and *Pr. 144* = 0.
Pr. 505 is always set as frequency (Hz).

NOTE

- Under V/F control, the output frequency of the inverter is displayed in terms of synchronous speed, and therefore, displayed value = actual speed + motor slip. The display changes to the actual speed (estimated value calculated based on the motor slip) when slip compensation was valid.
- Refer to *Pr. 52* when you want to change the PU main monitor (PU main display).
- Since the panel display of the operation panel is 4 digits in length, the monitor value of more than "9999" is displayed as "----".
- When the machine speed is displayed on the FR-PU04/FR-PU07, do not change the speed by using an up/down key in the state where the set speed exceeding 65535 is displayed. The set speed may become arbitrary value.
- While the machine speed is displayed on the monitor, values of other parameters related to speed (*Pr. 1*, etc.) are in frequency increments. Set other parameters (*Pr.1*, etc.) related to speed in increments of frequency.
- Due to the limitations on the resolution of the set frequency, the indication in the second decimal place may differ from the setting.

CAUTION

Make sure that the running speed setting is correct.
Otherwise, the motor might run at extremely high speed, damaging the machine.

Parameters referred to

Pr. 1 Maximum frequency, Pr. 18 High speed maximum frequency ☞ *Refer to page 101*
Pr. 52 DU/PU main display data selection ☞ *Refer to page 152*
Pr. 999 Automatic parameter setting ☞ *Refer to page 273*

4.12.2 Monitor display selection of DU/PU and terminal FM (Pr. 52, Pr. 54, Pr. 170, Pr. 171, Pr. 268, Pr. 563, Pr. 564, Pr. 891)

The monitor to be displayed on the main screen of the operation panel and parameter unit (FR-PU04/FR-PU07) can be selected.
In addition, signal to be output from the terminal FM (pulse train output) can be selected.

Parameter Number	Name	Initial Value	Setting Range	Description
52 *	**DU/PU main display data selection**	0 (output frequency)	0, 5, 8 to 12, 14, 20, 23 to 25, 50 to 55, 61, 62, 64, 100	Select the monitor to be displayed on the operation panel and parameter unit. Refer to the following table for monitor description.
54 *	**FM terminal function selection**	1 (output frequency)	1 to 3, 5, 8 to 12, 14, 21, 24, 50, 52, 53, 61, 62	Select the monitor output to terminal FM.
170	**Watt-hour meter clear**	9999	0	Set "0" to clear the watt-hour meter monitor.
			10	Sets the maximum value for monitoring from communication to 9999kWh.
			9999	Sets the maximum value for monitoring from communication to 65535kWh.
171	**Operation hour meter clear**	9999	0, 9999	Set "0" in the parameter to clear the operation time monitor. Setting 9999 does not clear.
268 *	**Monitor decimal digits selection**	9999	0	Displayed as integral value
			1	Displayed in 0.1 increments
			9999	No function
563	**Energization time carrying-over times**	0	0 to 65535 (reading only)	The numbers of cumulative energization time monitor exceeded 65535h is displayed. (Reading only)
564	**Operating time carrying-over times**	0	0 to 65535 (reading only)	The numbers of operation time monitor exceeded 65535h is displayed. (Reading only)
891	**Cumulative power monitor digit shifted times**	9999	0 to 4	Set the number of times to shift the cumulative power monitor digit. Clamp the monitoring value at maximum.
			9999	No shift. Clear the monitor value when it exceeds the maximum value.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

* 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*.

(1) Monitor description list *(Pr. 52)*

- Set the monitor to be displayed on the operation panel and parameter unit (FR-PU04/FR-PU07) in *Pr. 52 DU/PU main display data selection* .
- Set the monitor to be output to the terminal FM (pulse train output) in *Pr. 54 FM terminal function selection*.
- Refer to the following table and set the monitor to be displayed. (The monitor marked with × cannot be selected.)

Types of Monitor	Unit	*Pr. 52* Setting: Operation panel LED	*Pr. 52* Setting: PU main monitor	*Pr. 54* (FM) Setting	Terminal FM Full Scale Value	Description
Output frequency	0.01Hz	0/100		1	*Pr. 55*	Displays the inverter output frequency.
Output current*7	0.01A	0/100		2	*Pr. 56*	Displays the inverter output current effective value.
Output voltage	0.1V	0/100		3	200V class 400V 400V class 800V	Displays the inverter output voltage.
Fault display	—	0/100		×	—	Displays past 8 faults individually.
Frequency setting value	0.01Hz	5	*1	5	*Pr. 55*	Displays the set frequency.
Converter output voltage	0.1V	8	*1	8	200V class 400V 400V class 800V	Displays the DC bus voltage value.

Types of Monitor	Unit	*Pr. 52* Setting: Operation panel LED	*Pr. 52* Setting: PU main monitor	*Pr. 54* (FM) Setting	Terminal FM Full Scale Value	Description
Regenerative brake duty	0.1%	9	*1	9	*Pr. 70*	Brake duty set in *Pr. 30, Pr. 70*
Electronic thermal relay function load factor	0.1%	10	*1	10	100%	Displays the thermal cumulative value on the assumption that the thermal operation level is 100% (Larger thermal between the motor thermal and transistor thermal). *6
Output current peak value	0.01A	11	*1	11	*Pr. 56*	Holds and displays the peak value of the output power monitor. (Cleared at every start)
Converter output voltage peak value	0.1V	12	*1	12	200V class: 400V 400V class: 800V	Holds and displays the peak value of the DC bus voltage value. (Cleared at every start)
Output power *7	0.01kW	14	*1	14	Rated inverter power × 2	Displays the power on the inverter output side
Input terminal status	—	—	*1	×	—	Displays the input terminal ON/OFF status on the operation panel. (*Refer to page 155*)
Output terminal status	—	—	*1	×	—	Displays the output terminal ON/OFF status on the operation panel. (*Refer to page 155*)
Cumulative energization time *2	1h	20		×	—	Adds up and displays the energization time after inverter shipment. You can check the numbers of the monitor value exceeded 65535h with *Pr. 563*.
Reference voltage output	—	—		21	—	Terminal FM: Output 1440 pulse/s
Actual operation time *2, *3	1h	23		×	—	Adds up and displays the inverter operation time. You can check the numbers of the monitor value exceeded 65535h with *Pr. 564*. Can be cleared by *Pr. 171. (Refer to page 156)*
Motor load factor	0.1%	24		24	200%	Displays the output current value on the assumption that the rated inverter current is 100%. Monitor value = output power monitor value/rated inverter current 100 [%]
Cumulative power *5	0.01kWh *4	25		×	—	Adds up and displays the power amount based on the output power monitor. Can be cleared by *Pr. 170. (Refer to page 155)*
Power saving effect	Variable according to parameters	50		50	Inverter capacity	Displays energy saving effect monitor. You can change the monitor to power saving, average power saving, cost savings monitor and % display using parameters. *(For details, refer to page 176)*
Cumulative power saving *6	Variable according to parameters	51		×	—	
PID set point	0.1%	52		52	100%	Displays the set point, measured value and deviation during PID control (*Refer to page 255* for details)
PID measured value	0.1%	53		53	100%	
PID deviation	0.1%	54		×	—	
Inverter I/O terminal monitor	—	55	×	×	—	Displays the ON/OFF status of the inverter input terminal and output terminal on the operation panel (*Refer to page 155* for details)
Motor thermal load factor	0.1%	61		61	Thermal relay operation level (100%)	Motor thermal heat cumulative value is displayed. (Motor overload trip (E.THM) at 100%)
Inverter thermal load factor	0.1%	62		62	Thermal relay operation level (100%)	Transistor thermal heat cumulative value is displayed. (Inverter overload trip (E.THT) at 100%)

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Types of Monitor	Unit	*Pr. 52* Setting		*Pr. 54* (FM) Setting	Terminal FM Full Scale Value	Description
		Operation panel LED	PU main monitor			
PTC thermistor resistance	0.01kΩ	64		×	—	Displays the PTC thermistor resistance at terminal 2 when PTC thermistor protection is active. (0.10kΩ to 31.5kΩ) *(Refer to page 119)*

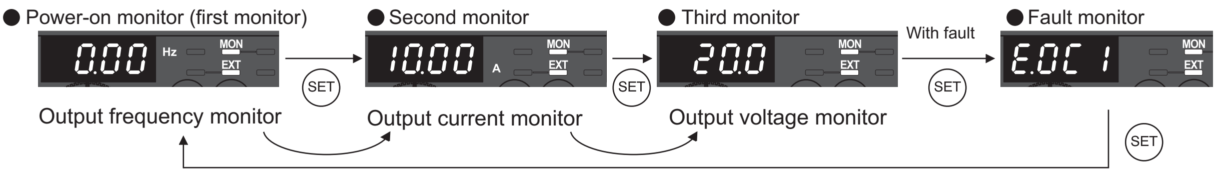
∗1 Frequency setting to output terminal status on the PU main monitor are selected by "other monitor selection" of the parameter unit (FR-PU04/FR-PU07).
∗2 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel is used, the time is displayed up to 65.53 (65530h) in the indication of 1h = 0.001, and thereafter, it is added up from 0.
∗3 The actual operation time is not added up unless the inverter is operated one or more hours continuously.
∗4 When using the parameter unit (FR-PU04/FR-PU07), "kW" is displayed.
∗5 Since the panel display of the operation panel is 4 digits in length, the monitor value of more than "9999" is displayed as "----".
∗6 Larger thermal value between the motor thermal and transistor thermal is displayed. A value other than 0% is displayed if the surrounding air temperature (heatsink temperature) is high even when the inverter is at a stop.
∗7 When the output current is less than the specified current level (5% of the rated inverter current), the output current is monitored as 0A. Therefore, the monitored value of an output current and output power may be displayed as "0" when using a much smaller-capacity motor compared to the inverter or in other instances that cause the output current to fall below the specified value.

REMARKS

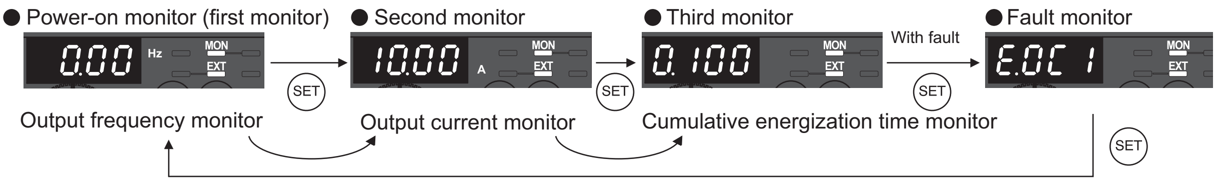
- By setting "0" in *Pr. 52*, the monitoring of output speed to fault display can be selected in sequence by SET.
- When the operation panel is used, the displayed units are Hz and A only, and the others are not displayed.
- The monitor set in *Pr. 52* is displayed in the third monitor position. However, change the output current monitor for the motor load factor.

Initial Value

∗The monitor displayed at powering ON is the first monitor. Display the monitor you want to display on the first monitor and hold down SET for 1s. (To return to the output frequency monitor, hold down SET for 1s after displaying the output frequency monitor.)



Example)When *Pr. 52* is set to "20" (cumulative energization time), the monitor is displayed on the operation panel as described below.



(2) Display set frequency during stop *(Pr. 52)*

- When "100" is set in *Pr. 52*, the set frequency and output frequency are displayed during stop and operation respectively. (LED of Hz flickers during stop and is lit during operation.)

	Pr. 52		
	0	100	
	During running/stop	During stop	During running
Output frequency	Output frequency	Set frequency∗	Output frequency
Output current	Output current		
Output voltage	Output voltage		
Fault display	Fault display		

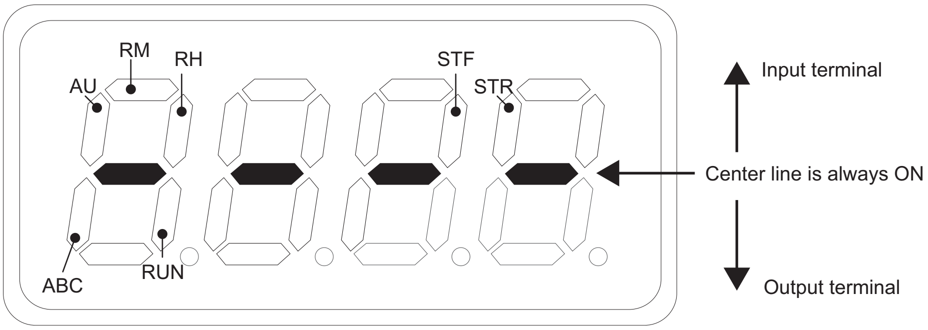
∗ The set frequency displayed indicates the frequency to be output when the start command is ON. Different from the frequency setting displayed when *Pr. 52* = "5", the value based on maximum/minimum frequency and frequency jump is displayed.

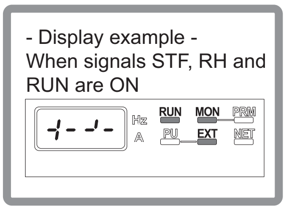
REMARKS

- During an error, the output frequency at error occurrence appears.
- During MRS signal is ON, the values displayed are the same as during a stop.
- During offline auto tuning, the tuning status monitor has priority.

(3) Operation panel I/O terminal monitor *(Pr. 52)*

- When *Pr. 52* = "55", the I/O terminal status can be monitored on the operation panel.
- The I/O terminal monitor is displayed on the third monitor.
- The LED is ON when the terminal is ON, and the LED is OFF when the terminal is OFF. The center line of LED is always ON.
- On the I/O terminal monitor (*Pr. 52* = "55"), the upper LEDs denote the input terminal status and the lower the output terminal status.





(4) Cumulative power monitor and clear *(Pr. 170, Pr. 891)*

- On the cumulative power monitor (*Pr. 52* = "25"), the output power monitor value is added up and is updated in 100ms increments. (The value is stored in EEPROM in 1h increments.)
- The operation panel, parameter unit (FR-PU04/FR-PU07) and communication (RS-485 communication) display increments and display ranges are as indicated below.

Operation Panel *1		Parameter Unit *2		Communication		
Range	Unit	Range	Unit	Range		Unit
				Pr. 170 = 10	*Pr. 170* = 9999	
0 to 99.99kWh	0.01kWh	0 to 999.99kWh	0.01kWh	0 to 9999kWh	0 to 65535kWh (initial value)	1kWh/ 0.01kWh *3
100.0 to 999.9kWh	0.1kWh	1000.0 to 9999.9kWh	0.1kWh			
1000 to 9999kWh	1kWh	10000 to 99999kWh	1kWh			

*1 Power is measured in the range of 0 to 9999.99kWh, and displayed in 4 digits.
When the monitor value exceeds "99.99", a carry occurs, e.g. "100.0", so the value is displayed in 0.1kWh increments.
*2 Power is measured in the range of 0 to 99999.99kWh, and displayed in 5 digits.
When the monitor value exceeds "999.99", a carry occurs, e.g. "1000.0", so the value is displayed in 0.1kWh increments.
*3 In monitoring with communication, cumulative power is displayed in 1kWh increments. And cumulative power 2 is displayed in 0.01kWh. (*Refer to page 226* for communication)

- The monitor data digit can be shifted to the right by the number of *Pr. 891* settings.
  For example, if the cumulative power value is 1278.56kWh when *Pr. 891* = "2", the operation panel display or parameter unit (FR-PU04/FR-PU07) display is 12.78 (display in 100kWh increments) and the communication data is 12.
- If the maximum value is exceeded at *Pr. 891* = "0 to 4", the power is clamped at the maximum value, indicating that a digit shift is necessary. If the maximum value is exceeded at *Pr. 891* = "9999", the power returns to 0 and is recounted.
  If the maximum value is exceeded at *Pr. 891* = "9999", the power returns to 0 and is recounted.
- Writing "0" in *Pr. 170* clears the cumulative power monitor.

REMARKS

- If "0" is written to *Pr. 170* and *Pr. 170* is read again, "9999" or "10" is displayed.

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(5) Cumulative energization time and actual operation time monitor *(Pr. 171, Pr. 563, Pr. 564)*

- Cumulative energization time monitor (*Pr. 52* = "20") accumulates energization time from shipment of the inverter every one hour.
- On the actual operation time monitor (*Pr. 52* = "23"), the inverter running time is added up every hour. (Time is not added up during a stop.)
- If the monitored value exceeds 65535, it is added up from 0. You can check the numbers of cumulative energization time monitor exceeded 65535h with *Pr. 563* and the numbers of actual operation time monitor exceeded 65535h with *Pr. 564*.
- Writing "0" to *Pr. 171* clears the cumulative energization power monitor. (The cumulative time monitor can not be cleared.)

REMARKS

- The cumulative energization time does not increase if the power is ON for less than an hour.
- The actual operation time does not increase if the cumulative running time during power-ON status is less than an hour.
- If "0" is written to *Pr. 171* and *Pr. 171* is read again, "9999" is always displayed. Setting "9999" does not clear the actual operation time meter.

(6) You can select the decimal digits of the monitor *(Pr. 268)*

- As the operation panel display is 4 digits long, the decimal places may vary at analog input, etc. The decimal places can be hidden by selecting the decimal digits.
  In such a case, the decimal digits can be selected by *Pr. 268*.

Pr. 268 Setting	Description
9999 (initial value)	No function
0	For the first or second decimal places (0.1 increments or 0.01 increments) of the monitor, numbers in the first decimal place and smaller are rounded to display an integral value (1 increments).The monitor value smaller than 0.99 is displayed as 0.
1	When 2 decimal places (0.01 increments) are monitored, the 0.01 decimal place is dropped and the monitor displays the first decimal place (0.1 increments). The monitored digits in 1 increments are displayed.

REMARKS

- The number of display digits on the cumulative energization time (*Pr. 52* = "20"), actual operation time (*Pr. 52* = "23"), cumulative power (*Pr. 52* = "25"), and cumulative power saving monitor (*Pr. 52* = ”51”) does not change.

Parameters referred to

Pr. 30 Regenerative function selection, Pr. 70 Special regenerative brake duty ☞ *Refer to page 131*
Pr. 37 Speed display ☞ *Refer to page 150*
Pr. 55 Frequency monitoring reference, Pr. 56 Current monitoring reference ☞ *Refer to page 157*

4.12.3 Reference of the terminal FM (pulse train output) (Pr. 55, Pr. 56)

The pulse train output terminal FM is available for monitor output.
Set the reference of the signal output from terminal FM.

Parameter Number	Name	Initial Value	Setting Range	Description
55*1	**Frequency monitoring reference**	60Hz*2	0 to 400Hz	Full-scale value when frequency monitor value is output to terminal FM.
56*1	**Current monitoring reference**	Rated inverter current*2	0 to 500A	Full-scale value when current monitor value is output to terminal FM.

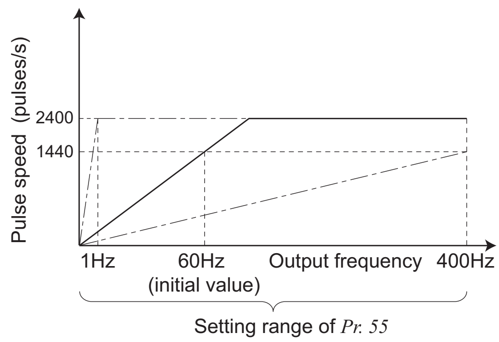
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

*1 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*.

*2 Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

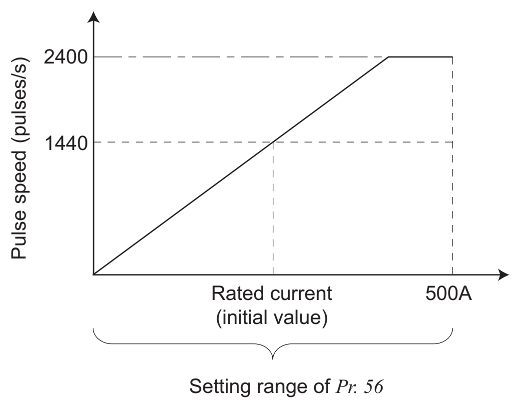
(1) Frequency monitor reference *(Pr. 55)*

- Set the full scale value when outputting the frequency monitor from terminal FM.
- Set the frequency when the optional frequency meter (1mA analog meter), which is connected to the terminal FM and SD, shows 60Hz or 120Hz (shows full scale).
- Set the inverter output frequency (set frequency) at which the pulse speed of the FM output is 1440 pulses/s.
- The pulse speed and inverter output frequency are proportional to each other. (The maximum pulse train output is 2400 pulses/s.)



(2) Current monitor reference *(Pr. 56)*

- Set the full scale value when outputting the current monitor from terminal FM.
- Set the output current at which the pulse speed of the FM output is 1440 pulses/s.
- The pulse speed and output current monitor value are proportional to each other. (The maximum pulse train output is 2400 pulses/s.)



4.12.4 Terminal FM calibration (calibration parameter C0 (Pr. 900))

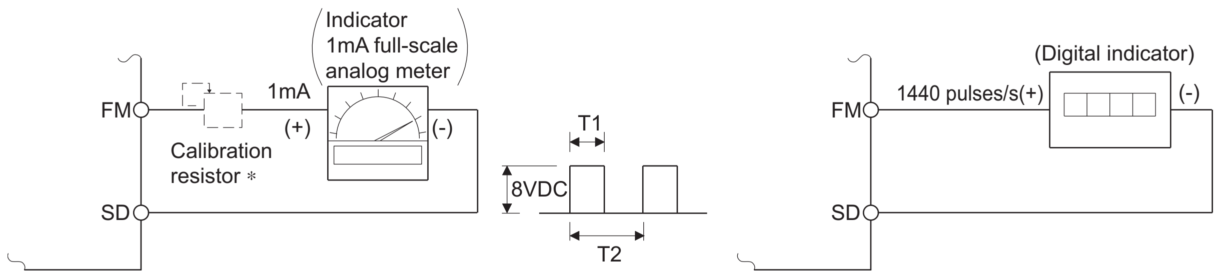
By using the operation panel or parameter unit, you can calibrate terminal FM to full scale deflection.

Parameter Number	Name	Initial Value	Setting Range	Description
C0 (900)	**FM terminal calibration**	—	—	Calibrates the scale of the meter connected to terminal FM.

*1 The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
*2 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).
*3 The above parameter 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*.

(1) FM terminal calibration *(C0 (Pr. 900))*

- The terminal FM is preset to output pulses. By setting the *FM terminal calibration C0 (Pr. 900)*, the meter connected to the inverter can be calibrated by parameter setting without use of a calibration resistor.
- Using the pulse train output of the terminal FM, a digital display can be provided to connect a digital counter.
  The monitor value is 1440 pulses/s output at the full-scale value of monitor description list *(page 152) (Pr. 54 FM terminal function selection)*.



Pulse width T1: Adjust using calibration parameter C0
Pulse cycle T2: Set with *Pr. 55* (frequency monitor)
Set with *Pr. 56* (current monitor)

*1 Not needed when the operation panel or parameter unit (FR-PU04/FR-PU07) is used for calibration.
Use a calibration resistor when the indicator (frequency meter) needs to be calibrated by a neighboring device because the indicator is located far from the inverter.
However, the frequency meter needle may not deflect to full-scale if the calibration resistor is connected. In this case, perform calibration using the operation panel or parameter unit.

- Calibrate the terminal FM in the following procedure.
  1) Connect an indicator (frequency meter) across terminals FM-SD of the inverter. (Note the polarity. The terminal FM is positive)
  2) When a calibration resistor has already been connected, adjust the resistance to "0" or remove the resistor.
  3) Refer to the monitor description list *(page 152)* and set *Pr. 54*.
     When you selected the running frequency or inverter output current at monitor, preset the running frequency or current value, at which the output signal will be 1440 pulses/s, to *Pr. 55 Frequency monitoring reference* or *Pr. 56 Current monitoring reference*.
     At 1440 pulses/s, the meter generally deflects to full-scale.

REMARKS

- When calibrating a monitor output signal, which cannot be adjusted to 100% value without an actual load and a measurement equipment, set *Pr. 54* to "21" (reference voltage output). 1440 pulses/s are output from the terminal FM.
- The wiring length of the terminal FM should be 200m at maximum.

NOTE

- **The initial value of the calibration parameter *C0 (Pr.900)* is set to 1mA full scale and 1440 pulse/s terminal FM pulse train output when the inverter output frequency is 60Hz. The maximum pulse train output of terminal FM is 2400 pulses/s.**
- **When a frequency meter is connected across terminals FM to SD to monitor the running frequency, the terminal FM output is filled to capacity at the initial value if the maximum output frequency reaches or exceeds 100Hz. In this case, the *Pr. 55* setting must be changed to the maximum frequency.**

Parameters referred to

Pr. 54 FM terminal function selection ☞ *Refer to page 152*
Pr. 55 Frequency monitoring reference ☞ *Refer to page 157*
Pr. 56 Current monitoring reference ☞ *Refer to page 157*

4.12.5 How to calibrate the terminal FM when using the operation panel

Perform the following procedure to calibrate terminal FM using the operation panel FR-DU07. *Refer to page 158* for the details of parameters.

Operation	Display
1. Confirm the operation status indicator and operation mode indicator	(When *Pr. 54* = 1) 0.00 Hz MON PU
2. Press (MODE) to choose the parameter setting mode.	PRM indicator is lit. MODE ⇨ P. 0 PRM (The parameter number read previously appears.)
3. Turn the setting dial until P. 160 appears.	P. 160
4. Press (SET) to read the present set value. "9999" (initial value) appears.	SET ⇨ 9999
5. Turn the setting dial to change it to the setting value of "0".	⇨ 0
6. Press (SET) to set.	SET ⇨ 0 ⇄ P. 160 **Flicker...Parameter setting complete!!**
7. Turn the setting dial until C. . . appears.	⇨ C. . .
8. Press (SET) to display C - - - .	SET ⇨ C - - - (C0 to C7 settings are enabled.)
9. Turn the setting dial until C 0 appears. Set to *C0 FM terminal calibration.*	⇨ C 0
10. Press (SET) to enable setting.	SET ⇨ 0.00 Hz (The monitor set to *Pr. 54 FM terminal function selection* is displayed.)
11. If the inverter is at a stop, press the (RUN) key to start the inverter. (Motor needs not be connected.)	RUN ⇨ 0.00 Hz MON PU
12. Turn the setting dial to adjust the indicator needle to the desired position.	+ / − ⇨  Analog indicator
13. Press (SET). Setting is complete.	SET ⇨ 60.00 Hz ⇄ C 0 **Flicker...Parameter setting complete!!**

- Turn the setting dial to read another parameter.
- Press (SET) to return to the C - - - indication (step 8).
- Press (SET) twice to show the next parameter (Pr.CL).

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REMARKS

- Calibration can also be made for External operation. Set the frequency in the External operation mode, and make calibration in the above procedure.
- Calibration can be made even during operation.
- For operation from the parameter unit (FR-PU04/FR-PU07), *refer to the Instruction Manual* of the parameter unit.

Parameters referred to

Pr. 54 FM terminal function selection ☞ *Refer to page 152*
Pr. 55 Frequency monitoring reference ☞ *Refer to page 157*
Pr. 56 Current monitoring reference ☞ *Refer to page 157*
C0(Pr.900) FM terminal calibration ☞ *Refer to page 138*

4.13 Operation selection at power failure and instantaneous power failure

Purpose	Parameter that should be Set		Refer to Page
At instantaneous power failure occurrence, restart inverter without stopping motor (general-purpose motor control)	**Automatic restart operation after instantaneous power failure/flying start**	**Pr. 30, Pr. 57, Pr. 58, Pr. 96, Pr. 162, Pr. 165, Pr. 298, Pr. 299, Pr. 611**	*161*
At instantaneous power failure occurrence, restart inverter without stopping motor (IPM motor control)	**Automatic restart operation after instantaneous power failure / flying start**	**Pr. 57, Pr. 162, Pr. 611**	*166*
When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.	**Power failure-time deceleration-to-stop function**	**Pr. 261**	*168*

4.13.1 Automatic restart after instantaneous power failure/flying start under general-purpose motor control (Pr. 30, Pr. 57, Pr. 58, Pr. 96, Pr. 162, Pr. 165, Pr. 298, Pr. 299, Pr. 611) V/F GP MFVC

You can restart the inverter without stopping the motor in the following cases:
- When power comes back ON after an instantaneous power failure
- When motor is coasting at start

Parameter Number	Name	Initial Value	Setting Range	Description
30	**Regenerative function selection**	0	0, 1	The motor starts at the starting frequency when MRS (X10) turns ON then OFF
			2	Restart operation is performed when MRS (X10) turns ON then OFF
57	**Restart coasting time**	9999	0	1.5K or lower ... 1s 2.2K to 7.5K .... 2s 11K and 15K.... 3s The above times are coasting time.
			0.1 to 5s	Waiting time for inverter-triggered restart after an instantaneous power failure.
			9999	No restart
58	**Restart cushion time**	1s	0 to 60s	Voltage starting time at restart.
96	**Auto tuning setting/status**	0	0	Offline auto tuning is not performed
			11	For General-purpose magnetic flux vector control Offline auto tuning is performed without motor running (motor constants (R1) only) *(Refer to page 93)*
			21	Offline auto tuning (tuning performed without motor running) for V/F control and automatic restart after instantaneous power failure (with frequency search)
162	**Automatic restart after instantaneous power failure selection**	1	0	Frequency search only performed at the first start
			1	Reduced voltage start only performed at the first start (no frequency search)
			10	Frequency search at every start
			11	Reduced voltage start at every start (no frequency search)
165	**Stall prevention operation level for restart**	120%	0 to 150%	Considers the rated inverter current as 100% and sets the stall prevention operation level during restart operation.
298	**Frequency search gain**	9999	0 to 32767	When offline auto tuning is performed under V/F control, frequency search gain necessary for frequency search for automatic restart after instantaneous power failure is set as well as the motor constants (R1).
			9999	Uses the Mitsubishi motor (SF-JR, SF-HR, SF-JRCA, SF-HRCA) constants
299	**Rotation direction detection selection at restarting**	0	0	Without rotation direction detection
			1	With rotation direction detection
			9999	When *Pr. 78* = 0, With rotation direction detection When *Pr. 78* = 1, 2 Without rotation direction detection
611	**Acceleration time at a restart**	9999	0 to 3600s	Acceleration time to reach *Pr.20 Acceleration/deceleration reference frequency* at a restart.
			9999	Acceleration time for restart is the normal acceleration time (e.g. *Pr. 7*)

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

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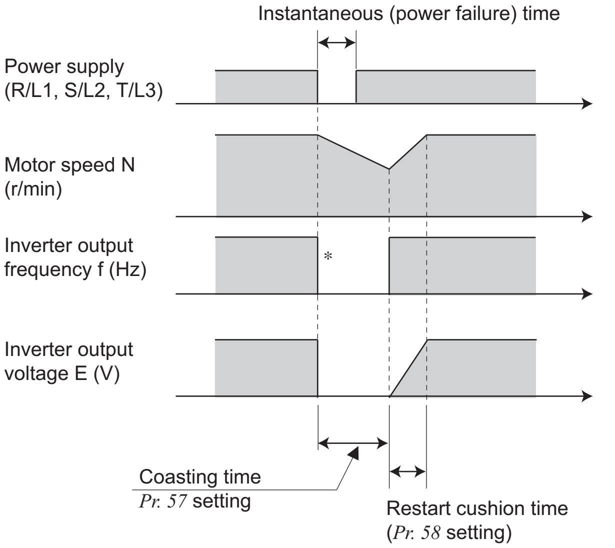
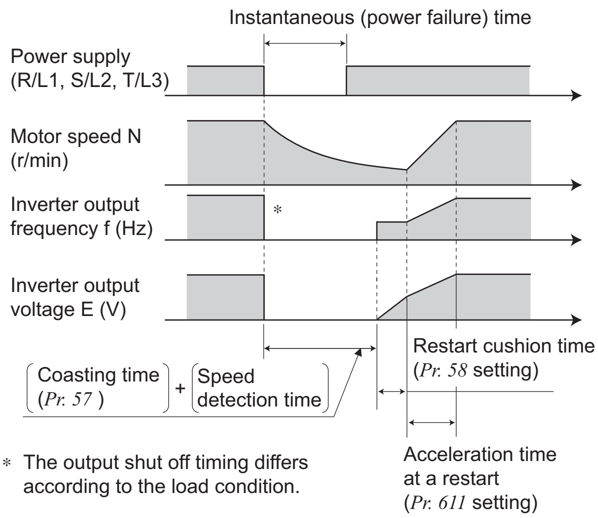
When *Pr. 162* = 1, 11 (without frequency search)



* The output shut off timing differs according to the load condition.

When *Pr. 162* = 0, 10 (with frequency search)



* The output shut off timing differs according to the load condition.

(1) Automatic restart operation selection
(Pr. 30, Pr. 162, Pr. 299)

● **Without frequency search**

When *Pr. 162* = "1 (initial value) or 11", automatic restart operation is performed in a reduced voltage system, where the voltage is gradually risen with the output frequency unchanged from prior to an instantaneous power failure independently of the coasting speed of the motor.

REMARKS

- This system stores the output frequency and rotation direction prior to an instantaneous power failure and restart using the stored value. Therefore, if the instantaneous power failure time exceeds 0.2s and the stored value cannot be retained, the inverter starts at *Pr. 13 Starting frequency* (initial value = 0.5Hz) in the starting direction upon power restoration.

● **With frequency search**

When "0 or 10" is set in *Pr. 162*, the inverter smoothly starts after detecting the motor speed upon power restoration. (The motor capacity should be equal to or one rank lower than the inverter capacity)

When using the frequency search, perform offline auto tuning.

(Refer to page *125* for General-purpose magnetic flux vector control and *page 163* for V/F control.)

- During reverse rotation, the inverter can be restarted smoothly as the direction of rotation is detected.
- You can select whether to make rotation direction detection or not with *Pr. 299 Rotation direction detection selection at restarting*.

  When capacities of the motor and inverter differ, set "0" (without rotation direction detection) in *Pr. 299*.

Pr. 299 Setting	*Pr. 78* Setting		
	0	1	2
9999	○	×	×
0 (initial value)	×	×	×
1	○	○	○

○: the rotation direction is detected.
×: the rotation direction is not detected.

REMARKS

- Speed detection time (frequency search) changes according to the motor speed. (maximum 100ms)
- When the inverter capacity is two rank or more larger than the motor capacity, the inverter may not start due to overcurrent trip (E.OC□).
- If two or more motors are connected to one inverter, the function does not operate properly. (The inverter does not start properly.)
- When reverse rotation is detected under the condition of *Pr. 78* = "1" (reverse rotation disabled), the rotation direction is changed to forward rotation after decelerates in reverse rotation when the start command is forward rotation. The inverter will not start when the start command is reverse rotation.

NOTE

- When automatic restart operation after instantaneous power failure is activated while the motor is running at a low speed (less than 10Hz), the motor restarts in the direction prior to instantaneous power failure without detecting the rotation direction (*Pr. 299 Rotation direction detection selection at restarting* = "1").
- If the frequency search result exceeds the set frequency, the output frequency is limited at the set frequency.
- When the wiring length exceeds 100m, select without frequency search (*Pr. 162* = "1, 11").

- **Restart operation at every start**
  When *Pr. 162* = "10 or 11", automatic restart operation is also performed every start, in addition to the automatic restart after instantaneous power failure. When *Pr. 162* = "0", automatic restart operation is performed at the first start after power supply ON, but not performed at the second time or later.
- **Automatic restart operation selection of MRS (X10) signal (When *Pr. 162* = "0, 1")**
  Restart operation after turning MRS (X10) signal ON then OFF using *Pr. 30* can be selected as in the table below. When automatic restart after instantaneous power failure is selected while using the high power factor converter (FR-HC2), normally set "2" in *Pr. 30*.

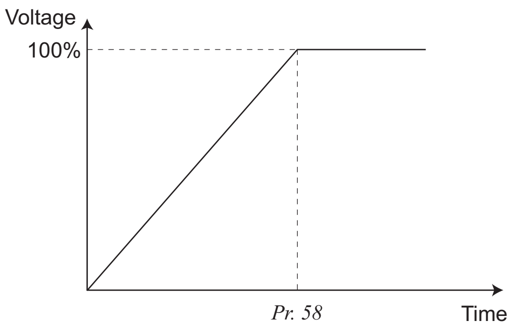
Pr. 30 Setting	Operation after MRS and X10 Signal Turns OFF, ON, then OFF.
0, 1	Start at the *Pr. 13 Starting frequency*.
2	Restart operation (Starts at the coasting speed)

(2) Restart coasting time *(Pr. 57)*

•Coasting time is the time from when the motor speed is detected until automatic restart control is started.
•Set *Pr. 57* to "0" to perform automatic restart operation.
The coasting time is automatically set to the value below. Generally this setting will pose no problems.
1.5K or lower 1s
2.2K to 7.5K 2s
11K and 15K..... 3s
•Operation may not be performed well depending on the magnitude of the moment of inertia (J) of the load or running frequency. Adjust the coasting time between 0.1s and 5s according to the load specifications.

(3) Restart cushion time *(Pr. 58)*

•Cushion time is the length of time taken to raise the voltage appropriate to detected motor speed (output frequency prior to instantaneous power failure when *Pr. 162* = "1, 11") from 0V.
•Normally the initial value need not be changed for operation, but adjust it according to the magnitude of the moment of inertia (J) of the load or torque.



(4) Automatic restart operation adjustment *(Pr. 165, Pr. 611)*

•Using *Pr. 165*, you can set the stall prevention operation level at a restart.
•Using *Pr. 611*, you can set the acceleration time until *Pr. 20 Acceleration/deceleration reference frequency* is reached when automatic restart operation is performed besides the normal acceleration time.

(5) Frequency search gain *(Pr. 298)*, offline auto tuning *(Pr. 96)*

•When automatic restart after instantaneous power failure operation (with frequency search) is valid at V/F control, perform offline auto tuning.
•Perform offline auto tuning during V/F control in the following order to set *Pr. 298 Frequency search gain* automatically. (Refer to *page 125* during General-purpose magnetic flux vector control.)

●Before performing offline auto tuning

Check the following points before performing offline auto tuning.

•The inverter is under V/F control
•General-purpose motors (three-phase motors) are connected. The motors are in stop status when the tuning starts.
•The motor capacity should be equal to or one rank lower than the inverter capacity.
•A high-slip motor, high-speed motor and special motor cannot be tuned. (Do not tune an IPM motor.)
•The maximum frequency is 120Hz.
•The motor may run slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs (caution is required especially in vertical lift applications). Note that tuning performance is unaffected even if the motor runs slightly.
•Offline auto tuning will not be performed properly if it is performed with a surge voltage suppression filter (FR-ASF-H, FR-BMF-H) connected between the inverter and motor. Remove it before starting tuning.

●Setting

1) Set "21" in *Pr. 96 Auto tuning setting/status*.
   Tuning is performed without motor running.
2) Set the rated motor current (initial value is rated inverter current) in *Pr. 9 Electronic thermal O/L relay*. *(Refer to page 119)*
3) Set *Pr. 71 Applied motor* according to the motor used.

Motor		*Pr.71* Setting ∗1
Mitsubishi standard motor 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 manufacturer's standard motor	—	3
Other manufacturer's constant-torque motor	—	13

∗1 *Refer to page 123*, for other settings of *Pr. 71*.

●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)

1) When performing PU operation, press (RUN) of the operation panel.
   For External operation, turn ON the start 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, FM, A, B, C
  Note that the progress status of offline auto tuning is output in five steps from FM when speed and output frequency are selected.
- **Since the RUN signal turns ON when tuning is started, caution is required especially when a sequence which releases a mechanical brake by the RUN signal has been designed.**
- **When executing offline auto tuning, input the run command after switching ON the main circuit power (R/L1, S/L2, T/L3) of the inverter.**
- **Do not perform ON/OFF switching of the second function selection signal (RT) during execution of offline auto tuning. Auto tuning is not executed properly.**

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)	Operation Panel Indication
Pr. 96 setting	21	21
(1) Setting	READ:List 21 ---STOP PU	
(2) Tuning in progress	TUNE 22 STF FWD PU	
(3) Normal end	TUNE 23 COMPLETION STF STOP PU	Flickering 
(4) Error end (when inverter protective function operation is activated)	TUNE ERROR 9 STF STOP PU	

REMARKS

It takes approximately 9s until tuning is completed.

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), frequency search gain are not set.
Perform an inverter reset and restart tuning.

Error Display	Error Cause	Remedy
8	Forced end	Set "21" 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 A motor is not connected.	Check the motor wiring and make setting again. 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 properly. (The frequency search gain 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*.

NOTE

- **The frequency search gain 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.**
- **The set frequency monitor displayed during the offline auto tuning is 0Hz.**
- **Changing the terminal assignment using *Pr.178 to Pr.182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **The SU and FU signals are not output during a restart. These are output after the restart cushion time has elapsed.**
- **Automatic restart operation will also be performed after a reset or when a retry is made by the retry function.**

⚠ CAUTION

⚠ **When automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the reset time has elapsed) after occurrence of an instantaneous power failure.**
Stay away from the motor and machine.
When you have selected automatic restart after instantaneous power failure function, apply in easily visible places the CAUTION stickers supplied to the Instruction Manual (Basic).

⚠ **When the start signal is turned OFF or STOP RESET is pressed during the restart cushion time after instantaneous power failure, deceleration starts after *Pr. 58 Restart cushion time* has elapsed.**

Parameters referred to

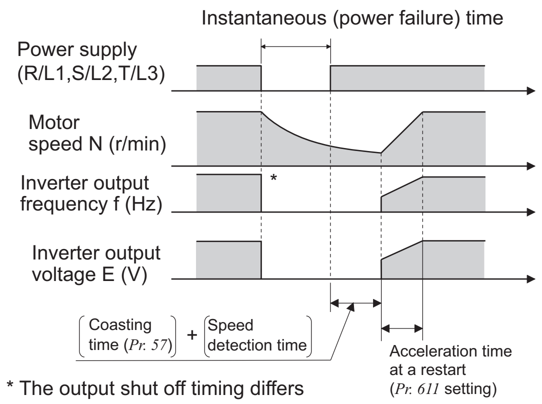
Pr. 7 Acceleration time Refer to page 113
Pr. 13 Starting frequency Refer to page 116
Pr. 65, Pr. 67 to Pr. 69 Retry function Refer to page 170
Pr. 71 Applied motor Refer to page 123
Pr. 78 Reverse rotation prevention selection Refer to page 197
Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 134

4.13.2 Automatic restart after instantaneous power failure/flying start under IPM motor control (Pr. 57, Pr. 162, Pr. 611) IPM

You can restart the inverter without stopping the motor in the following cases:
- When power comes back ON after an instantaneous power failure
- When motor is coasting at start

Parameter Number	Name	Initial Value	Setting Range	Description
57	**Restart coasting time**	9999	0	No waiting time
			0.1 to 5s	Set the waiting time for inverter-triggered restart after an instantaneous power failure.
			9999	No restart
162	**Automatic restart after instantaneous power failure selection**	1	0, 1	Frequency search at an initial start
			10, 11	Frequency search at every start
611	**Acceleration time at a restart**	9999	0 to 3600s	Set the acceleration time that takes to reach *Pr.20 Acceleration/deceleration reference frequency* setting at a restart.
			9999	Standard acceleration time (like *Pr. 7*) is applied at restart.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*



* The output shut off timing differs according to the load condition.

(1) Automatic restart operation

- The inverter smoothly starts after detecting the motor speed (frequency search) upon power restoration.
- During reverse rotation, the inverter can be restarted smoothly as the direction of rotation is detected.

REMARKS
Since the DC injection brake is operated instantaneously when the speed is detected at a restart, the speed may reduce if the moment of inertia (J) of the load is small.

- **Restart operation at every start**
  When *Pr. 162* = "10 (11)", automatic restart operation is also performed every start, in addition to the automatic restart after instantaneous power failure. When *Pr. 162* = "0 (1)", automatic restart operation is performed at the first start after power supply-ON, but starts at the starting frequency at the second time or later.

REMARKS
Automatic restart operation with reduced voltage is not available under IPM motor control. While *Pr. 162* = "1 or 11," automatic restart operation is performed with a frequency search (setting "0 or 10").

(2) Restart coasting time *(Pr. 57)*

- Coasting time is the time from when the motor speed is detected until automatic restart control is started.
- Set *Pr. 57* to "0" (without coasting time) to perform automatic restart operation.
  Generally this setting will pose no problems.
- Operation may not be performed well depending on the magnitude of the moment of inertia (J) of the load or running frequency. Adjust the coasting time between 0.1s and 5s according to the load specifications.

(3) Automatic restart operation adjustment *(Pr. 611)*

•Using *Pr. 611*, the acceleration time to reach *Pr. 20 Acceleration/deceleration reference frequency* can be set. This can be set separately from the normal acceleration time.

REMARKS

Even if the *Pr. 21 Acceleration/deceleration time increments* setting is changed, the setting increments of *Pr. 611* remain unchanged.

NOTE

- An IPM motor is a motor with interior permanent magnets. Regression voltage is generated when the motor coasts at an instantaneous power failure or makes a flying start. The inverter's DC bus voltage increases if the motor coasts fast or makes a flying start in this condition.
  When using the automatic restart after instantaneous power failure function (*Pr. 57 Restart coasting time* ≠ "9999"), it is recommended to use the regenerative avoidance operation (*Pr. 882 Regeneration avoidance operation selection* = "1") in combination for more a stable start. If the overvoltage protective function (E.OV□) activates at restart even with the regeneration avoidance function, additionally use the retry function (*Pr. 67*).

⚠ CAUTION

⚠ An IPM motor is a motor with interior permanent magnets. High voltage is generated at motor terminals while the motor is running. Do not touch motor terminals and other parts until the motor stops to prevent an electric shock.

⚠ When automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the reset time has elapsed) after occurrence of an instantaneous power failure.
Stay away from the motor and machine.
When you have selected the automatic restart after instantaneous power failure function, apply in easily visible places the CAUTION stickers supplied.

Parameters referred to

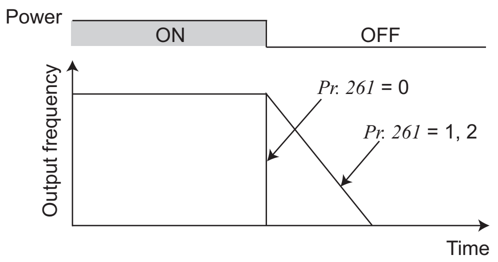
Pr. 13 Starting frequency ☞ *Refer to page 116*
Pr. 65, Pr. 67 to Pr. 69 Retry function ☞ *Refer to page 170*
Pr. 78 Reverse rotation prevention selection ☞ *Refer to page 197*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*
Pr. 882 Regeneration avoidance operation selection ☞ *Refer to page 262*

4.13.3 Power-failure deceleration stop function (Pr. 261) V/F GP MFVC

When a power failure or undervoltage occurs, the inverter can be decelerated to a stop or can be decelerated and re-accelerated to the set frequency.

Parameter Number	Name	Initial Value	Setting Range	Description
261	**Power failure stop selection**	0	0	Coasts to stop. When undervoltage or power failure occurs, the inverter output is shut off.
			1	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.
			2	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop. If power is restored during a power failure, the inverter accelerates again.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

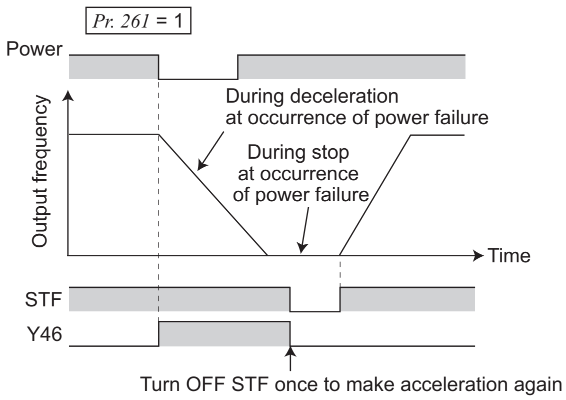


(1) Parameter setting

•When *Pr. 261* is set to "1 or 2", the inverter decelerates to a stop if an undervoltage or power failure occurs.

(2) Operation outline of deceleration to stop at power failure

•When undervoltage or power failure occurs, the output frequency is decreased and controlled so that the converter circuit (DC bus) voltage is constant and decreased to 0Hz to stop.

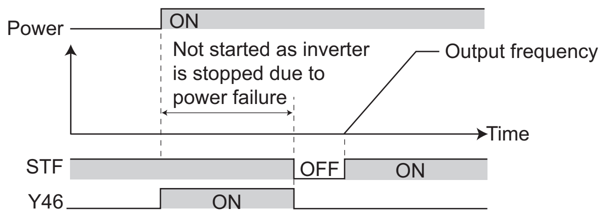


(3) Power failure stop function (*Pr. 261* = "1")

•If power is restored during power failure deceleration, deceleration to a stop is continued and the motor remains stopped. To restart, turn OFF the start signal once, then turn it ON again.

REMARKS

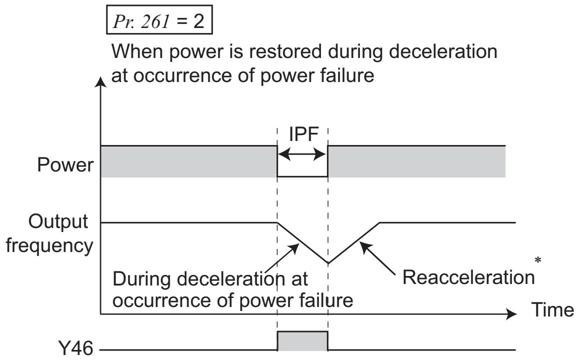
- When automatic restart after instantaneous power failure is selected (*Pr. 57* ≠ "9999"), power failure stop function is made invalid and automatic restart operation after instantaneous power failure is valid.
- When the power failure deceleration stop function is active (*Pr. 261* = "1"), the inverter will not start even if the power is turned ON with the start signal (STF/STR) ON. After switching ON the power, turn OFF the start signal once and then ON again to make a start.

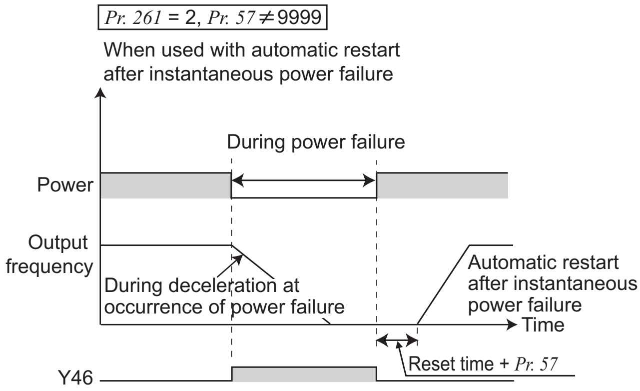


(4) Operation continuation at instantaneous power failure function (*Pr. 261* = "2")

•When power is restored during deceleration after a power failure, acceleration is made again up to the set frequency.

•When this function is used in combination with the automatic restart after instantaneous power failure function (*Pr. 57* ≠ "9999"), deceleration can be made at a power failure and acceleration can be made again after power restoration.





* Acceleration time depends on *Pr. 7 (Pr. 44)*.

NOTE

- **When operation continuation at instantaneous power failure function is used, keep the starting signal (STF/STR) ON even during instantaneous power failure. If the starting signal turns OFF during instantaneous power failure, the inverter decelerates according to the deceleration time setting, causing the motor to coast if enough regenerative energy is not obtained.**

(5) Power failure deceleration signal (Y46 signal)

•The Y46 signal is ON during deceleration at an instantaneous power failure or during a stop after deceleration at an instantaneous power failure.

•After a power failure stop, the inverter can not start even if power is restored and the start command is given. In this case, check the power failure deceleration signal (Y46 signal). (at occurrence of input phase loss (E.ILF), etc.)

•For the Y46 signal, set "46 (forward operation)" or "146 (reverse operation)" to *Pr. 190 or Pr. 192 (output terminal function selection)* to assign the function.

REMARKS

- During a stop or trip, the power failure stop selection is not performed.

NOTE

- **Changing the terminal assignment using *Pr. 190 and Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **The power failure deceleration stop function is unavailable under IPM motor control regardless of the *Pr. 261* setting.**

⚠ CAUTION

⚠ **Even if the power failure stop function is valid, some loads may cause the inverter to trip and the motor to coast.**
The motor will coast if enough regenerative energy is not given from the motor to the inverter.

Parameters referred to

Pr. 57 Restart coasting time ☞ *Refer to page 161*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*

4.14 Operation setting at fault occurrence

Purpose	Parameter that should be Set		Refer to Page
Recover by retry operation at fault occurrence	Retry operation	Pr. 65, Pr. 67 to Pr. 69	170
Do not output input/output phase failure alarm	Input/output phase failure protection selection	Pr. 251, Pr. 872	172
Detect an earth (ground) fault at start	Earth (ground) fault detection at start	Pr. 249	172
Prevent the motor from overspeeding	Overspeed detection level	Pr. 374	173

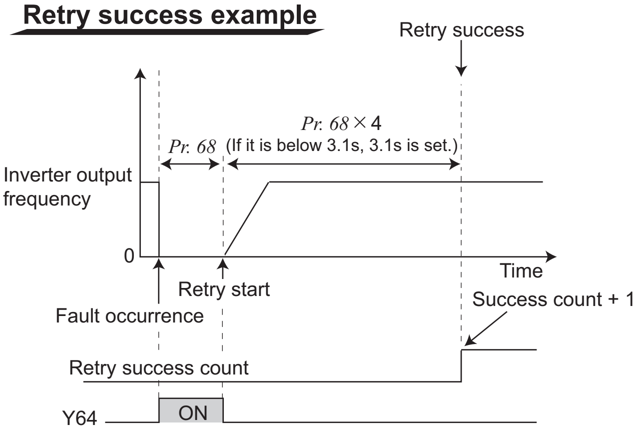
4.14.1 Retry function (Pr. 65, Pr. 67 to Pr. 69)

If a fault occurs, the inverter resets itself automatically to restart. You can also select the fault for a retry.
When you have selected automatic restart after instantaneous power failure (*Pr. 57 Restart coasting time* ≠ 9999), restart operation is performed at the retry operation time which is the same of that of a power failure. (*Refer to page 161* for the restart function.)

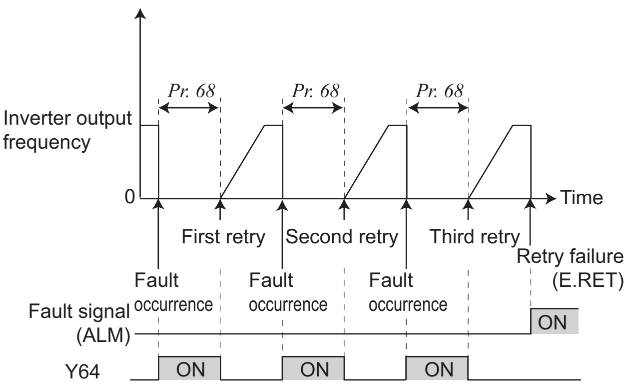
Parameter Number	Name	Initial Value	Setting Range	Description
65	**Retry selection**	0	0 to 5	A fault for retry can be selected. *(Refer to the next page)*
67	**Number of retries at fault occurrence**	0	0	No retry function
			1 to 10	Set the number of retries at fault occurrence. A fault output is not provided during retry operation.
			101 to 110	Set the number of retries at fault occurrence. (The setting value of minus 100 is the number of retries.) A fault output is provided during retry operation.
68	**Retry waiting time**	1s	0.1 to 600s	Set the waiting time from when an inverter fault occurs until a retry is made.
69	**Retry count display erase**	0	0	Clear the number of restarts succeeded by retry.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

Retry success example



Retry failure example



- Retry operation automatically resets a fault and restarts the inverter at the starting frequency when the time set in *Pr. 68* elapses after the inverter is tripped.
- Retry operation is performed by setting *Pr. 67* to any value other than "0". Set the number of retries at fault occurrence in *Pr. 67*.
- When retries fail consecutively equal to or more than the number of times set in *Pr. 67*, a retry count excess fault (E.RET) occurs, resulting in inverter trip. (Refer to retry failure example)
- Use *Pr. 68* to set the waiting time from when the inverter trips until a retry is made in the range of 0.1 to 600s.
- For IPM motor control, set *Pr. 68* (waiting time) longer than the coasting time. Otherwise, the retry operation may be performed while the motor is coasting. Alternatively, enable the automatic restart after instantaneous power failure by setting *Pr. 162* = "10" (with frequency search at every start).
- Reading the *Pr. 69* value provides the cumulative number of successful restart times made by retry.
  The cumulative count in *Pr. 69* is increased by 1 when a retry is regarded as successful after normal operation continues without faults occurring for more than four times longer than the time (3.1s at shortest) set in *Pr. 68* after a retry start.
  (When retry is successful, cumulative number of retry failure is cleared.)
- Writing "0" to *Pr. 69* clears the cumulative count.

- During a retry, the Y64 signal is ON. For the Y64 signal, assign the function by setting "64 (positive operation)" or "164 (negative operation)" to *Pr. 190 or Pr. 192 (output terminal function selection)* .
- Using *Pr. 65*, you can select the fault that will cause a retry to be executed. No retry will be made for the fault not indicated. (*Refer to page 298* for the fault description.)
  ● indicates the faults selected for retry.

Fault for Retry	*Pr. 65* Setting					
	0	1	2	3	4	5
E.OC1	●	●		●	●	●
E.OC2	●	●		●	●	
E.OC3	●	●		●	●	●
E.OV1	●		●	●	●	
E.OV2	●		●	●	●	
E.OV3	●		●	●	●	
E.THM	●					
E.THT	●					
E.UVT	●				●	
E. BE	●				●	

Fault for Retry	*Pr. 65* Setting					
	0	1	2	3	4	5
E. GF	●				●	
E.OHT	●					
E.PTC	●					
E.OLT	●				●	
E. PE	●				●	
E.ILF	●				●	
E.CDO	●				●	
E.SOT	●	●		●	●	●
E.OS	●				●	
E.PID	●				●	

NOTE

- **Use the retry function only when the operation can be resumed after resetting a protective function activation. Making a retry against the protective function, which is activated by an unknown condition, will lead the drive unit and motor to be faulty. Identify in what condition the protective function was activated, and eliminate such condition before resuming the operation.**
- **When terminal assignment is changed using *Pr. 190 and Pr. 192*, the other functions may be affected. Set parameters after confirming the function of each terminal.**
- **The data stored as the error reset for retry is only that of the fault which occurred the first time.**
- **When an inverter fault is reset by the retry function at the retry time, the accumulated data of the electronic thermal relay function, regeneration brake duty etc. are not cleared. (Different from the power-ON reset.)**
- **Retry is not performed if E.PE (Parameter storage device fault) occurred at power ON.**
- **If a fault that is not selected for a retry occurs during retry operation (retry waiting time), the retry operation stops while the fault indication is still displayed.**
- **The retry function is invalid for the fault initiated by the fault initiation function.**

⚠ CAUTION

⚠ **When you have selected the retry function, stay away from the motor and machine in the case of the inverter is tripped. The motor and machine will start suddenly (after the reset time has elapsed) after the inverter trip.**
When you have selected the retry function, apply in easily visible places the CAUTION stickers supplied to the Instruction Manual (Basic).

Parameters referred to

Pr. 57 Restart coasting time ☞ *(Refer to page 161, 166)*
Pr. 162 Automatic restart after instantaneous power failure selection ☞ *(Refer to page 166)*
Pr. 190, Pr. 192 (output function selection) ☞ *(Refer to page 140)*

4.14.2 Input/output phase loss protection selection (Pr. 251, Pr. 872)

You can choose whether to make Input/output phase loss protection valid or invalid.
- Output phase loss protection is a function to stop the inverter output if one of the three phases (U, V, W) on the inverter's output side is lost.
- Input phase loss protection is a function to stop the inverter output if one of the three phases (R/L1, S/L2, T/L3) on the inverter's input side is lost.

Parameter Number	Name	Initial Value	Setting Range	Description
251	**Output phase loss protection selection**	1	0	Without output phase loss protection
			1	With output phase loss protection
872	**Input phase loss protection selection**	0	0	Without input phase loss protection
			1	With input phase loss protection

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

(1) Output phase loss protection selection *(Pr. 251)*

- If phase loss occurs during inverter operation (except for during DC brake operation, or output frequency is 1Hz or less), output phase loss protection (E.LF) activates, and inverter trips.
- When *Pr. 251* is set to "0", output phase loss protection (E.LF) becomes invalid.

(2) Input phase loss protection selection *(Pr. 872)*

- When *Pr. 872* is set to "1", input phase loss protection (E.ILF) is provided if a phase loss of one phase among the three phases is detected for 1s continuously.

NOTE
- **If an input phase loss continues for a long time, the converter section and capacitor lives of the inverter will be shorter.**
- **If the load is light or during a stop, lost phase cannot be detected because detection is performed based on the fluctuation of bus voltage. Large unbalanced phase-to-phase voltage of the three-phase power supply may also cause input phase loss protection (E.ILF).**
- **Phase loss can not be detected during regeneration load operation.**

4.14.3 Earth (ground) fault detection at start (Pr. 249)

You can choose whether to make earth (ground) fault detection at start valid or invalid. Earth (Ground) fault detection is executed only right after the start signal is input to the inverter.
Protective function will not activate if an earth (ground) fault occurs during operation.

Parameter Number	Name	Initial Value	Setting Range	Description
249	**Earth (ground) fault detection at start**	0	0	Without earth (ground) fault detection
			1	With earth (ground) fault detection

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

NOTE
- As detection is executed at start, output is delayed for approx. 20ms every start.
- If an earth (ground) fault is detected with "1" set in *Pr. 249*, output side earth (ground) fault overcurrent (E.GF) is detected and the inverter trips. (*Refer to page 305)*
- If the motor capacity is smaller than the inverter capacity when using the 5.5K or higher, earth (ground) fault detection may not be provided.

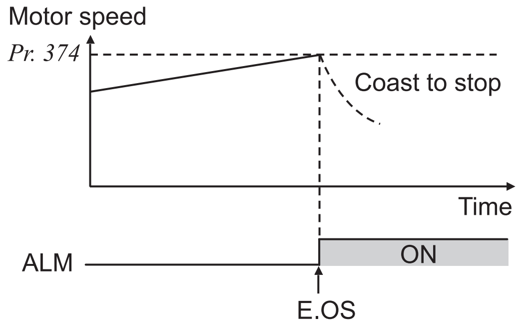
4.14.4 Overspeed detection function (*Pr.374*)

Inverter outputs are stopped when the motor speed exceeds the *Pr.374 Overspeed detection level* under IPM motor control.

Parameter Number	Name	Initial value	Setting range	Description
374 Ver.UP	**Overspeed detection level**	9999	0 to 400Hz	When the motor speed exceeds the speed set in *Pr.374*, overspeed (E.OS) occurs, and the inverter outputs are stopped.
			9999	No function

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

Ver.UP ..... Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.



Selecting the IPM motor control by the parameter setting mode or *Pr.998 IPM parameter initialization* changes the *Pr.374* setting to "maximum motor frequency (motor speed) × 105%". (For the details of parameter setting mode and *Pr.998 IPM parameter initialization*, refer to *page 83*.)

NOTE

- An E.OS activation at a high frequency setting (a frequency higher than "maximum motor speed × 105%") may damage the inverter.

4

PARAMETERS

4.15 Energy saving operation and energy saving monitor

Purpose	Parameter that should be Set		Refer to Page
Energy saving operation	**Optimum excitation control**	**Pr. 60**	*174*
How much energy can be saved	**Energy saving monitor**	**Pr. 52, Pr. 54, Pr. 158, Pr. 891 to Pr. 899**	*175*

4.15.1 Optimum excitation control (Pr. 60) V/F

Without a fine parameter setting, the inverter automatically performs energy saving operation.
This operation is optimum for fan and pump applications

Parameter Number	Name	Initial Value	Setting Range	Description
60	**Energy saving control selection ***	0	0	Normal operation mode
			9	Optimum excitation control mode

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

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

- When "9" is set in *Pr. 60*, the inverter operates in the Optimum excitation control mode.
- The Optimum excitation control mode is a control system which controls excitation current to improve the motor efficiency to maximum and determines output voltage as an energy saving method.

REMARKS

- When the motor capacity is too small as compared to the inverter capacity or two or more motors are connected to one inverter, the energy saving effect is not expected.

NOTE

- **When the Optimum excitation control mode is selected, deceleration time may be longer than the setting value. Since overvoltage alarm tends to occur as compared to the constant-torque load characteristics, set a longer deceleration time.**
- **Optimum excitation control will not be performed during an automatic restart after instantaneous power failure.**
- **Since output voltage is controlled by Optimum excitation control, output current may slightly increase.**

Parameters referred to

Pr. 57 Restart coasting time ☞ *Refer to page 161*

4.15.2 Energy saving monitor (Pr. 891 to Pr. 899)

From the power consumption estimated value during commercial power supply operation, the energy saving effect by use of the inverter can be monitored/output.

Parameter Number	Name	Initial Value	Setting Range	Description
52	**DU/PU main display data selection**	0 (output frequency)	0, 5, 8 to 12, 14, 20, 23 to 25, 50 to 55, 61, 62, 64, 100	50: Power saving monitor 51: Cumulative power saving monitor
54	**FM terminal function selection**	1 (output frequency)	1 to 3, 5, 8 to 12, 14, 21, 24, 50, 52, 53, 61, 62	50:Power saving monitor
891	**Cumulative power monitor digit shifted times**	9999	0 to 4	Set the number of times to shift the cumulative power monitor digit (Clamps the monitor value at maximum.)
			9999	No shift (Clears the monitor value when it exceeds the maximum value.)
892	**Load factor**	100%	30 to 150%	Set the load factor for commercial power-supply operation. Multiplied by the power consumption rate *(page 179)* during commercial power supply operation.
893	**Energy saving monitor reference (motor capacity)** *	Rated inverter capacity	0.4 to 15kW	The motor capacity (pump capacity). Set when calculating power saving rate, average power saving rate, commercial operation power.
894	**Control selection during commercial power-supply operation**	0	0	Discharge damper control (fan)
			1	Inlet damper control (fan)
			2	Valve control (pump)
			3	Commercial power-supply drive (fixed value)
895	**Power saving rate reference value**	9999	0	Consider the value during commercial power-supply operation as 100%
			1	Consider the *Pr. 893* setting as 100%.
			9999	No function
896	**Power unit cost**	9999	0 to 500	The power unit cost. Displays the power cost savings on the energy saving monitor.
			9999	No function
897	**Power saving monitor average time**	9999	0	Average for 30 minutes
			1 to 1000h	Average for the set time
			9999	No function
898	**Power saving cumulative monitor clear**	9999	0	Cumulative monitor value clear
			1	Cumulative monitor value hold
			10	Accumulation continued (communication data upper limit 9999)
			9999	Accumulation continued (communication data upper limit 65535)
899	**Operation time rate (estimated value)**	9999	0 to 100%	Set the annual operation ratio (consider 365 days × 24h as 100%). (Use for calculation of annual power saving amount.)
			9999	No function

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
The above parameters allow their settings to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.
* Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

4

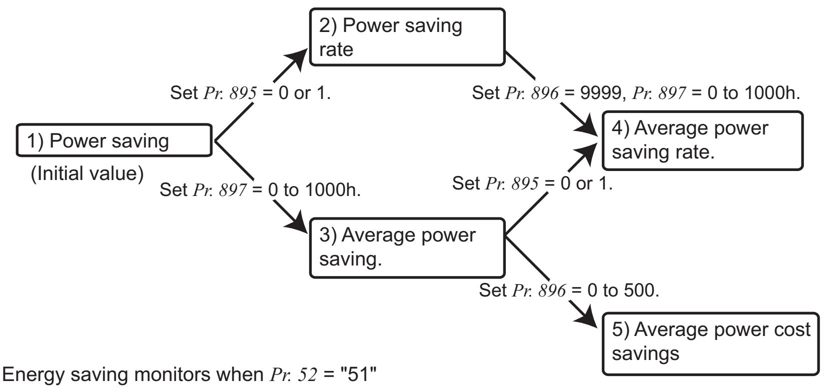
PARAMETERS

(1) Energy saving monitor list

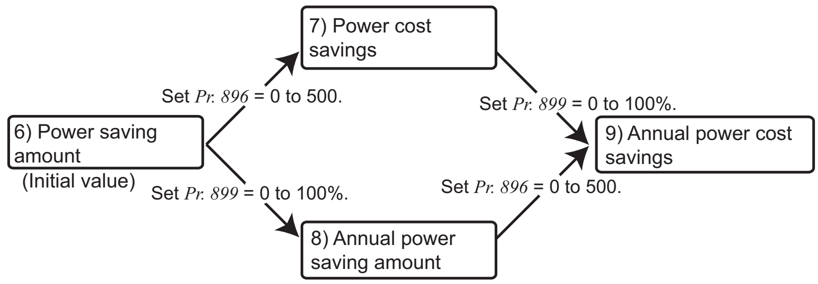
Category	Energy Saving Monitored Item	Description	Remarks
Real-time energy saving	**1) Power saving** **2) Power saving rate**	Displays the real-time energy savings based on the following calculation: The (estimated) power consumption during the commercial power supply operation - the input power to the inverter The energy saving effect by the inverter operation can be checked in real time.	Monitoring is available when *Pr. 52* or *Pr. 54* = "50."
Average energy saving effect	**3) Average power saving** **4) Average power saving rate** **5) Average power cost savings**	Displays the energy savings per hour, which is the average for the period set in the parameter (30min to 40 days). Monitored values can be periodically obtained using analog outputs and communication. The obtained data is useful for statistical analysis and forecasts.	
Cumulative energy savings	**6) Power saving amount** **7) Power cost savings**	Displays the cumulative energy savings. The cumulative energy savings can be checked. The cumulative energy savings can be cleared to zero or can be set cumulative. It is useful to check the energy saving effect for a particular operation, including a test operation.	Monitoring is available when *Pr. 52* = "51."
Annual energy saving estimation	**8) Annual power saving amount** **9) Annual power cost savings**	Annual energy savings can be estimated with the cumulative energy saving during an inverter operation and an operating time. Set an annual operating time ratio (annual operating ratio) in the parameter. The energy savings is automatically calculated inside the inverter.	

(*Pr. 54* (terminal FM) only accepts the outputs of 1) Power saving and 3) Average power saving.)

● Energy saving monitors when *Pr. 52* or *Pr. 54* = "50"



● Energy saving monitors when *Pr. 52* = "51"



• Details of the energy saving monitors (*Pr. 52* and *Pr. 54* = "50")

<table>
<tr><th rowspan="2"></th><th rowspan="2">Energy Saving Monitored Item</th><th rowspan="2">Description and Formula</th><th rowspan="2">Unit</th><th colspan="4">Parameter Setting</th></tr>
<tr><th>Pr. 895</th><th>Pr. 896</th><th>Pr. 897</th><th>Pr. 899</th></tr>
<tr><td>1)</td><td>Power saving</td><td>Difference between the estimated value of power necessary for commercial power supply operation and the input power calculated by the inverter
Power during commercial power supply operation − input power monitor</td><td>0.01kW</td><td>9999</td><td rowspan="3">—</td><td rowspan="3">9999</td><td rowspan="8">—</td></tr>
<tr><td rowspan="2">2)</td><td rowspan="2">Power saving rate</td><td>Ratio of power saving on the assumption that power during commercial power supply operation is 100%
$\frac{\text{1) Power saving}}{\text{Power during commercial power supply operation}} \times 100$</td><td rowspan="2">0.1%</td><td>0</td></tr>
<tr><td>Ratio of power saving on the assumption that Pr. 893 is 100%
$\frac{\text{1) Power saving}}{Pr.\ 893} \times 100$</td><td>1</td></tr>
<tr><td>3)</td><td>Average power saving</td><td>Average value of power saving amount per hour during predetermined time (Pr. 897)
$\frac{\Sigma(\text{ 1) Power saving} \times \Delta t)}{Pr.\ 897}$</td><td>0.01kWh</td><td>9999</td><td rowspan="3">9999</td><td rowspan="4">0 to 1000h</td></tr>
<tr><td rowspan="2">4)</td><td rowspan="2">Average power saving rate</td><td>Ratio of average power saving on the assumption that the value during commercial power supply operation is 100%
$\frac{\Sigma(\text{ 2) Power saving rate} \times \Delta t)}{Pr.\ 897} \times 100$</td><td rowspan="2">0.1%</td><td>0</td></tr>
<tr><td>Ratio of average power saving on the assumption that Pr. 893 is 100%
$\frac{\text{3) Average power saving}}{Pr.\ 893} \times 100$</td><td>1</td></tr>
<tr><td>5)</td><td>Average power cost savings</td><td>Average power saving represented in terms of cost
3) Average power saving × Pr. 896</td><td>0.01</td><td>—</td><td>0 to 500</td></tr>
</table>

•Details of the cumulative power saving monitors (*Pr. 52* = "51")

(The monitor value of the cumulative monitor can be shifted to the right with *Pr. 891 Cumulative power monitor digit shifted times*.)

<table>
<tr><th rowspan="2"></th><th rowspan="2">Energy Saving Monitor Item</th><th rowspan="2">Description and Formula</th><th rowspan="2">Unit</th><th colspan="4">Parameter Setting</th></tr>
<tr><th>Pr. 895</th><th>Pr. 896</th><th>Pr. 897</th><th>Pr. 899</th></tr>
<tr><td>6)</td><td>Power saving amount</td><td>Power saving is added up per hour.
$\Sigma(\text{ 1) Power saving} \times \Delta t)$</td><td>0.01kWh *1*2</td><td>—</td><td>9999</td><td rowspan="4">—</td><td rowspan="2">9999</td></tr>
<tr><td>7)</td><td>Power cost savings</td><td>Power saving amount represented in terms of cost
6) Power saving amount × Pr. 896</td><td>0.01*1</td><td>—</td><td>0 to 500</td></tr>
<tr><td>8)</td><td>Annual power saving amount</td><td>Estimated value of annual power saving amount
$\frac{\text{6) Power saving amount}}{\text{Operation time during accumulation of power saving amount}} \times 24 \times 365 \times \frac{Pr.\ 899}{100}$</td><td>0.01kWh *1*2</td><td>—</td><td>9999</td><td rowspan="2">0 to 100%</td></tr>
<tr><td>9)</td><td>Annual power cost savings</td><td>Annual power saving amount represented in terms of cost
8) Annual power saving amount × Pr. 896</td><td>0.01*1</td><td>—</td><td>0 to 500</td></tr>
</table>

*1 For RS-485 communication, the display increments are 1. For example, 10.00kWh indicates that communication data is 10.

*2 When using the parameter unit (FR-PU04/FR-PU07), "kW" is displayed.

REMARKS

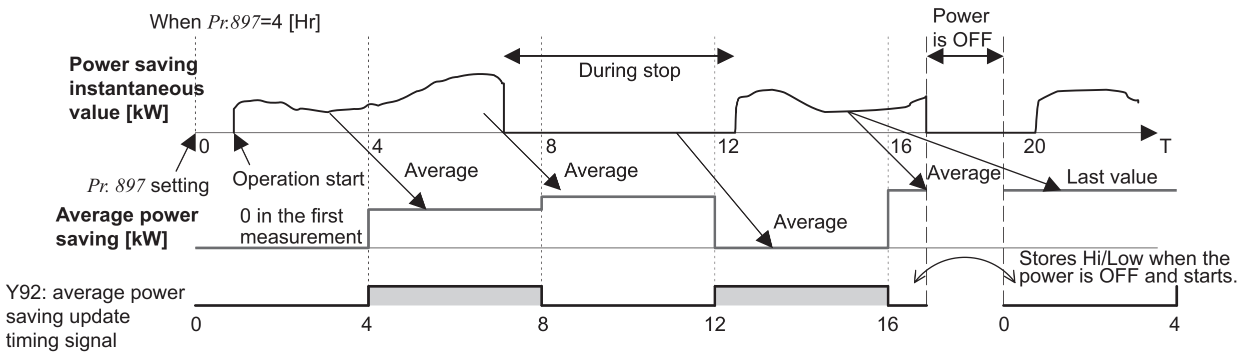
- Since four digits are displayed on the operation panel, the value is displayed in 0.1 increments when a monitor value in 0.01 increments exceeds 99.99, then rounded up to 100.0. The maximum display is "9999".
- As the operation panel (FR-PU04/FR-PU07) is 5-digit display, it displays in 0.1 increments since a carry occurs, e.g. "1000.0", when a monitor value in 0.01 increments exceeds "999.99". The maximum display is "99999".
- The upper limit of RS-485 communication is "65535" when *Pr. 898* Power saving cumulative monitor clear = "9999". The upper limit of 0.01 increments monitor is "655.35" and that of 0.1 increments monitor is "6553.5"

(2) Power saving instantaneous monitor (1) power savings, 2) power saving rate)

- On the power saving monitor (1)), an energy saving effect as compared to the power consumption during commercial power supply operation (estimated value) is calculated and displays on the main monitor.
- In the following case, the power saving monitor (1)) is "0".
  (a)Calculated values of the power saving monitor are negative values.
  (b)During the DC injection brake operation
  (c)Motor is not connected (output current monitor is 0A)
- On the power saving rate monitor (2)), setting "0" in *Pr. 895 Power saving rate reference value* displays the power saving rate on the assumption that power (estimated value) during commercial power supply operation is 100%. When *Pr. 895* = "1", the power saving rate on the assumption that the *Pr. 893 Energy saving monitor reference (motor capacity)* value is 100% is displayed.

(3) Average power saving monitor (3) average power saving, 4) average power saving rate, 5) average power cost savings)

- Average power saving monitor is displayed by setting a value other than "9999" in *Pr. 897 Power saving monitor average time*.
- The average power saving monitor (3)) displays the unit time average value of the power saving amount at averaging.
- The average value is updated every time an average time has elapsed after the *Pr. 897* setting is changed, power is turned ON or the inverter is reset, assuming as a starting point. The power savings average value update timing signal (Y92) is inverted every time the average value is updated.



- When *Pr. 895 Power saving rate reference value* = "0 or 1", the average power saving rate (2)) for the averaging time period is displayed on the average power saving rate monitor (4)).
- By setting the charge (power unit) per 1kWh of power amount in *Pr. 896 Power unit cost*, the average power cost savings monitor (5)) displays the cost relative to the average power saving (average power saving (3)) × *Pr. 896*).

(4) Cumulative power saving monitor (6) power saving amount, 7) power cost savings, 8) annual power saving amount, 9) annual power cost savings)

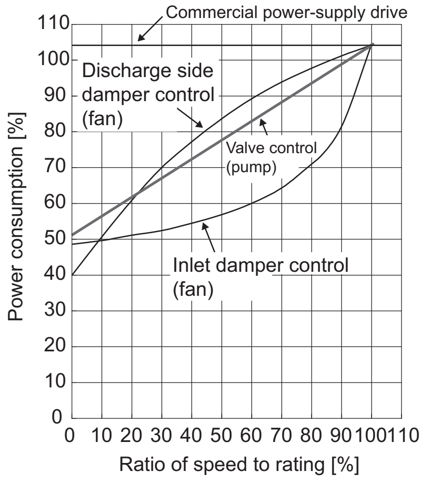
- On the cumulative power saving monitor, the monitor data digit can be shifted to the right by the number of *Pr. 891 Cumulative power monitor digit shifted times* settings. For example, if the cumulative power value is 1278.56kWh when *Pr. 891* = "2", the PU/DU display is 12.78 (display in 100kWh increments) and the communication data is 12. If the maximum value is exceeded at *Pr. 891* = "0 to 4", the power is clamped at the maximum value, indicating that a digit shift is necessary. If the maximum value exceeded at *Pr. 891* = "9999", the power returns to 0 and is recounted. The other monitors are clamped at the display maximum value.
- The cumulative power saving monitor (6)) can measure the power amount during a predetermined period. Measure according to the following steps
  1)Write "9999" or "10" in *Pr. 898 Power saving cumulative monitor clear*.
  2)Write "0" in *Pr. 898* at measurement start timing to clear the cumulative power saving monitor value and start accumulation of power saving.
  3)Write "1" in *Pr. 898* at measurement end timing to hold the cumulative power saving monitor value.

REMARKS

- The cumulative power saving monitor value is stored every hour. Hence, when the power supply is switched OFF within one hour, and switched ON again, the previously stored monitor value is displayed and accumulation starts. (The cumulative monitor value may decrease)

(5) Power estimated value of commercial power supply operation *(Pr. 892, Pr. 893, Pr. 894)*

- Select the commercial power supply operation pattern from among the four patterns of discharge damper control (fan), inlet damper control (fan), valve control (pump) and commercial power supply drive, and set it to *Pr. 894 Control selection during commercial power-supply operation*.
- Set the motor capacity (pump capacity) in *Pr. 893 Energy saving monitor reference (motor capacity)*.
- The power consumption rate (%) during commercial power supply operation is estimated from the operation pattern and the ratio of speed to rating (current output frequency / *Pr. 3 Base frequency* (rated frequency under the IPM motor control *(Refer to page 86)*) in the following chart.



- From the motor capacity set in *Pr. 893* and *Pr. 892 Load factor*, the power estimated value (kW) during commercial power supply operation is found by the following formula.

Power estimated value (kW) during commercial power supply operation

$$= \textit{Pr. 893}\ \textbf{(kW)} \times \frac{\textbf{Power consumption (\%)}}{\textbf{100}} \times \frac{\textit{Pr. 892}\ \textbf{(\%)}}{\textbf{100}}$$

REMARKS

- Since the speed does not increase above the power supply frequency in commercial power supply operation, it becomes constant when the output frequency rises to or above *Pr. 3 Base frequency* (60Hz under IPM motor control).

(6) Annual power saving amount, power cost *(Pr. 899)*

- By setting the operation time rate [%] (ratio of time when the motor is actually driven by the inverter during a year) in *Pr. 899*, the annual energy saving effect can be predicted.
- When the operation pattern is predetermined to some degree, the estimated value of the annual power saving amount can be found by measurement of the power saving amount during a given measurement period.
- Refer to the following and set the operation time rate.
  1)Predict the average time [h/day] of operation in a day.
  2)Find the annual operation days [days/year]. (Monthly average operation days × 12 months)
  3)Calculate the annual operation time [h/year] from 1) and 2).

Annual operation time (h/year) = Average time (h/day) × Operation days (days/year)

4)Calculate the operation time rate and set it to *Pr. 899*.

$$\textbf{Operation time rate (\%)} = \frac{\textbf{Annual operation time (h/year)}}{\textbf{24 (h/day) x 365 (days/year)}} \times \textbf{100(\%)}$$

REMARKS

- Operation time rate setting example: When operation is performed for about 21 hours per day and the monthly average operation days are 16 days
  Annual operation time = 21 (h/day) × 16 (days/month) × 12 months = 4032 (h/year)

$$\text{Operation time rate (\%)} = \frac{\text{4032 (h/year)}}{\text{24 (h/day)} \times \text{365 (days/year)}} \times \text{100(\%)} = \underline{\text{46.03\%}}$$

Set 46.03% to *Pr. 899*.

- Calculate the annual power saving amount from *Pr. 899 Operation time rate (estimated value)* and average power saving monitor

Annual power saving amount (kWh/year) = Average power saving (kW) during accumulation when *Pr. 898* = 10 or 9999 × 24h × 365 days × $\frac{\textit{Pr. 899}}{100}$

- The annual power cost savings can be monitored by setting the power cost per hour in *Pr. 896 Power unit cost*.
  Calculate the annual power cost savings in the following method.

Annual power cost savings = Annual power saving amount (kWh/year) × *Pr. 896*

REMARKS

In the regeneration mode, make calculation on the assumption that "power saving = power during commercial power supply operation (input power = 0)".

Parameters referred to

Pr. 3 Base frequency ☞ *Refer to page 103*
Pr. 52 DU/PU main display data selection ☞ *Refer to page 152*
Pr. 54 FM terminal function selection ☞ *Refer to page 152*

4.16 Motor noise, EMI measures, mechanical resonance

Purpose of Use	Parameter that should be Set		Refer to Page
Reduction of the motor noise **Measures against EMI and leakage currents**	**Carrier frequency and Soft-PWM selection**	**Pr. 72, Pr. 240, Pr. 260**	*181*
Reduce mechanical resonance	**Speed smoothing control**	**Pr. 653**	*182*

4.16.1 PWM carrier frequency and Soft-PWM control (Pr. 72, Pr. 240, Pr. 260)

You can change the motor sound.

Parameter Number	Name	Initial Value	Setting Range	Description	
72 *1	**PWM frequency selection**	1	0 to 15	You can change the PWM carrier frequency.	
				V/F GP MFVC	The setting is in [kHz]. Note that 0 indicates 0.7kHz and 15 indicates 14.5kHz.
				IPM	0 to 4 : 2.5kHz 5 to 7 : 5kHz 8, 9 : 7.5kHz 10 to 12 : 10kHz 13 to 15 : 12.5kHz
240 *1	**Soft-PWM operation selection**	1 *2	0	Soft-PWM is invalid	
			1	When the PWM carrier frequency (*Pr. 72*) is 5kHz or less, the Soft-PWM function is valid.	
260	**PWM frequency automatic switchover**	1 *3	0	PWM carrier frequency is constant independently of load.	
			1	Decreases PWM carrier frequency automatically when load increases.	

The above parameters can be set when *Pr.160 Extended function display selection* = "0". *(Refer to page 197)*

*1 These parameters allow their settings to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr.77 Parameter write selection.*

*2 Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

*3 Performing IPM parameter initialization sets back the settings to the initial settings. *(Refer to page 85)*

(1) PWM carrier frequency changing *(Pr. 72)*

- You can change the PWM carrier frequency of the inverter.
- Changing the PWM carrier frequency produces an effect on avoiding the resonance frequency of a mechanical system or motor or on EMI measures or on leakage current reduction caused by the PWM switching.

(2) Soft-PWM control *(Pr. 240)*

- Soft-PWM control is a control method that changes the motor noise from a metallic tone into an unoffending complex tone.

(3) PWM carrier frequency automatic reduction function *(Pr. 260)*

- If continuous operation is performed at 85% of the rated inverter current or higher while *Pr. 260* = "1 (initial setting)" and *Pr. 72* (inverter carrier frequency) ≥ "3" (3kHz) (5kHz or higher under the IPM motor control), E.THT (inverter overload trip) is likely to occur. To avoid that, the carrier frequency is automatically lowered to as low as 2kHz. (The motor noise increases, but not to the point of failure.)
- When *Pr. 260* is set to "0," the carrier frequency becomes constant (*Pr. 72* setting) independently of the load, making the motor sound uniform. Note that continuous operation should be performed at less than 85% of the inverter rating.

NOTE

- **Decreasing the PWM carrier frequency affects on EMI measures and on leakage current reduction, but increases motor noise.**
- **When PWM carrier frequency is set to 1kHz or less (*Pr. 72* ≤ 1), fast response current limit may function prior to stall prevention operation due to increase in ripple currents, resulting in insufficient torque. In such case, set fast-response current limit operation invalid using *Pr. 156 Stall prevention operation selection* .**

Parameters referred to

Pr. 156 Stall prevention operation selection ☞ *Refer to page 96*

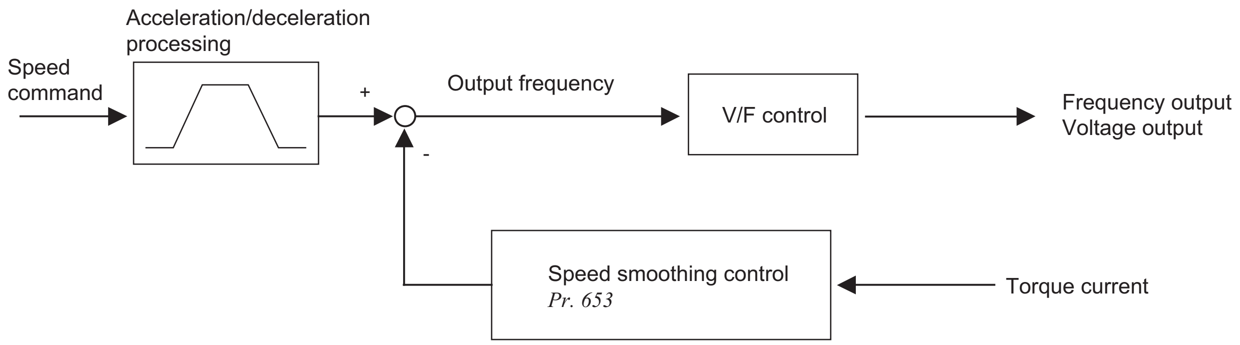
4.16.2 Speed smoothing control (Pr. 653) V/F GP MFVC

Vibration due to mechanical resonance influences the inverter control, causing the output current (torque) unstable. In this case, the output current (torque) fluctuation can be reduced to ease vibration by changing the output frequency.

Parameter Number	Name	Initial Value	Setting Range	Description
653	**Speed smoothing control**	0	0 to 200%	Increase or decrease the value using 100% as reference to check an effect.

The above parameter can be set when *Pr.160 Extended function display selection* = "0". *(Refer to page 197)*

(1) Control block diagram



(2) Setting method

If vibration due to mechanical resonance occurs, set 100% in *Pr. 653*, run the inverter at the frequency which generates maximum vibration and check if the vibration will be reduced or not after several seconds.
If effect is not produced, gradually increase the *Pr. 653* setting and check the effect repeatedly until the most effective value is set in *Pr. 653*.
If vibration becomes large by increasing the *Pr. 653* setting, gradually decrease the *Pr. 653* setting than 100% to check the effect in a similar manner.

NOTE

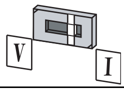
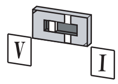
Depending on the machine, vibration may not be reduced enough or an effect may not be produced.

4.17 Frequency setting by analog input (terminal 2, 4)

Purpose	Parameter that should be Set		Refer to Page
Selection of voltage/current input (terminal 2, 4) **Perform forward/reverse rotation by analog input.**	**Analog input selection**	**Pr. 73, Pr. 267**	*183*
Noise elimination at the analog input	**Input filter**	**Pr. 74**	*187*
Adjustment (calibration) of analog input frequency and voltage (current)	**Bias and gain of frequency setting voltage (current)**	**Pr. 125, Pr. 126, Pr. 241, C2 to C7 (Pr. 902 to Pr. 905)**	*188*

4.17.1 Analog input selection (Pr. 73, Pr. 267)

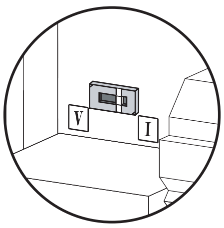
You can select the function that switches between forward rotation and reverse rotation according to the analog input terminal specifications and input signal.

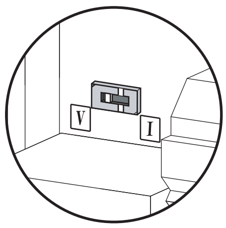
Parameter Number	Name	Initial Value	Setting Range	Description	
73	**Analog input selection**	1	0	Terminal 2 input 0 to 10V	Without reversible operation
			1	Terminal 2 input 0 to 5V	
			10	Terminal 2 input 0 to 10V	With reversible operation
			11	Terminal 2 input 0 to 5V	
267	**Terminal 4 input selection**	0		**Voltage/current input switch**	**Description**
			0		Terminal 4 input 4 to 20mA
			1		Terminal 4 input 1 to 5V
			2		Terminal 4 input 2 to 10V

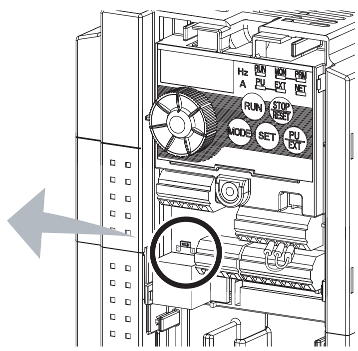
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

(1) Selection of analog input specifications

- For the terminal 2 for analog voltage input, 0 to 5V (initial value) or 0 to 10V can be selected.
- Either voltage input (0 to 5V, 0 to 10V) or current input (4 to 20mA initial value) can be selected for terminal 4 used for analog input.
  Change the input specifications to change *Pr. 267* and voltage/current input switch.
- Rated specifications of terminal 4 change according to the voltage/current input switch setting.
  Voltage input: Input resistance 10kΩ ± 1kΩ, Maximum permissible input voltage 20VDC
  Current input: Input resistance 233Ω ± 5Ω, Maximum permissible input voltage 30mA


Current input (initial setting)


Voltage input



NOTE

- **Set *Pr. 267* and a voltage/current input switch correctly, then input an analog signal in accordance with the setting. Incorrect setting as in the table below could cause component damage. Incorrect settings other than below can cause abnormal operation.**

Setting Causing Component Damage		Operation
Switch setting	**Terminal input**	
I (current input)	Voltage input	This could cause component damage to the analog signal output circuit of signal output devices. (electrical load in the analog signal output circuit of signal output devices increases)
V (voltage input)	Current input	This could cause component damage of the inverter signal input circuit. (output power in the analog signal output circuit of signal output devices increases)

•Refer to the following table and set *Pr. 73* and *Pr. 267*.

(indicates main speed setting)

Terminal 4 Input		*Pr.73* Setting	Terminal 2 Input	Reversible Operation
AU signal				
OFF	—	0	0 to 10V	Not function
		1 (initial value)	0 to 5V	
		10	0 to 10V	Yes
		11	0 to 5V	
ON	According to the *Pr. 267* setting	0	—	Not function
	0: 4 to 20mA (initial value)	1 (initial value)		
	1: 1 to 5V	10	—	Yes
	2: 2 to 10V	11		

- : invalid

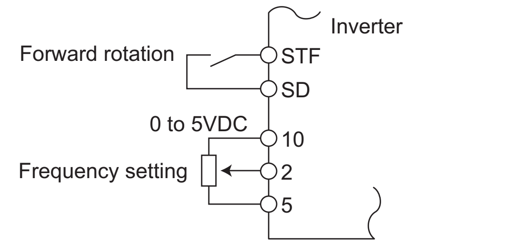
* If the input specification to terminal 4 is changed from the current input (*Pr. 267* = "0") to the 0 to 5V or 0 to 10V voltage input (*Pr.267* = "1 or 2"), calibrate the input with C6. (*Refer to page 188*)

REMARKS

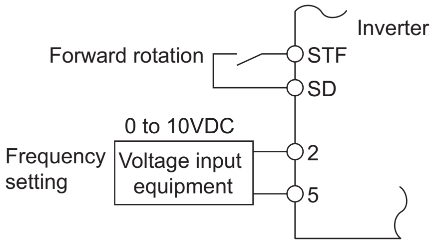
- Turn ON the AU signal to make the terminal 4 function valid. The AU signal is assigned to the terminal AU in the initial setting. By setting "4" in any of *Pr.178 to Pr.182 (input terminal function selection)*, the AU signal can be assigned to other terminals.
- Use *Pr. 125 (Pr. 126) (frequency setting gain)* to change the maximum output frequency at input of the maximum output frequency command voltage (current). At this time, the command voltage (current) need not be input.
  Also, the acceleration/deceleration time, which is a slope up/down to the acceleration/deceleration reference frequency, is not affected by the change in *Pr. 73* setting.
- The terminal 2 does not accept analog output frequency commands when *Pr.561 PTC thermistor protection level* ≠ "9999."

NOTE

- **Make sure that the parameter and switch settings are the same. Different setting may cause a fault, failure or malfunction.**
- **Always calibrate the input after changing the voltage/input input signal with *Pr. 267* and the voltage/current input selection switch.**
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**



Connection diagram using terminal 2 (0 to 5VDC)



Connection diagram using terminal 2 (0 to 10VDC)

(2) Perform operation by analog input selection

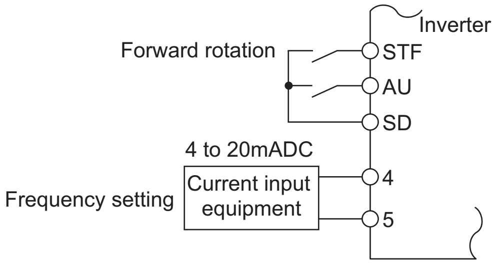
- The frequency setting signal inputs 0 to 5VDC (or 0 to 10VDC) across the terminals 2 and 5. The 5V (10V) input is the maximum output.
- The power supply 5V can be input by either using the internal power supply or preparing an external power supply. Prepare an external power supply to input the power supply 10V. For the built-in power supply, terminals 10-5 provide 5VDC output.

Terminal	Inverter Built-in Power Supply Voltage	Frequency Setting Resolution	*Pr.73* (terminal 2 input power)
10	5VDC	0.12Hz/60Hz	0 to 5VDC input

- When inputting 10VDC to the terminal 2, set "0" or "10" in *Pr. 73*. (The initial value is 0 to 5V)
- Setting "1 (0 to 5VDC)" or "2 (0 to 10VDC)" in *Pr. 267* and a voltage/current input switch in the "V" position changes the terminal 4 to the voltage input specification. When the AU signal turns ON, the terminal 4 input becomes valid.

REMARKS

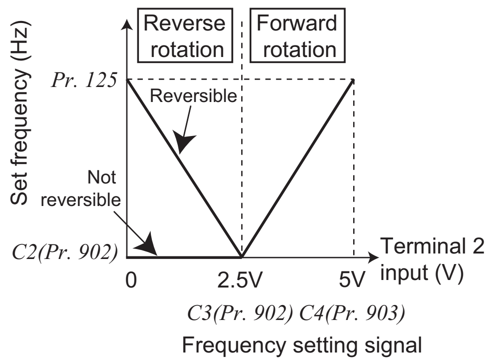
The wiring length of the terminals 10, 2, and 5 should be 30m at maximum.



Connection diagram using terminal 4 (4 to 20mADC)

(3) Perform operation by analog input selection

- When the pressure or temperature is controlled constantly by a fan, pump, etc., automatic operation can be performed by inputting the output signal 4 to 20mADC of the adjuster across the terminals 4 and 5.
- The AU signal must be turned ON to use the terminal 4.



Reversible operation example

(4) Perform forward/reverse rotation by analog input (polarity reversible operation)

- Setting "10" or "11" in *Pr. 73* and adjusting *Pr. 125* (*Pr. 126*) *Terminal 2 frequency setting gain frequency* (*Terminal 4 frequency setting gain frequency*) and *C2 (Pr. 902) Terminal 2 frequency setting bias frequency* to *C7 (Pr.905) Terminal 4 frequency setting gain* makes reverse operation by terminal 2 (terminal 4) valid.

Example)When performing reversible operation by terminal 2 (0 to 5V) input

1) Set "11" in *Pr. 73* to make reversible operation valid.
   Set frequency at maximum analog input in *Pr. 125 (Pr. 903)*
2) Set 1/2 of the value set in *C4 (Pr. 903)* in *C3 (Pr. 902)*.
3) Reversible operation is performed when 0 to 2.5VDC is input and forward rotation when 2.5 to 5VDC.

NOTE

- **When reversible operation is set, be aware of reverse rotation operation when analog input stops (only the start signal is input).**
- **When reversible operation is valid, reversible operation (0 to 4mA: reverse operation, 4mA to 20mA: forward operation) is performed by terminal 4 in the initial setting.**

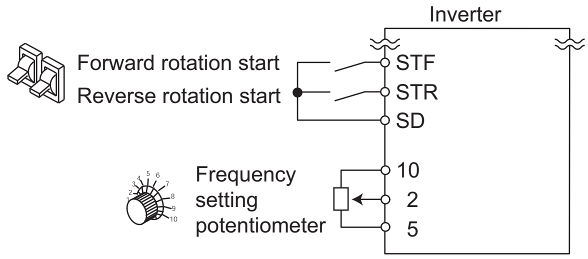
Parameters referred to

Pr. 125 Terminal 2 frequency setting gain frequency, Pr. 126 Terminal 4 frequency setting gain frequency Refer to page 188
Pr. 561 PTC thermistor protection level Refer to page 119
C2 (Pr. 902) Terminal 2 frequency setting bias frequency to C7 (Pr. 905) Terminal 4 frequency setting gain Refer to page 188
Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 134

4.17.2 Setting the frequency by analog input (voltage input)

POINT
- Switch ON the STF (STR) signal to give a start command.
- Use the (frequency setting) potentiometer to give a frequency command.

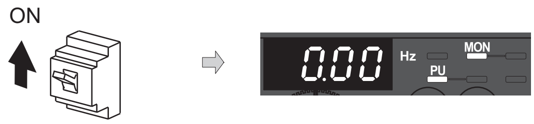
[Connection diagram]
(The inverter supplies 5V power to the frequency setting potentiometer. (terminal 10))



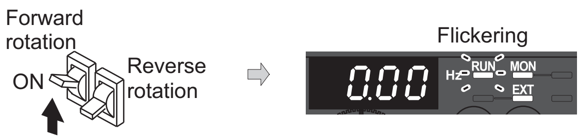
Operation example | Operate at 60Hz.

Operation — **Display**

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



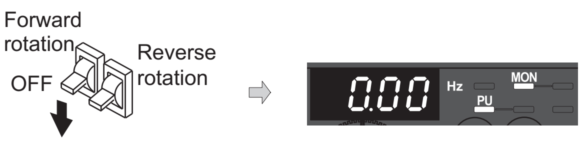
2. Start
   Turn ON the start switch (STF or STR).
   [RUN] indicator flickers fast because the frequency command is not given.



3. Acceleration → constant speed
   Turn the potentiometer clockwise slowly to full.
   The frequency value on the display increases in *Pr. 7 Acceleration time,* and "60.00" (60.00Hz) appears.
   [RUN] indicator is lit during forward rotation operation and flickers slowly during reverse rotation operation.

4. Deceleration
   Turn the potentiometer counterclockwise slowly to full.
   The frequency value on the display decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with "0.00" (0.00Hz) displayed.
   [RUN] flickers fast.

5. Stop
   Turn OFF the start switch (STF or STR).
   [RUN] indicator turns OFF.



REMARKS

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

? The motor will not rotate ... Why?

☞ Check that [EXT] is lit.
[EXT] is valid when *Pr. 79* = "0" (initial value) or "2."

Use PU/EXT to lit [EXT].

☞ Check that wiring is correct. Check once again.

? Change the frequency (0Hz) of the minimum value of potentiometer (at 0V initial value)

☞ Adjust the frequency in *calibration parameter C2 Terminal 2 frequency setting bias frequency.* *(Refer to page 188.)*

4.17.3 Response level of analog input and noise elimination (Pr. 74)

The time constant of the primary delay filter can be set for the external frequency command (analog input (terminal 2, 4) signal).

Parameter Number	Name	Initial Value	Setting Range	Description
74	**Input filter time constant**	1	0 to 8	Primary delay filter time constant for the analog input. A larger setting results in a larger filter.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

- Valid for eliminating noise of the frequency setting circuit.
- Increase the filter time constant if steady operation cannot be performed due to noise.
  A larger setting results in slower response. (The time constant can be set between approximately 5ms to 1s with the setting of 0 to 8.)

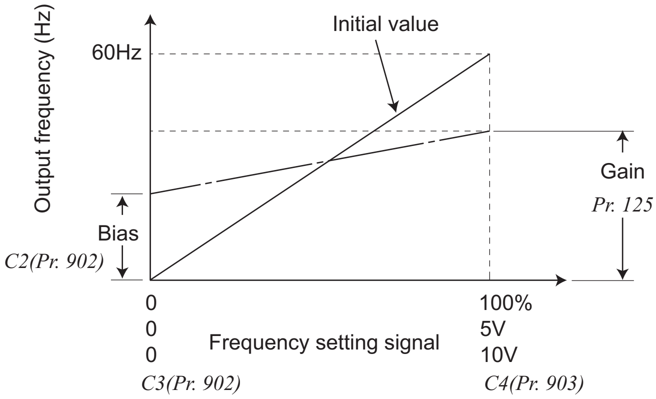
4.17.4 Bias and gain of frequency setting voltage (current) (Pr. 125, Pr. 126, Pr. 241, C2 (Pr. 902) to C7 (Pr. 905))

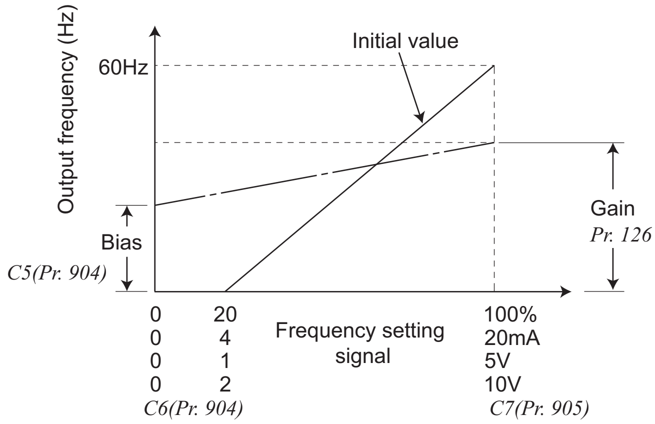
You can set the magnitude (slope) of the output frequency as desired in relation to the frequency setting signal (0 to 5VDC, 0 to 10VDC or 4 to 20mADC).
Set *Pr. 267* and voltage/current input switch to switch among 0 to 5VDC, 0 to 10VDC, and 0 to 20mADC input using terminal 4. *(Refer to page 183)*

[Frequency setting bias/gain parameter]

Parameter Number	Name	Initial Value	Setting Range	Description	
125	**Terminal 2 frequency setting gain frequency**	60Hz ∗4	0 to 400Hz	Frequency of terminal 2 input gain (maximum).	
126	**Terminal 4 frequency setting gain frequency**	60Hz ∗4	0 to 400Hz	Frequency of terminal 4 input gain (maximum).	
241 ∗1, ∗3	**Analog input display unit switchover**	0	0	Displayed in %	Unit for analog input display.
			1	Displayed in V/mA	
C2 (902) ∗1, ∗2	**Terminal 2 frequency setting bias frequency**	0Hz	0 to 400Hz	Frequency on the bias side of terminal 2 input.	
C3 (902) ∗1, ∗2	**Terminal 2 frequency setting bias**	0%	0 to 300%	Converted % of the bias side voltage of terminal 2 input.	
C4 (903) ∗1, ∗2	**Terminal 2 frequency setting gain**	100%	0 to 300%	Converted % of the gain side voltage of terminal 2 input.	
C5 (904) ∗1, ∗2	**Terminal 4 frequency setting bias frequency**	0Hz	0 to 400Hz	Frequency on the bias side of terminal 4 input.	
C6 (904) ∗1, ∗2	**Terminal 4 frequency setting bias**	20%	0 to 300%	Converted % of the bias side current (voltage) of terminal 4 input.	
C7 (905) ∗1, ∗2	**Terminal 4 frequency setting gain**	100%	0 to 300%	Converted % of the gain side current (voltage) of terminal 4 input.	

∗1 The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
∗2 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).
∗3 This parameter 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*.
∗4 Performing IPM parameter initialization changes the settings. *(Refer to page 85)*





(1) Change the frequency at maximum analog input *(Pr. 125, Pr. 126)*

•Set *Pr. 125 (Pr. 126)* when changing frequency setting (gain) of the maximum analog input voltage (current) only. (*C2 (Pr. 902)* to *C7 (Pr.905)* setting need not be changed)

(2) Analog input bias/gain calibration *(C2 (Pr. 902) to C7 (Pr. 905))*

•The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the inverter to set the output frequency, e.g. 0 to 5VDC, 0 to 10VDC or 4 to 20mADC, and the output frequency.

•Set the bias frequency of the terminal 2 input using *C2 (Pr. 902)*.
(It is initially set to the frequency at 0V)

•Set the output frequency in *Pr. 125* for the frequency command voltage set with *Pr. 73 Analog input selection*.

•Set the bias frequency of the terminal 4 input using *C5 (Pr. 904)*.
(It is initially set to the frequency at 4mA)

•Using *Pr. 126*, set the output frequency relative to 20mA of the frequency command current (4 to 20mA).

• There are three methods to adjust the frequency setting voltage (current) bias/gain.
  a) Method to adjust any point by application of a voltage (current) across terminals 2-5 (4-5) ☞ *page 190*
  b) Method to adjust any point without application of a voltage (current) across terminals 2-5 (4-5) ☞ *page 191*
  c) Method to adjust frequency only without adjustment of voltage (current) ☞ *page 192*

NOTE

- **When voltage/current input signal for terminal 4 was switched using *Pr. 267* and voltage/current input switch, perform calibration without fail.**

(3) Analog input display unit changing *(Pr. 241)*

- You can change the analog input display unit (%/V/mA) for analog input bias/gain calibration.
- Depending on the terminal input specification set to *Pr. 73*, *Pr. 267*, and voltage/current switch, the display units of *C3 (Pr. 902), C4 (Pr. 903), C6 (Pr. 904), C7 (Pr. 905)* change as shown below.

Analog Command (terminal 2, 4) (depending on *Pr. 73, Pr. 267*, and voltage/current input switch)	*Pr. 241* = 0 (initial value)	*Pr. 241* = 1
0 to 5V input	0 to 5V → 0 to 100% (0.1%) display	0 to 100% → 0 to 5V (0.01V) display
0 to 10V input	0 to 10V → 0 to 100% (0.1%) display	0 to 100% → 0 to 10V (0.01V) display
0 to 20mA input	0 to 20mA → 0 to 100%(0.1%) display	0 to 100% → 0 to 20mA (0.01mA) display

Parameters referred to

Pr. 73 Analog input selection, Pr. 267 Terminal 4 input selection ☞ *Refer to page 183*
Bias and gain of built-in frequency setting potentiometer ☞ *Refer to page 284*

4
PARAMETERS

4.17.5 Frequency setting signal (current) bias/gain adjustment method

Follow the following procedure to adjust the bias and gain of the frequency setting voltage (current) using the operation panel. *Refer to page 188* for the details of parameters.

(a) Method to adjust any point by application of a voltage (current) across terminals 2 and 5 (4 and 5).

Operation	Display
1. Confirm the operation status indicator and operation mode indicator ● The inverter should be at a stop. ● The inverter should be in the PU operation mode. (Using PU/EXT)	0.00 Hz, PU, MON
2. Press MODE to choose the parameter setting mode.	PRM indicator is lit. MODE ⇨ P. 0 PRM (The parameter number read previously appears.)
3. Turn the setting dial until C... appears.	⇨ C...
4. Press SET to display C - - - .	SET ⇨ C - - - (C0 to C25 settings are enabled.)
5. Turn the setting dial until C 4 (C 7) appears. Set to *C4 Terminal 2 frequency setting gain.*	⇨ C 4: Terminal 2 input is selected C 7: Terminal 4 input is selected
6. Press SET to display the analog voltage (current) value (%).	SET ⇨ 0.0 Analog voltage (current) value (%) across terminals 2 and 5 (across terminals 4 and 5)
7. Apply a 5V (20mA) voltage (current). (Turn the external potentiometer connected across terminals 2 and 5 (across terminals 4 and 5) to maximum (any position).)	⇨ 100 * * The value is nearly 100 (%) in the maximum position of the potentiometer.

NOTE

After performing operation in step 6, do not touch the setting dial until completion of calibration.

Operation	Display
8. Press SET to set.	SET ⇨ 100 * ⟷ C 4 (Terminal 2 input is selected) / C 7 (Terminal 4 input is selected) **Flicker...Parameter setting complete!!** * The value is nearly 100 (%) in the maximum position of the potentiometer.

- •Turn the setting dial to read another parameter.
- •Press SET to return to the C - - - indication (step 4).
- •Press SET twice to show the next parameter (Pr.CL).

REMARKS

- If the frequency meter (display meter) connected across the terminals FM and SD does not indicate exactly 60Hz, set the *calibration parameter C0 FM terminal calibration*. *(Refer to page 158)*
- If the gain and bias of frequency setting voltage (current) are too close, an error (Er3) may be displayed at setting.

(b) Method to adjust any point without application of a voltage (current) across terminals 2 and 5 (4 and 5)
(To change from 4V (80%) to 5V (100%))

Operation	Display
1. Confirm the operation status indicator and operation mode indicator ● The inverter should be at a stop. ● The inverter should be in the PU operation mode. (Use PU/EXT)	0.00 Hz MON PU
2. Press MODE to choose the parameter setting mode.	MODE ⇨ P. 0 PRM PRM indicator is lit. (The parameter number read previously appears.)
3. Turn the dial until C. . . appears.	⇨ C. . .
4. Press SET to display C - - - .	SET ⇨ C - - - (C0 to C25 settings are enabled.)
5. Turn the dial until C 4 (C 7) appears. Set to *C4 Terminal 2 frequency setting gain*.	⇨ C 4 Terminal 2 input is selected C 7 Terminal 4 input is selected
6. Press SET to display the analog voltage (current) value (%).	SET ⇨ 0.0 Analog voltage (current) value (%) across terminals 2 and 5 (across terminals 4 and 5)
7. Turn the dial to set gain voltage (%). "0V(0mA) is 0%, 10V(5V, 20mA) is 100%"	⇨ 100 The gain frequency is reached when the analog voltage (current) value across terminals 2 and 5 (across terminals 4 and 5) is 100%.

REMARKS

The current setting at the instant of turning the dial is displayed. 80
You can not check after performing operation in step 7.

Operation	Display
8. Press SET to set.	SET ⇨ 100 / C 4 (Terminal 2 input is selected) / C 7 (Terminal 4 input is selected)

Flicker...Parameter setting complete!!
(Adjustment completed)

- •Turn the dial to read another parameter.
- •Press SET to return to the C - - - indication (step 4).
- •Press SET twice to show the next parameter (P.r.C.L).

REMARKS

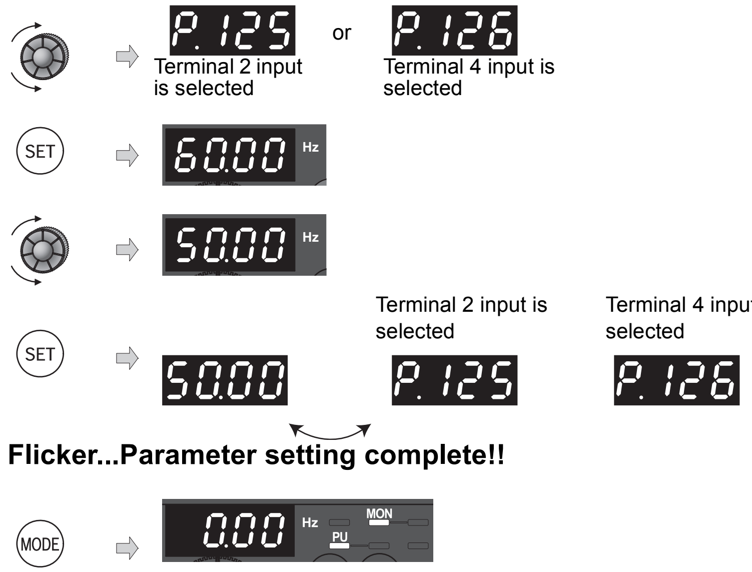
By pressing the dial after step 6, you can confirm the current frequency setting bias/gain setting.
You can not check after performing operation in step 7.

(c) Adjusting only the frequency without adjusting the gain voltage (current).
(When changing the gain frequency from 60Hz to 50Hz)

Operation

1. Turn until P.125 *(Pr. 125)* or P.126 *(Pr. 126)* appears
2. Press SET to show the present set value. (60.00Hz)
3. Turn to change the set value to "50.00". (50.00Hz)
4. Press SET to set.
5. Mode/monitor check
   Press MODE twice to choose the monitor/ frequency monitor.
6. Apply a voltage across the inverter terminals 2 and 5 (across 4 and 5) and turn ON the start command (STF, STR).
   Operation starts at 50Hz.

Display



REMARKS

- Changing *C4 (Pr. 903)* or *C7 (Pr. 905)* (gain adjustment) value will not change the *Pr. 20 Acceleration/deceleration reference frequency* setting.
- For operation from the parameter unit (FR-PU04/FR-PU07), refer to the Instruction Manual of the FR-PU04/FR-PU07.
- When setting the value to 120Hz or more, it is necessary to set *Pr. 18 High speed maximum frequency* to 120Hz or more. *(Refer to page 101)*
- Make the bias frequency setting using the *calibration parameter C2 (Pr. 902) or C5 (Pr. 904)*. *(Refer to page 189)*
- Refer to *page 284* to use the FR-E500 series operation panel (PA02).

⚠ CAUTION

⚠ Be cautious when setting any value other than "0" as the bias frequency at 0V (0mA). Even if a speed command is not given, merely turning ON the start signal will start the motor at the preset frequency.

Parameters referred to

Pr. 18 High speed maximum frequency ☞ Refer to page 101
Pr. 20 Acceleration/deceleration reference frequency ☞ Refer to page 113
Pr. 125 Terminal 2 frequency setting gain frequency ☞ Refer to page 188
Pr. 126 Terminal 4 frequency setting gain frequency ☞ Refer to page 188
Pr. 241 Analog input display unit switchover ☞ Refer to page 188
C0 (Pr. 900) FM terminal calibration ☞ Refer to page 158
C2 (Pr. 902) Terminal 2 frequency setting bias frequency ☞ Refer to page 188
C3 (Pr. 902) Terminal 2 frequency setting bias ☞ Refer to page 188
C4 (Pr. 903) Terminal 2 frequency setting gain ☞ Refer to page 188
C5 (Pr. 904) Terminal 4 frequency setting bias frequency ☞ Refer to page 188
C6 (Pr. 904) Terminal 4 frequency setting bias ☞ Refer to page 188
C7 (Pr. 905) Terminal 4 frequency setting gain ☞ Refer to page 188
Bias and gain of built-in frequency setting potentiometer ☞ Refer to page 284

4.18 Misoperation prevention and parameter setting restriction

Purpose	Parameter that should be Set		Refer to Page
Limits reset function Trips when PU is disconnected Stops from PU	**Reset selection/disconnected PU detection/PU stop selection**	**Pr. 75**	*193*
Prevention of parameter rewrite	**Parameter write disable selection**	**Pr. 77**	*196*
Prevention of reverse rotation of the motor	**Reverse rotation prevention selection**	**Pr. 78**	*197*
Displays necessary parameters	**Display of applied parameters**	**Pr. 160**	*197*
Parameter restriction with using password	**Password function**	**Pr. 296, Pr. 297**	*198*
Control of parameter write by communication	**EEPROM write selection**	**Pr. 342**	*225*

4.18.1 Reset selection/disconnected PU detection/PU stop selection (Pr. 75)

You can select the reset input acceptance, disconnected PU (FR-PU04/FR-PU07) connector detection function and PU stop function.

Parameter Number	Name	Initial Value	Setting Range	Description
75	**Reset selection/ disconnected PU detection/ PU stop selection**	14	0 to 3, 14 to 17	For the initial value, reset always enabled, without disconnected PU detection, and with PU stop function.

•The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
•This parameter allows its setting to be changed during the operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*. This setting does not return to the initial value even though the (all) parameter clear is performed.

Pr. 75 Setting	Reset Selection	Disconnected PU Detection	PU Stop Selection
0	Reset input normally enabled	When the PU is disconnected, operation is continued.	Pressing STOP RESET decelerates the motor to a stop only in the PU operation mode.
1	Reset input is enabled only when the fault occurs.		
2	Reset input normally enabled	When the PU is disconnected, the inverter trips.	
3	Reset input is enabled only when the fault occurs.		
14 (initial value)	Reset input normally enabled	When the PU is disconnected, operation is continued.	Pressing STOP RESET decelerates the motor to a stop in any of the PU, external and communication operation modes.
15	Reset input is enabled only when the fault occurs.		
16	Reset input normally enabled	When the PU is disconnected, the inverter trips.	
17	Reset input is enabled only when the fault occurs.		

(1) Reset selection

•You can select the enable condition of reset function (RES signal, reset command through communication) input.
•When *Pr. 75* is set to any of "1, 3, 15, 17", a reset can be input only when the inverter is tripped.

NOTE
- **When the reset signal (RES) is input during operation, the motor coasts since the inverter being reset shuts off the output.**
- **When reset is performed, cumulative values of electronic thermal O/L relay, and regenerative brake duty are cleared.**
- **The reset key of the PU is only valid when the inverter is tripped, independently of the *Pr. 75* setting.**

(2) Disconnected PU detection

- This function detects that the PU (FR-PU04/FR-PU07) has been disconnected from the inverter for longer than 1s and causes the inverter to provide a fault output (E.PUE) and come to trip.
- When *Pr. 75* is set to any of "0, 1, 14, 15", operation is continued even if the PU is disconnected.

REMARKS

- When the PU has been disconnected since before power-ON, it is not judged as a fault.
- To make a restart, confirm that the PU is connected and then reset the inverter.
- The motor decelerates to a stop when the PU is disconnected during PU Jog operation with *Pr. 75* set to any of "0, 1, 14, 15" (which selects operation to be continued if the PU is disconnected).
- When RS-485 communication operation is performed through the PU connector, the reset selection/PU stop selection function is valid but the disconnected PU detection function is invalid.

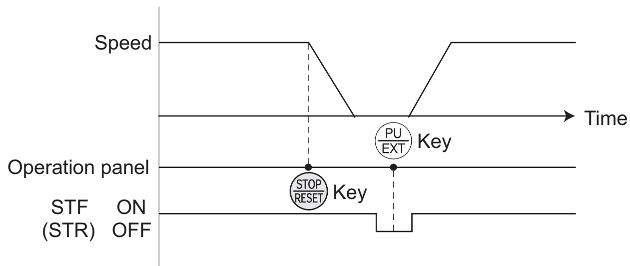
(3) PU stop selection

- In any of the PU operation, External operation and Network operation modes, the motor can be stopped by pressing STOP key of the operation panel or parameter unit (FR-PU04/FR-PU07, operation panel for FR-E500 (PA02)).
- When the inverter is stopped by the PU stop function, "PS" (PS) is displayed. A fault output is not provided.
- After the motor is stopped from the PU, it is necessary to perform PU stop (PS) reset to restart. PS reset can be made from the unit from which PU stop is made (operation panel, parameter unit (FR-PU04/PU07, operation panel for FR-E500 (PA02)).
- The motor can be restarted by making PS cancel using a power supply reset or RES signal.
- When *Pr. 75* is set to any of "0 to 3", PU stop (PS display) is invalid, and deceleration to a stop by STOP/RESET is valid only in the PU operation mode.

REMARKS

During operation in the PU operation mode through RS-485 communication from the PU connector, the motor decelerates to stop (PU stop) when entered from the operation panel STOP/RESET.

(4) How to restart the motor stopped by STOP/RESET input from the PU in External operation mode (PU stop (PS) reset method)



Stop/restart example for External operation

a) Operation panel

1)After completion of deceleration to a stop, switch OFF the STF or STR signal.

2)Press PU/EXT to display PU .... (PS reset)

3)Press PU/EXT to return to EXT.

4)Switch ON the STF or STR signal.

b) Parameter unit (FR-PU04/FR-PU07)

1)After completion of deceleration to a stop, switch OFF the STF or STR signal.

2)Press EXT .... (PS reset)

3)Switch ON the STF or STR signal.

- The motor can be restarted by making a reset using a power supply reset or RES signal.

REMARKS

- If *Pr. 250 Stop selection* is set to other than "9999" to select coasting to a stop, the motor will not be coasted to a stop but decelerated to a stop by the PU stop function during External operation.

(5) Restart (PS reset) method when PU stop (PS display) is made during PU operation

•PU stop (PS display) is made when the motor is stopped from the unit where control command source is not selected (operation panel, parameter unit (FR-PU04/FR-PU07, operation panel for FR-E500 (PA02)) in the PU operation mode. For example, when *Pr. 551 PU mode operation command source selection* = "9999" (initial value), the motor is stopped from the PU (PS display) if entered from the operation panel STOP/RESET in PU operation mode with the parameter unit mounted.

When the motor is stopped from the PU while the parameter unit (FR-PU04/FR-PU07) is selected as control command source.

1) After the motor has decelerated to a stop, press STOP/RESET of the parameter unit (FR-PU04/FR-PU07).

2) Press PU/EXT to display EXT .(PS reset)

3) Press PU of the parameter unit (FR-PU04/FR-PU07) to select the PU operation mode.

4) Press FWD or REV of the parameter unit (FR-PU04/FR-PU07).

REMARKS

- When *Pr. 551* = "9999", the priorities of the PU control source is parameter unit (FR-PU04/FR-PU07) > operation panel.

⚠ CAUTION

⚠ **Do not reset the inverter while the start signal is being input.**
Otherwise, the motor will start instantly after resetting, leading to potentially hazardous conditions.

Parameters referred to

Pr. 250 Stop selection ☞ *Refer to page 133*
Pr. 551 PU mode operation command source selection ☞ *Refer to page 214*

4.18.2 Parameter write disable selection (Pr. 77)

You can select whether write to various parameters can be performed or not. Use this function to prevent parameter values from being rewritten by misoperation.

Parameter Number	Name	Initial Value	Setting Range	Description
77	**Parameter write selection**	0	0	Write is enabled only during stop.
			1	Parameter can not be written.
			2	Parameter write is enabled in any operation mode regardless of operation status.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

Pr. 77 can always be set independently from the operation mode and operation status.

(1) Write parameters only during stop *(setting "0", initial value)*

- Parameters can be written only during a stop in the PU operation mode.
- The shaded parameters in the parameter list *(page 64)* can always be written regardless of the operation mode and operating status. However, *Pr. 72 PWM frequency selection* and *Pr. 240 Soft-PWM operation selection* can be written when the inverter is running in the PU operation mode, but cannot be written in the External operation mode.

(2) Disable parameter write *(setting "1")*

- Parameter write is not enabled. (Read is enabled.)
- Parameter clear and all parameter clear cannot be performed, either.
- The parameters given on the right can be written even if *Pr. 77* = "1".

Parameter Number	Name
22	Stall prevention operation level
75	Reset selection/disconnected PU detection/ PU stop selection
77	Parameter write selection
79	Operation mode selection
160	Extended function display selection
296	Password lock level
297	Password lock/unlock
997	Fault initiation

(3) Write parameters during operation *(setting "2")*

- Parameters can always be written.
- The following parameters cannot be written when the inverter is running even if *Pr. 77* = "2". Stop the inverter when changing their parameter settings.

Parameter Number	Name
23	Stall prevention operation level compensation factor at double speed
40	RUN key rotation direction selection
48	Second stall prevention operation current
60	Energy saving control selection
66	Stall prevention operation reduction starting frequency
71	Applied motor
79	Operation mode selection
80	Motor capacity
82	Motor excitation current
83	Rated motor voltage

Parameter Number	Name
84	Rated motor frequency
90	Motor constant (R1)
96	Auto tuning setting/status
178 to 182	(input terminal function selection)
190, 192	(output terminal function selection)
261	Power failure stop selection
298	Frequency search gain
450	Second applied motor
561	PTC thermistor protection level
800	Control method selection
998	IPM parameter initialization
999	Automatic parameter setting

☞ Parameters referred to

Pr. 79 Operation mode selection ☞ *Refer to page 200*

4.18.3 Reverse rotation prevention selection (Pr. 78)

This function can prevent reverse rotation fault resulting from the incorrect input of the start signal.

Parameter Number	Name	Initial Value	Setting Range	Description
78	**Reverse rotation prevention selection**	0	0	Both forward and reverse rotations allowed
			1	Reverse rotation disabled
			2	Forward rotation disabled

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

- Set this parameter when you want to limit the motor rotation to only one direction.
- This parameter is valid for all of the reverse rotation and forward rotation keys of the enclosure surface operation panel and of parameter unit (FR-PU04/FR-PU07), the start signals (STF, STR signals) via external terminals, and the forward and reverse rotation commands through communication.

4.18.4 Extended parameter display (Pr. 160)

Parameter which can be read from the operation panel and parameter unit can be restricted.
In the initial setting, only the simple mode parameters are displayed.

Parameter Number	Name	Initial Value	Setting Range	Description
160	**Extended function display selection**	9999	9999	Displays only the simple mode parameters
			0	Displays simple mode + extended parameters

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

(1) Display of simple mode parameters and extended parameters *(Pr. 160)*

- When *Pr. 160* = "9999"(initial value), only the simple mode parameters can be displayed on the operation panel and parameter unit (FR-PU04/FR-PU07). (Refer to the parameter list *, page 64*, for the simple mode parameters.)
- When *Pr. 160* = "0", simple mode parameters and extended parameters can be displayed.

REMARKS

- When RS-485 communication is used to read the parameters with *Pr. 551 PU mode operation command source selection* ≠ "2", all parameters can be read regardless of the *Pr. 160* setting.
- *Pr. 15 Jog frequency*, *Pr. 16 Jog acceleration/deceleration time*, and *Pr. 991 PU contrast adjustment* are displayed as simple mode parameter when the parameter unit (FR-PU04/FR-PU07) is fitted.

Parameters referred to

Pr. 15 Jog frequency ☞ *Refer to page 108*
Pr. 16 Jog acceleration/deceleration time ☞ *Refer to page 108*
Pr. 551 PU mode operation command source selection ☞ *Refer to page 214*
Pr. 991 PU contrast adjustment ☞ *Refer to page 282*

4.18.5 Password function (Pr. 296, Pr. 297)

Registering a 4-digit password can restrict parameter reading/writing.

Parameter Number	Name	Initial Value	Setting Range	Description
296*1	Password lock level	9999	1 to 6, 101 to 106	Select restriction level of parameter reading/ writing when a password is registered.
			9999	No password lock
297*2	Password lock/unlock	9999	1000 to 9998	Register a 4-digit password
			(0 to 5)*3	Displays password unlock error count. (Reading only) (Valid when *Pr. 296* = "101" to "106")
			(9999)*3	No password lock (Reading only)

*1 This parameter can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 197*)
*2 If *Pr. 296* = "9999" (no password lock), *Pr. 297* can be set while *Pr. 160* = "0." When the password lock is valid, *Pr. 297* can be set regardless of the *Pr. 160* setting.
*3 "0 or 9999" can be set to *Pr.297* at any time although the setting is invalid (the displayed value does not change).

(1) Parameter reading/writing restriction level (*Pr. 296*)

•Level of reading/writing restriction by PU/NET mode operation command can be selected by *Pr. 296*.

Pr. 296 Setting	PU Mode Operation Command *3		NET Mode Operation Command *4	
	Read *1	Write *2	Read *1	Write *2
9999	○	○	○	○
1, 101	○	×	○	×
2, 102	○	×	○	○
3, 103	○	○	○	×
4, 104	×	×	×	×
5, 105	×	×	○	○
6, 106	○	○	×	×

○: enabled, ×: restricted

*1 If the parameter reading is restricted by the *Pr. 160* setting, those parameters are unavailable for reading even when "○" is indicated.
*2 If the parameter writing is restricted by the *Pr. 77* setting, those parameters are unavailable for writing even when "○" is indicated.
*3 Parameter access from unit where parameter is written in PU operation mode (initially set to operation panel, parameter unit) is restricted. (*Refer to page 214* for PU mode operation command source selection)
*4 Parameter access in NET operation mode with RS-485 communication is restricted.

(2) Password lock/unlock (*Pr. 296, Pr. 297*)

<Lock>

1) Set parameter reading/writing restriction level.(*Pr. 296* ≠ 9999)

Pr. 296 Setting Value	Restriction of Password Unlock Error	*Pr. 297* Display
1 to 6	No restriction	Always 0
101 to 106	Restricted at fifth error	Displays error count (0 to 5)

* During [*Pr. 296* = "101 to 106"], if password unlock error has occurred 5 times, correct password will not unlock the restriction. All parameter clear can unlock the restriction. (In this case, parameter settings are cleared.)

2) Write a four-digit number (1000 to 9998) in *Pr. 297* as a password.
(When *Pr. 296* = "9999", *Pr. 297* cannot be written.)
When the password is registered, parameter reading/writing is restricted with the restriction set level in *Pr. 296* until unlocking.

REMARKS

- After registering a password, a read value of *Pr. 297* is always "0" to "5".
- When a password restricted parameter is read/written, LOCd is displayed.
- Even if a password is registered, parameters which the inverter itself writes, such as inverter parts life, are overwritten as needed.
- Even if a password is registered, *Pr. 991 PU contrast adjustment* can be read/written when a parameter unit (FR-PU04/FR-PU07) is connected.

<Unlock>

There are two ways of unlocking the password.

- Enter a password in *Pr. 297*.
  Unlocked when a password is correct. If a password is incorrect, an error occurs and not unlocked.
  During [*Pr. 296* = "101 to 106"], if password unlock error has occurred 5 times, correct password will not unlock the restriction. (During password lock)
- Perform all parameter clear.
  Password lock is unlocked. However, other parameter settings are also cleared.

NOTE

- **If the password has been forgotten, perform all parameter clear to unlock the parameter restriction. In that case, other parameters are also cleared.**
- **All parameter clear cannot be performed during the operation.**
- **Do not use FR Configurator under the conditions that parameter read is restricted (*Pr. 296* = "4, 5, 104, 105"). FR Configurator may not function properly.**

(3) Parameter operation during password lock/unlock

Parameter operation		Unlocked		Password registered	Locked
		Pr. 296 = 9999 *Pr. 297* = 9999	*Pr. 296* ≠ 9999 *Pr. 297* = 9999	*Pr. 296* ≠ 9999 *Pr. 297* = 0 to 4 (Read value)	*Pr. 296* = 101 to 106 *Pr. 297* = 5 (Read value)
Pr. 296	Read	○ *1	○	○	○
	Write	○ *1	○ *1	×	×
Pr. 297	Read	○ *1	○	○	○
	Write	×	○	○	○ *3
Performing parameter clear		○	○	×	×
Performing parameter all clear		○	○	○ *2	○ *2
Performing parameter copy		○	○	×	×

○: enabled, ×: restricted

*1 Reading/writing is unavailable when there is restriction to reading by the *Pr. 160* setting.
*2 Unavailable during the operation.
*3 Correct password will not unlock the restriction.

REMARKS

- When *Pr. 296* = "4, 5, 104, 105" and using the parameter unit (FR-PU04/FR-PU07), PUJOG operation is unavailable.
- When writing is restricted from PU mode operation command (*Pr. 296* = 1, 2, 4, 5, 101, 102, 104, 105), switching of operation mode by easy setting mode is unavailable. (*Refer to page 60*)
- During password lock, parameter copy of the parameter unit (FR-PU07) cannot be performed.

Parameters referred to

Pr. 77 Parameter write selection *Refer to page 196*
Pr. 160 Extended function display selection *Refer to page 197*
Pr. 551 PU mode operation command source selection *Refer to page 214*

4.19 Selection of operation mode and operation location

Purpose	Parameter that should be Set		Refer to Page
Operation mode selection	**Operation mode selection**	**Pr. 79**	*200*
Started in Network operation mode	**Operation mode at power-on**	**Pr. 79, Pr. 340**	*213*
Selection of operation location	**Operation command source and speed command source during communication operation, selection of operation location**	**Pr. 338, Pr. 339 Pr. 551**	*214*

4.19.1 Operation mode selection (Pr. 79)

Used to select the operation mode of the inverter.
Mode can be changed as desired among operation using external command signals (External operation), operation from the operation panel and PU (FR-PU07/FR-PU04) (PU operation), combined operation of PU operation and External operation (External/PU combined operation), and Network operation (when RS-485 communication is used).

Parameter Number	Name	Initial Value	Setting Range
79	**Operation mode selection**	0	0 to 4, 6, 7

The above parameter can be changed during a stop in any operation mode.

POINT

- **Use the easy setting mode to set *Pr. 79* in simple steps. *(Refer to page 60)***

<table>
<tr><th>Pr.79 Setting</th><th colspan="3">Description</th><th>LED Indication
: OFF : ON</th><th>Refer to Page</th></tr>
<tr><td>0
(Initial value)</td><td colspan="3">Use External/PU switchover mode (At power ON, the inverter is in the External operation mode.)
Press PU/EXT to switch between the PU and External operation mode.</td><td>PU operation mode
PU
External operation mode
EXT
NET operation mode
NET</td><td>204</td></tr>
<tr><td rowspan="2">1</td><th>Operation mode</th><th>Frequency command</th><th>Start command</th><td rowspan="2">PU operation mode
PU</td><td rowspan="2">204</td></tr>
<tr><td>PU operation mode (fixed)</td><td>Setting by the operation panel and PU (FR-PU04/FR-PU07)</td><td>Input by RUN on the operation panel or FWD and REV on PU (FR-PU04/FR-PU07)</td></tr>
<tr><td>2</td><td>External operation mode (fixed)
The operation can be performed by switching between the External and NET operation modes.</td><td>External signal input (from terminal 2, 4, JOG, multi-speed selection, etc.)</td><td>External signal input (from terminal STF and STR)</td><td>External operation mode
EXT
NET operation mode
NET</td><td>204</td></tr>
<tr><td>3</td><td>External/PU combined operation mode 1</td><td>Operation panel and PU (FR-PU04/FR-PU07) setting or external signal input (multi-speed setting, across terminals 4 and 5 (valid when AU signal turns ON)). *</td><td>External signal input (from terminal STF and STR)</td><td rowspan="2">External/PU combined operation mode
PU EXT</td><td>205</td></tr>
<tr><td>4</td><td>External/PU combined operation mode 2</td><td>External signal input (Terminal 2, 4, JOG, multi-speed selection, etc.)</td><td>Input by RUN on the operation panel or FWD and REV on PU (FR-PU04/FR-PU07)</td><td>205</td></tr>
<tr><td>6</td><td colspan="3">Switchover mode
Switch among PU operation, External operating, and NET operation while keeping the same operating status.</td><td rowspan="2">PU operation mode
PU
External operation mode
EXT
NET operation mode
NET</td><td>206</td></tr>
<tr><td>7</td><td colspan="3">External operation mode (PU operation interlock)
X12 signal ON: Operation mode can be switched to the PU operation mode.
(output stop during External operation)
X12 signal OFF: Operation mode cannot be switched to the PU operation mode.</td><td>206</td></tr>
</table>

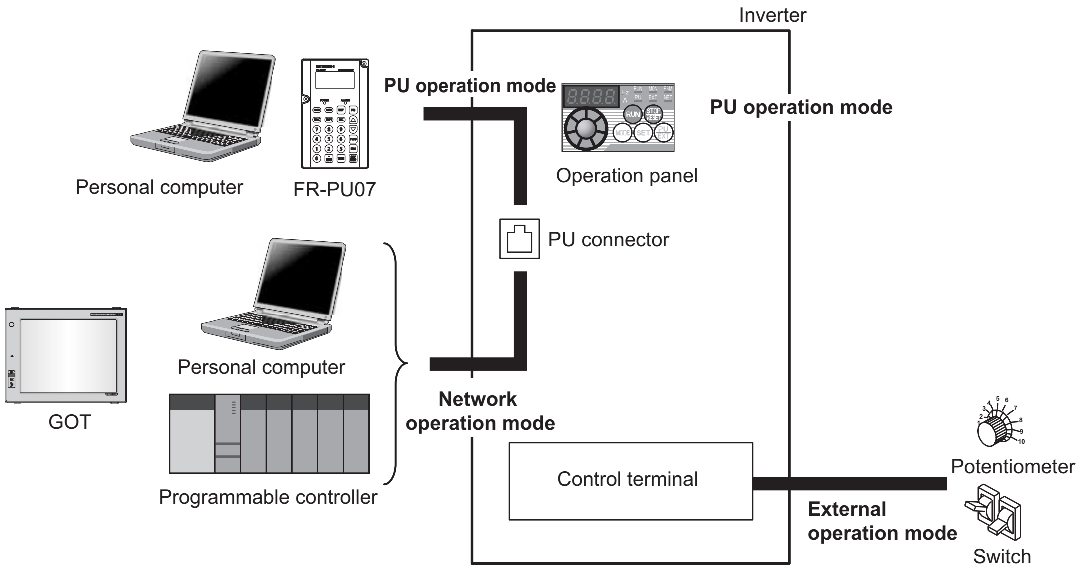
* The priorities of the frequency commands when *Pr. 79* = "3" are "Multi-speed operation (RL/RM/RH/REX) > PID control (X14) > terminal 4 analog input (AU) > digital input from the operation panel".

REMARKS

- If switching of the operation mode is invalid even though *Pr. 79* is set, *refer to page 314*.

(1) Operation mode basics

- The operation mode specifies the source of the start command and the frequency command for the inverter.
- Basically, there are following operation modes.
  - External operation mode: For inputting start command and frequency command with an external potentiometer and switches which are connected to the control circuit terminal.
  - PU operation mode: For inputting start command and frequency command with the operation panel or parameter unit (FR-PU04 / FR-PU07).
  - Network operation mode (NET operation mode): For inputting start command and frequency command with RS-485 communication through PU connector.
- The operation mode can be selected from the operation panel or with the communication instruction code.

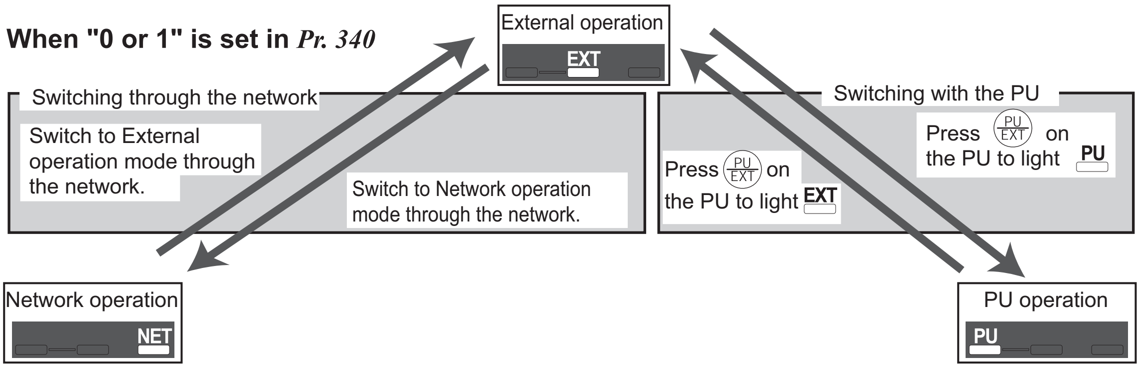


REMARKS

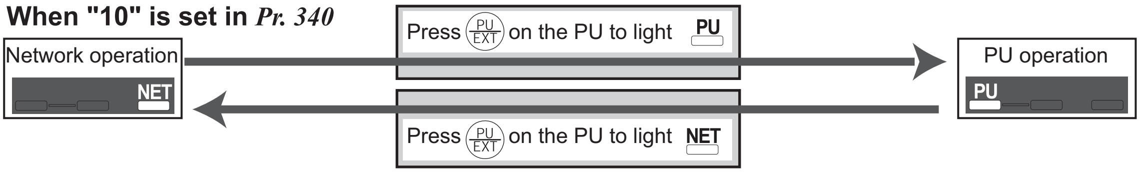
- Either "3" or "4" may be set to select the PU/External combined mode. *Refer to page 200* for details.
- The stop function (PU stop selection) activated by pressing STOP/RESET of the operation panel and parameter unit (FR-PU04/FR-PU07) is valid even in other than the PU operation mode in the initial setting.
  (*Refer to Pr. 75 Reset selection/disconnected PU detection/PU stop selection (page 193)*)

(2) Operation mode switching method

● **When "0 or 1" is set in *Pr. 340***



● **When "10" is set in *Pr. 340***



REMARKS

- Refer to the following for switching by the external terminal.
  PU operation external interlock signal (X12) ☞ *Refer to page 206*
  PU-External operation switch-over signal (X16) ☞ *Refer to page 207*
  External-NET operation switchover signal (X65), NET-PU operation switchover signal (X66) ☞ *Refer to page 208*
  Pr. 340 Communication startup mode selection ☞ *Refer to page 213*

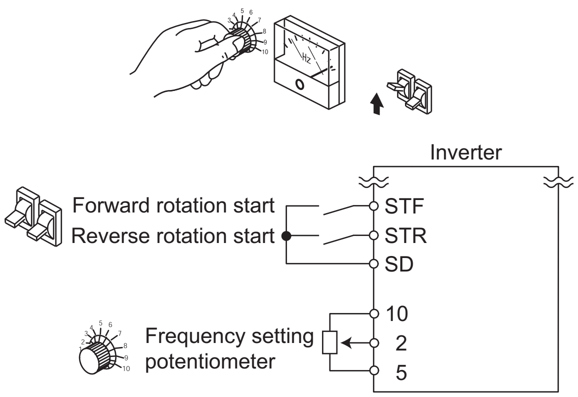
(3) Operation mode selection flow

In the following flowchart, select the basic parameter setting and terminal connection related to the operation mode.

START

Where is the start command source?	Where is the frequency command source?	Connection	Parameter setting	Operation
From outside (STF/STR terminal)	From outside (Terminal 2, 4, JOG, multi-speed, etc.)	STF (forward rotation) /STR (reverse rotation) *(Refer to page 134.)* Terminal 2, 4 (analog), AU, RM, RH, JOG, etc.		Frequency setting terminal ON STF(STR)-ON
	From the operation panel (digital setting)	STF (forward rotation) /STR (reverse rotation) *(Refer to page 134)*	*Pr. 79* = "3" (External/PU combined operation 1)	Operation panel, PU digital setting STF(STR)-ON
	From communication (PU connector (RS-485 communication)	STF (forward rotation) /STR (reverse rotation) *(Refer to page 134)*	*Pr. 338* = "1" *Pr. 340* = "1"	Communication frequency setting command sending STF(STR)-ON
From the operation panel (RUN/FWD/REV key)	From outside (terminal 2, 4, JOG, multi-speed, etc.)	Terminal 2, 4 (analog), AU, RM, RH, JOG, etc.	*Pr. 79* = "4" (External/PU combined operation 2)	Frequency setting terminal ON RUN/FWD/REV key-ON
	From the operation panel (digital setting)		*Pr. 79* = "1" (fixed to PU operation)	Digital setting RUN/FWD/REV key-ON
	From communication (PU connector (RS-485 communication)	✕ Disabled		
From communication (PU connector (RS-485 communication))	From outside (terminal 2, 4, JOG, multi-speed, etc.)	Terminal 2, 4 (analog), AU, RM, RH, JOG, etc.	*Pr. 339* = "1" *Pr. 340* = "1"	Frequency setting terminal ON Communication start command sending
	From the operation panel (digital setting)	✕ Disabled		
	From communication (PU connector (RS-485 communication)		*Pr. 340* = "1"	Communication frequency setting command sending Communication start command sending

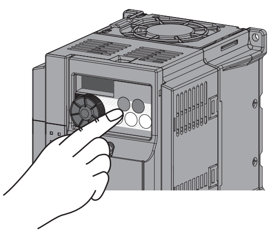
(4) External operation mode *(setting "0" (initial value), "2")*



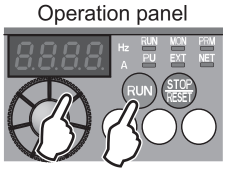
- Select the External operation mode when the start command and the frequency command are applied from a frequency setting potentiometer, start switch, etc. which are provided externally and connected to the control circuit terminals of the inverter.
- Generally, parameter change cannot be performed in the External operation mode. (Some parameters can be changed. Refer to the detailed description of each parameter.)
- When "0 or 2" is selected for *Pr. 79*, the inverter enters the External operation mode at power-ON. (When using the Network operation mode, refer to *page 213*.)
- When parameter changing is seldom necessary, setting "2" fixes the operation mode to the External operation mode.
  When frequent parameter changing is necessary, setting "0" (initial value) allows the operation mode to be changed easily to the PU operation mode by pressing PU EXT of the operation panel. After you switched to the PU operation mode, always return to the External operation mode.
- The STF and STR signal are used as a start command, and the voltage or current signal to terminal 2, 4, multi-speed signal, JOG signal, etc. are used as a frequency commands.

☞ *Refer to page 186*

(5) PU operation mode *(setting "1")*



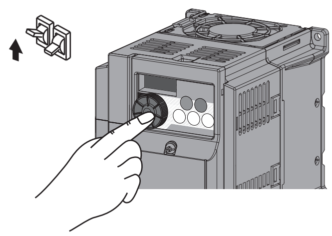
Operation panel

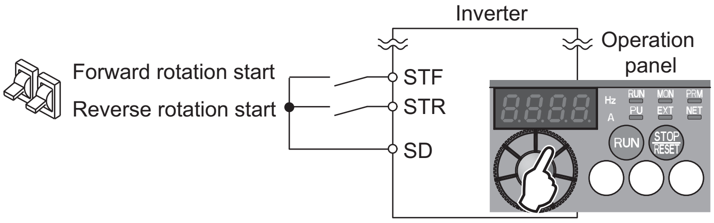


- Select the PU operation mode when applying start and frequency command by only the key operation of the operation panel (FR-PU04/FR-PU07). Also select the PU operation mode when making communication using the PU connector.
- When "1" is selected for *Pr. 79*, the inverter enters the PU operation mode at power-ON. You cannot change to the other operation mode.
- The setting dial of the operation panel can be used for setting like a potentiometer. *(Refer to Pr. 161 Frequency setting/key lock operation selection (page 278))*

☞ *Refer to page 209*

(6) PU/External combined operation mode 1 *(setting "3")*

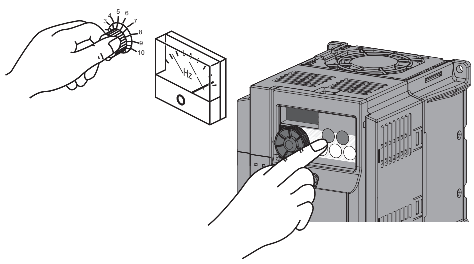


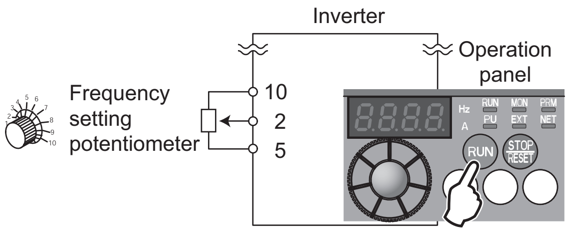


- Select the PU/External combined operation mode 1 when applying frequency command from the operation panel or parameter unit (FR-PU04/FR-PU07) and inputting the start command with the external start switch.
- Select "3" for *Pr. 79*. You cannot change to the other operation mode.
- When a frequency is applied from the external signal by multi-speed setting, it has a higher priority than the frequency command from the PU. When AU is ON, the command signal to terminal 4 is used.

☞ *Refer to page 211*

(7) PU/External combined operation mode 2 *(setting "4")*





- Select the PU/External combined operation mode 2 when applying frequency command from the external potentiometer, multi-speed or JOG signal and inputting the start command by key operation of the operation panel or parameter unit (FR-PU04/FR-PU07).
- Select "4" for *Pr. 79*. You cannot change to the other operation mode.

☞ *Refer to page 212*

4

PARAMETERS

(8) Switchover mode *(setting "6")*

- While continuing operation, you can switch among the PU operation, External operation and Network operation (NET operation).

Operation Mode Switching	Switching Operation/Operating Status
External operation → PU operation	Select the PU operation mode with the operation panel or parameter unit. • Rotation direction is the same as that of External operation. • The frequency set with the potentiometer (frequency command) or like is used unchanged. (Note that the setting will disappear when power is switched OFF or the inverter is reset.)
External operation → NET operation	Send the mode change command to the Network operation mode through communication. • Rotation direction is the same as that of External operation. • The value set with the setting potentiometer (frequency command) or like is used unchanged. (Note that the setting will disappear when power is switched OFF or the inverter is reset.)
PU operation → External operation	Press the External operation key of the operation panel or parameter unit. • The rotation direction is determined by the input signal of the External operation. • The set frequency is determined by the external frequency command signal.
PU operation → NET operation	Send the mode change command to the Network operation mode through communication. • Rotation direction and set frequency are the same as those of PU operation.
NET operation → External operation	Send the mode change command to the External operation mode through communication. • The rotation direction is determined by the input signal of the External operation. • The set frequency is determined by the external frequency command signal.
NET operation → PU operation	Select the PU operation mode with the operation panel or parameter unit. • The rotation direction and frequency command in the Network operation mode are used unchanged.

(9) PU operation interlock *(setting "7")*

- The PU operation interlock function is designed to forcibly change the operation mode to the External operation mode when the PU operation interlock signal (X12) input turns OFF.
  This function prevents the inverter from being inoperative by the external command if the mode is accidentally left unswitched from PU operation mode.
- Set "7" (PU operation interlock) in *Pr. 79*.
- For the terminal used for X12 signal (PU operation interlock signal) input, set "12" to any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function. (Refer to *page 134* for *Pr.178 to Pr.182*.)
- When the X12 signal is not assigned while MRS signal is assigned, function of the MRS signal switches from output stop to PU operation interlock signal.

X12 (MRS) Signal	Function/Operation	
	Operation Mode	Parameter Write
ON	Operation mode (External, PU, NET) switching enabled Output stop during External operation	Parameter write enabled (depending on *Pr. 77 Parameter write selection* and each parameter write conditions (Refer to *page 64* for the parameter list))
OFF	Forcibly switched to External operation mode External operation allowed Switching between the PU and Network operation mode is enabled	Parameter write disabled with exception of *Pr. 79*

<Function/operation changed by switching ON/OFF the X12 (MRS) signal>

Operating Condition		X12 (MRS) Signal	Operation Mode	Operating Status	Switching to PU, NET Operation Mode
Operation Mode	Status				
PU/NET	During stop	ON → OFF *1	External *2	If External operation frequency setting and start signal are entered, operation is performed in that status.	Not allowed
	Running	ON → OFF *1			Not allowed
External	During stop	OFF → ON	External *2	During stop	Allowed
		ON → OFF			Not allowed
	Running	OFF → ON		During operation → output stop	Not allowed
		ON → OFF		Output stop → operation	Not allowed

*1 The operation mode switches to the External operation mode independently of whether the start signal (STF, STR) is ON or OFF. Therefore, the motor is run in External operation mode when the X12 (MRS) signal is turned OFF with either of STF and STR ON.

*2 At fault occurrence, pressing STOP RESET of the operation panel resets the inverter.

NOTE

- **If the X12 (MRS) signal is ON, the operation mode cannot be switched to the PU operation mode when the start signal (STF, STR) is ON.**
- **When the MRS signal is used as the PU interlock signal, the MRS signal serves as the normal MRS function (output stop) by turning ON the MRS signal and then changing the *Pr. 79* value to other than "7" in the PU operation mode. As soon as "7" is set to *Pr. 79* , the MRS signal acts as the PU interlock signal.**
- **When the MRS signal is used as the PU interlock signal, the logic of the signal is as set in *Pr. 17*. When *Pr. 17* = "2", read ON as OFF and OFF as ON in the above explanation.**
- **Changing the terminal assignment using *Pr. 178 to Pr. 182 (input terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

(10) Switching of operation mode by external signal (X16 signal)

- When External operation and operation from the operation panel are used together, use of the PU-External operation switching signal (X16) allows switching between the PU operation mode and External operation mode during a stop (during a motor stop, start command OFF).
- When *Pr. 79* = any of "0, 6, 7", the operation mode can be switched between the PU operation mode and External operation mode. (*Pr. 79* = "6" At Switchover mode, operation mode can be changed during operation)
- For the terminal used for X16 signal input, set "16" to any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the function.

Pr. 79 Setting		X16 Signal State Operation Mode ON (External)	OFF (PU)	Remarks
0 (initial value)		External operation mode	PU operation mode	Can be switched to External, PU or NET operation mode
1		PU operation mode		Fixed to PU operation mode
2		External operation mode		Fixed to External operation mode (can be switched to NET operation mode)
3, 4		External/PU combined operation mode		External/PU combined mode fixed
6		External operation mode	PU operation mode	Switching among the External, PU, and NET operation mode is enabled while running.
7	X12 (MRS) ON	External operation mode	PU operation mode	Can be switched to External, PU or NET operation mode (output stop in External operation mode)
	X12 (MRS) OFF	External operation mode		Fixed to External operation mode (forcibly switched to External operation mode)

REMARKS

- The operation mode status changes depending on the setting of *Pr. 340 Communication startup mode selection* and the ON/OFF status of the X65 and X66 signals. (For details, refer to *page 208*)
- The priorities of *Pr. 79* , *Pr. 340* and signals are *Pr. 79* > X12 > X66 > X65 > X16 > *Pr. 340*.

NOTE

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

(11) Switching of operation mode by external signals (X65, X66 signals)

- When *Pr. 79* = any of "0, 2, 6", the operation mode switching signals (X65, X66) can be used to change the PU or External operation mode to the Network operation mode during a stop (during a motor stop or start command OFF). (*Pr. 79* = "6" Switchover mode can be changed during operation)
- When switching between the Network operation mode and PU operation mode
  1)Set *Pr. 79* to "0" (initial value) or "6".
  2)Set "10" in *Pr. 340 Communication startup mode selection*.
  3)Set "65" in any of *Pr. 178 to Pr. 182* to assign the NET-PU operation switching signal (X65) to the terminal.
  4)The operation mode changes to the PU operation mode when the X65 signal turns ON, or to the Network operation mode when the X65 signal turns OFF.

Pr. 340 Setting	*Pr. 79* Setting		X65 Signal State		Remarks
			ON (PU)	OFF (NET)	
10	0 (initial value)		PU operation mode *1	NET operation mode *2	—
	1		PU operation mode		Fixed to PU operation mode
	2		NET operation mode		Fixed to NET operation mode
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		PU operation mode *1	NET operation mode *2	Operation mode can be switched with operation continued
	7	X12 (MRS) ON	Switching among the External and PU operation mode is enabled *2		Output stop in External operation mode
		X12 (MRS) OFF	External operation mode		Forcibly switched to External operation mode

*1 NET operation mode when the X66 signal is ON.
*2 PU operation mode when the X16 signal is OFF.
External operation mode when the X16 signal is ON.

- When switching between the Network operation mode and External operation mode
  1) Set *Pr. 79* to "0 (initial value), 2, 6 or 7". (At the *Pr. 79* setting of "7", the operation mode can be switched when the X12 (MRS) signal is ON.)
  2) Set "0 (initial value) or 1" in *Pr. 340 Communication startup mode selection*.
  3) Set "66" in any of *Pr. 178 to Pr. 182* to assign the NET-PU operation switching signal (X66) to the terminal.
  4) The operation mode changes to the Network operation mode when the X66 signal turns ON, or to the External operation mode when the X66 signal turns OFF.

Pr. 340 Setting	*Pr. 79* Setting		X66 Signal State		Remarks
			ON (NET)	OFF (external)	
0 (initial value), 1	0 (initial value)		NET operation mode	External operation mode *1	—
	1		PU operation mode		Fixed to PU operation mode
	2		NET operation mode	External operation mode	Cannot be switched to PU operation mode
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		NET operation mode	External operation mode *1	Operation mode can be switched with operation continued
	7	X12 (MRS) ON	NET operation mode	External operation mode *1	Output stop in External operation mode
		X12 (MRS) OFF	External operation mode		Forcibly switched to External operation mode

*1 PU operation mode when the X16 signal is OFF. When the X65 signal has been assigned, the operation mode changes with the ON/OFF state of the X65 signal.

REMARKS

- The priorities of *Pr. 79* , *Pr. 340* and signals are *Pr. 79* > X12 > X66 > X65 > X16 > *Pr. 340*.

NOTE

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

Parameters referred to

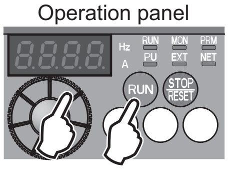
Pr. 15 Jog frequency Refer to page 108
Pr. 4 to 6, Pr. 24 to 27, Pr. 232 to Pr. 239 Multi-speed operation Refer to page 106
Pr. 75 Reset selection/disconnected PU detection/PU stop selection Refer to page 193
Pr. 161 Frequency setting/key lock operation selection Refer to page 278
Pr. 178 to Pr. 182 (input terminal function selection) Refer to page 134
Pr. 190, Pr. 192 (output terminal function selection) Refer to page 140
Pr. 340 Communication startup mode selection Refer to page 213

4.19.2 Setting the frequency by the operation panel

POINT

- **Use the operation panel to give a start command and a frequency command. (PU operation)**

Operation panel



Operation example	Operate at 30Hz.

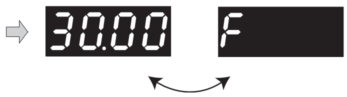
Operation / **Display**

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

2. Change the *Pr. 79* setting to "1".
   (*Refer to page 60* for change of the setting.)

3. Turn (dial) to show the frequency you want to set.
   The frequency flickers for about 5s.

4. While the value is flickering, press to set the frequency. After about 3s of flickering, the indication of the value goes back to "0.00" (monitor display).
   (If SET is not pressed, the indication of the value goes back to "0.00" (0.00Hz) after about 5s of flickering. In that case, go back to "operation step 3" and set the frequency again.)



Flicker...frequency setting complete!!
The monitor display appears after 3s.

5. Start → acceleration → constant speed
   Press RUN to start operation.
   The frequency value on the indication increases in *Pr. 7 Acceleration time,* and "30.00" (30.00Hz) appears.

6. To change the set frequency, perform the operation in above steps 3 and 4. (Starting from the previously set frequency.)
7. Deceleration → stop
   Press STOP/RESET to stop.
   The frequency value on the indication decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with "0.00" (0.00Hz) displayed.


Stop

REMARKS

? Operation cannot be performed at the set frequency ... Why?

☞ Did you carry out step 4 within 5s after step 3? (Did you press SET within 5s after turning ?)

? The frequency does not change by turning ... Why?

☞ Check to see if the operation mode selected is the External operation mode. (Press PU/EXT to change to the PU operation mode.)

? Operation does not change to the PU operation mode ... Why?

☞ Check that "0" (initial value) is set in *Pr. 79 Operation mode selection*?

☞ Check that the start command is not ON.

? Change acceleration deceleration time

☞ *Pr. 7 (Refer to page 113)*

? Change deceleration time

☞ *Pr. 8 (Refer to page 113)*

For example, operation not exceeding 60Hz

☞ Set "60Hz" in *Pr. 1*. (*Refer to page 101)*

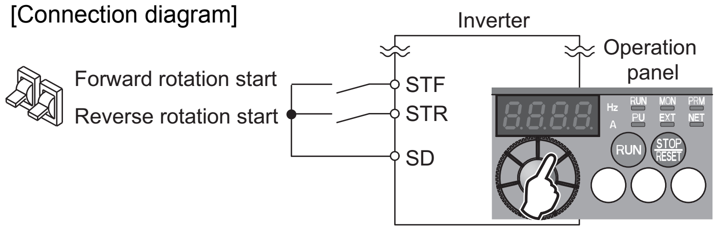
- When you always operate in the PU operation mode at power-ON, set *Pr.79 Operation mode selection* = "1" to choose PU operation mode always.
- To display the set frequency under PU operation mode or External/PU combined operation mode (*Pr.79 Operation mode selection* = "3"), press ( ) for 1s or longer.
- can also be used like a potentiometer to perform operation. (*Refer to page 278)*
- Use *Pr. 295 Magnitude of frequency change setting* to change the frequency setting increments of .

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

POINT

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

[Connection diagram]



Operation example	Operate at 30Hz.

Operation — Display

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

2. Change the *Pr. 79* setting to "3". (Refer to page *60* for change of the setting.)
   [PU] indicator and [EXT] indicator are lit.

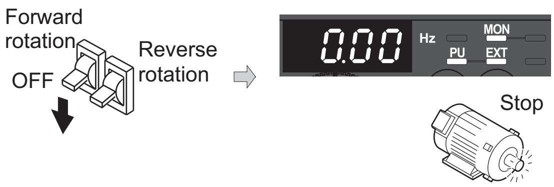
3. Turn to show the frequency you want to set.
   The frequency flickers for about 5s.

4. While the value is flickering, press (SET) to set the frequency.
   After the value flickered for about 3s, the display returns to "0.00" (monitor display).
   (If you do not press (SET), the value flickers for about 5s and the display then returns to "0.00" (0.00Hz). At this time, return to "Step 3" and set the frequency again.)

Flicker...frequency setting complete!!
The monitor display appears after 3s.

5. Start → acceleration → constant speed
   Turn the start switch (STF or STR) ON.
   The frequency value on the display increases in *Pr. 7 Acceleration time, and* "30.00" (30.00Hz) appears.
   [RUN] indicator is lit during forward rotation operation and flickers during reverse rotation operation.

6. To change the set frequency, perform the operation in above steps 3 and 4. (Starting from the previously set frequency.)
7. Deceleration → stop
   Turn OFF the start switch (STF or STR). The frequency value on the indication decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with "0.00" (0.00Hz) displayed.
   [RUN] turns OFF.



REMARKS

- *Pr. 178 STF terminal function selection* must be set to "60" (or *Pr. 179 STR terminal function selection* must be set to "61"). (all are initial values)
- When *Pr. 79 Operation mode selection* is set to "3", multi-speed operation *(Refer to page 106)* is also valid.

? Pressing (STOP RESET) to stop the motor and the display shows  .

1. Turn the start switch (STF or STR) OFF.
2. The display can be reset by (PU EXT).

4 PARAMETERS

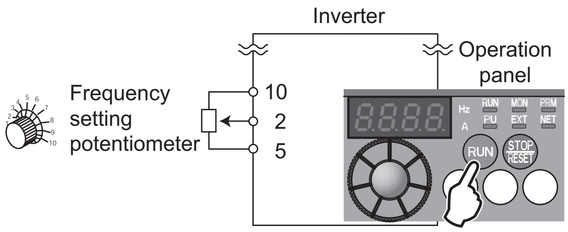
4.19.4 Setting the frequency by analog input (voltage input)

POINT

- Use the operation panel (RUN) to give a start command.
- Use the potentiometer (by connecting terminal 2 and 5) to give a frequentry command.
- Set "4" (External/PU combined operation mode 2) in *Pr. 79 Operation mode selection*.

[Connection diagram]

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



Operation example	Operate at 60Hz.

Operation	Display

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

2. Change the *Pr. 79* setting to "4".
   (Refer to *page 60* for change of the setting.)

[PU] indicator and [EXT] indicator are lit.

3. Start
   Turn ON (RUN).
   [RUN] flickers fast as no frequency command is given.

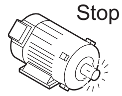
Flickering

4. Acceleration → constant speed
   Turn the potentiometer clockwise slowly to full.
   The frequency value on the indication increases in *Pr. 7 Acceleration time*, and "60.00" (60.00Hz) appears.
   [RUN] indicator is lit during forward rotation operation and flickers slowly during reverse rotation operation.

5. Deceleration
   Turn the potentiometer counterclockwise slowly to full.
   The frequency value on the indication decreases in *Pr. 8 Deceleration time,* and the motor stops rotating with "0.00" (0.00Hz) displayed.
   [RUN] flickers fast.

Flickering

Stop



6. Stop
   Switch power OFF (STOP/RESET).
   [RUN] turns OFF.

REMARKS

? Change the frequency (60Hz) at the maximum voltage input (5V initial value)
  ☞ Adjust the frequency in *Pr. 125 Terminal 2 frequency setting gain frequency*. (*Refer to page 188)*
? Change the frequency (0Hz) at the minimum voltage input (0V initial value)
  ☞ Adjust the frequency in *calibration parameter C2 Terminal 2 frequency setting bias frequency*. *(Refer to page 188)*

4.19.5 Operation mode at power-ON (Pr. 79, Pr. 340)

When power is switched ON or when power comes back ON after instantaneous power failure, the inverter can be started up in the Network operation mode.
After the inverter has started up in the Network operation mode, parameter write and operation can be performed from a program.
Set this mode for communication operation using PU connector.

Parameter Number	Name	Initial Value	Setting Range	Description
79	**Operation mode selection**	0	0 to 4, 6, 7	Operation mode selection *(Refer to page 203)*
340 *	**Communication startup mode selection**	0	0	As set in *Pr. 79*.
			1	Network operation mode
			10	Network operation mode Operation mode can be changed between the PU operation mode and Network operation mode from the operation panel.

The above parameters can be changed during a stop in any operation mode.
* The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

(1) Specify operation mode at power-ON *(Pr. 340)*

• Depending on the *Pr. 79* and *Pr. 340* settings, the operation mode at power-ON (reset) changes as described below.

Pr. 340 Setting	*Pr. 79* Setting	Operation Mode at Power-ON, Power Restoration, Reset	Operation Mode Switching
0 (initial value)	0 (initial value)	External operation mode	Switching among the External, PU and NET operation mode is enabled *1
	1	PU operation mode	Fixed to PU operation mode
	2	External operation mode	Switching between the External and NET operation mode is enabled Switching to PU operation mode disabled
	3, 4	External/PU combined mode	Operation mode switching disabled
	6	External operation mode	Switching among the External, PU, and NET operation mode is enabled while running.
	7	External operation mode when X12 (MRS) signal ON	Switching among the External, PU and Net operation mode is enabled *1
		External operation mode when X12 (MRS) signal OFF	Fixed to External operation mode (Forcibly switched to External operation mode.)
1	0	NET operation mode	Same as when *Pr. 340* = "0"
	1	PU operation mode	
	2	NET operation mode	
	3, 4	External/PU combined mode	
	6	NET operation mode	
	7	NET operation mode when X12 (MRS) signal ON	
		External operation mode when X12(MRS) signal OFF	
10	0	NET operation mode	Switching between the PU and NET operation mode is enabled *2
	1	PU operation mode	Same as when *Pr. 340* = "0"
	2	NET operation mode	Fixed to NET operation mode
	3, 4	External/PU combined mode	Same as when *Pr. 340* = "0"
	6	NET operation mode	Switching between the PU and NET operation mode is enabled while running *2
	7	External operation mode	Same as when *Pr. 340* = "0"

*1 Operation mode can not be directly changed between the PU operation mode and Network operation mode

*2 Operation mode can be changed between the PU operation mode and Network operation mode with PU/EXT key of the operation panel and X65 signal.

Parameters referred to

Pr. 79 Operation mode selection ☞ *Refer to page 200*

4.19.6 Start command source and frequency command source during communication operation (Pr. 338, Pr. 339, Pr. 551)

When the RS-485 communication with the PU connector is used, the external start command and frequency command can be valid. Command source in the PU operation mode can be selected.
From the communication device, parameter unit, etc. which have command source, parameter write or start command can be executed. Parameter read or monitoring can be performed in any operation mode.

Parameter Number	Name	Initial Value	Setting Range	Description
338	**Communication operation command source**	0	0	Start command source communication
			1	Start command source external
339	**Communication speed command source**	0	0	Frequency command source communication
			1	Frequency command source external
			2	Frequency command source external (Frequency command from communication is valid, frequency command from terminal 2 is invalid)
551 *	**PU mode operation command source selection**	9999	2	PU connector is the command source when PU operation mode.
			4	Operation panel is the command source when PU operation mode.
			9999	Parameter unit automatic recognition Normally, operation panel is the command source. When the parameter unit is connected to the PU connector, PU is the command source.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

* *Pr. 551* is always write-enabled.

(1) Selects the command source of the PU operation mode *(Pr. 551)*

- Any of the operation panel, PU connector can be specified as the command source in the PU operation mode.
- In the PU operation mode, set *Pr. 551* to "2" when executing parameter write, start command or frequency command during the RS-485 communication with PU connector.

PU...PU operation mode, NET...Network operation mode, —...without command source

Pr. 551 Setting	Command Source			Remarks
	Operation panel	Parameter unit	RS-485 communication	
2	—	PU	PU *1	Switching to NET operation mode disabled
4	PU	—	NET	
9999 (initial value)	PU *2	PU *2	NET	

*1 The Modbus-RTU protocol cannot be used in the PU operation mode. When using the Modbus-RTU protocol, set *Pr. 551* $\neq$ "2".

*2 When *Pr. 551* = "9999", the priorities of the PU control source is parameter unit (FR-PU04/FR-PU07) > operation panel.

NOTE

- **When performing the RS-485 communication with the PU connector when *Pr. 551* = "9999", PU mode command source does not automatically change to the PU connector.**
- **When *Pr. 551* = "2" (PU mode PU connector), the operation mode cannot be switched to the Network operation mode.**
- **Changed setting value is valid when powering ON or resetting the inverter.**
- **The Modbus-RTU protocol cannot be used in the PU operation mode. Select Network operation mode (NET mode command source).**
- **All of the operation mode indicator (PU EXT NET) of the operation panel turns OFF when command source is not operation panel.**

(2) Controllability through communication

- Controllability through communication in each operation mode is shown below.
- Monitoring and parameter read can be performed from any operation regardless of operation mode.

Operation Location	Condition (*Pr. 551* Setting)	Item \ Operation Mode	PU Operation	External Operation	External/PU Combined Operation Mode 1 (*Pr. 79* = 3)	External/PU Combined Operation Mode 2 (*Pr. 79* = 4)	NET Operation
Control by RS-485 communication from PU connector	2 (PU connector)	Run command (start)	○	×	×	○	×
		Run command (stop)	○	Δ *3	Δ *3	○	×
		Running frequency setting	○	×	○	×	×
		Parameter write	○*4	× *5	○*4	○ *4	× *5
		Inverter reset	○	○	○	○	×
	Other than the above	Run command (start)	×	×	×	×	○ *1
		Run command (stop)	×	×	×	×	○ *1
		Running frequency setting	×	×	×	×	○ *1
		Parameter write	× *5	× *5	× *5	× *5	○ *4
		Inverter reset	×	×	×	×	○ *2
Control circuit external terminals	—	Inverter reset	○	○	○	○	○
		Run command (start, stop)	×	○	○	×	× *1
		Frequency setting	×	○	Δ *6	○	× *1

○: Enabled, ×: Disabled, Δ: Some are enabled

*1 As set in *Pr. 338 Communication operation command source* and *Pr. 339 Communication speed command source* *(Refer to page 214)*
*2 At occurrence of RS-485 communication error, the inverter cannot be reset from the computer.
*3 Enabled only when stopped by the PU. At a PU stop, PS is displayed on the operation panel. As set in *Pr. 75 PU stop selection*. *(Refer to page 193)*
*4 Some parameters may be write-disabled according to the *Pr. 77 Parameter write selection* setting and operating status. *(Refer to page 196)*
*5 Some parameters are write-enabled independently of the operation mode and command source presence/absence. When *Pr. 77* = "2", write is enabled. (Refer to the parameter list on *page 64*) Parameter clear is disabled.
*6 Available with multi-speed setting and terminal 4-5 (valid when AU signal is ON).

(3) Operation at error occurrence

Error Definition	Condition (*Pr. 551* setting) \ Operation Mode	PU Operation	External Operation	External/PU Combined Operation Mode 1 (*Pr. 79* = 3)	External/PU Combined Operation Mode 2 (*Pr. 79* = 4)	NET Operation
Inverter fault	—	Stop				
PU disconnection of the PU	2 (PU connector) 9999 (automatic recognition)	Stop/continued *1, *3				
	Other than the above	Stop/continued*1				
RS-485 communication error of the PU connector	2 (PU connector)	Stop/ continued*2	Continued		Stop/continued*2	—
	Other than the above	Continued				Stop/continued*2

*1 Can be selected using *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*.
*2 Can be selected using *Pr. 122 PU communication check time interval*.
*3 In the PU JOG operation mode, operation is always stopped when the PU is disconnected. Whether fault (E.PUE) occurrence is allowed or not is as set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*.

(4) Selection of control source in Network operation mode *(Pr. 338, Pr. 339)*

- There are two control sources: start command source, which controls the signals related to the inverter start command and function selection, and speed command source, which controls signals related to frequency setting.
- In Network operation mode, the commands from the external terminals and communication are as listed below.

Operation Location Selection			*Pr. 338 Communication operation command source*	0: NET			1: External			Remarks
			Pr. 339 Communication speed command source	0: NET	1: External	2: External	0: NET	1: External	2: External	
Fixed function (terminal-equivalent function)			Running frequency from communication	NET	—	NET	NET	—	NET	
Fixed function (terminal-equivalent function)			Terminal 2	—	External	—	—	External	—	
Fixed function (terminal-equivalent function)			Terminal 4	—	External		—	External		
Selective function / *Pr. 178 to Pr. 182* setting	0	RL	Low-speed operation command/remote setting clear	NET	External		NET	External		*Pr. 59* = "0" (multi-speed) *Pr. 59* ≠ "0" (remote)
Selective function / *Pr. 178 to Pr. 182* setting	1	RM	Middle-speed operation command/remote setting function	NET	External		NET	External		
Selective function / *Pr. 178 to Pr. 182* setting	2	RH	High-speed operation command/remote setting function	NET	External		NET	External		
Selective function / *Pr. 178 to Pr. 182* setting	3	RT	Second function selection	NET			External			
Selective function / *Pr. 178 to Pr. 182* setting	4	AU	Terminal 4 input selection	—	Combined		—	Combined		
Selective function / *Pr. 178 to Pr. 182* setting	5	JOG	Jog operation selection	—			External			
Selective function / *Pr. 178 to Pr. 182* setting	7	OH	External thermal relay input	External						
Selective function / *Pr. 178 to Pr. 182* setting	8	REX	15-speed selection	NET	External		NET	External		*Pr. 59* = "0" (multi-speed)
Selective function / *Pr. 178 to Pr. 182* setting	10	X10	Inverter run enable signal	External						
Selective function / *Pr. 178 to Pr. 182* setting	12	X12	PU operation external interlock	External						
Selective function / *Pr. 178 to Pr. 182* setting	14	X14	PID control valid terminal	NET	External		NET	External		
Selective function / *Pr. 178 to Pr. 182* setting	16	X16	PU/External operation switchover	External						
Selective function / *Pr. 178 to Pr. 182* setting	24	MRS	Output stop	Combined			External			*Pr. 79* ≠ "7"
Selective function / *Pr. 178 to Pr. 182* setting	24	MRS	PU operation interlock	External						*Pr. 79* = "7" When the X12 signal is not assigned
Selective function / *Pr. 178 to Pr. 182* setting	25	STOP	Start self-holding selection	—			External			
Selective function / *Pr. 178 to Pr. 182* setting	60	STF	Forward rotation command	NET			External			
Selective function / *Pr. 178 to Pr. 182* setting	61	STR	Reverse rotation command	NET			External			
Selective function / *Pr. 178 to Pr. 182* setting	62	RES	Inverter reset	External						
Selective function / *Pr. 178 to Pr. 182* setting	64	X64	PID forward/reverse action switchover	NET	External		NET	External		
Selective function / *Pr. 178 to Pr. 182* setting	65	X65	PU/NET operation switchover	External						
Selective function / *Pr. 178 to Pr. 182* setting	66	X66	External/NET operation switchover	External						
Selective function / *Pr. 178 to Pr. 182* setting	67	X67	Command source switchover	External						
Selective function / *Pr. 178 to Pr. 182* setting	72	X72	PID integral value reset	NET	External		NET	External		

[Explanation of the table]

External : Command is valid only from control terminal.
NET : Command only from communication is valid.
Combined : Command from both control terminal and communication is valid.
— : Command from either of control terminal and communication is invalid.

REMARKS

- The command source of communication is as set in *Pr. 551* .
- The *Pr. 338* and *Pr. 339* settings can be changed while the inverter is running when *Pr. 77* = "2". Note that the setting change is applied after the inverter has stopped. Until the inverter stops, communication operation command source and communication speed command source before the setting change are valid.

(5) Switching of command source by external signal (X67)

- In the Network operation mode, the command source switching signal (X67) can be used to switch the start command source and speed command source.
- Set "67" to any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign the X67 signal to the control terminal.
- When the X67 signal is OFF, the start command source and speed command source are control terminal.

X67 Signal State	Start Command Source	Speed Command Source
No signal assignment	According to *Pr. 338*	According to *Pr. 339*
ON	According to *Pr. 338*	According to *Pr. 339*
OFF	Command is valid only from control terminal.	

REMARKS

- The ON/OFF state of the X67 signal is applied only during a stop. It is applied after a stop when the terminal is switched while the inverter is running.
- When the X67 signal is OFF, a reset via communication is disabled.

NOTE

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

Parameters referred to

Pr. 59 Remote function selection ☞ *Refer to page 110*
Pr. 79 Operation mode selection ☞ *Refer to page 200*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*

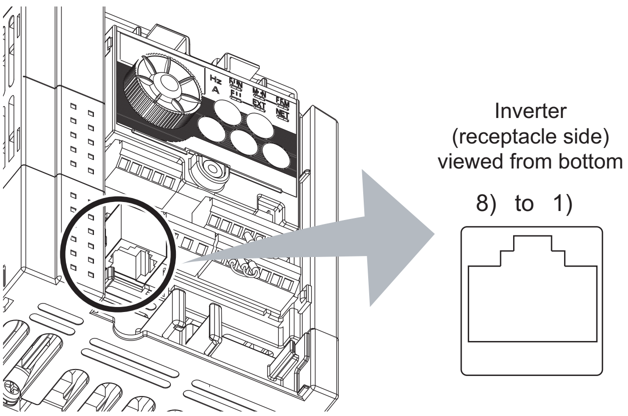
4.20 Communication operation and setting

Purpose	Parameter that should be Set		Refer to Page
Communication operation from PU connector	Initial setting of computer link communication (PU connector)	Pr. 117 to Pr. 124	221
	Modbus-RTU communication specifications	Pr. 117, Pr. 118, Pr. 120, Pr. 122, Pr. 343, Pr. 502, Pr. 549	238
Restrictions on parameter write through communication	Communication EEPROM write selection	Pr. 342	225
Operation selection at a communication error	Stop mode selection at communication error	Pr. 121, Pr. 122, Pr. 502, Pr. 779	222

4.20.1 Wiring and configuration of PU connector

Using the PU connector, you can perform communication operation from a personal computer, etc.
When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the inverter or read and write to parameters.

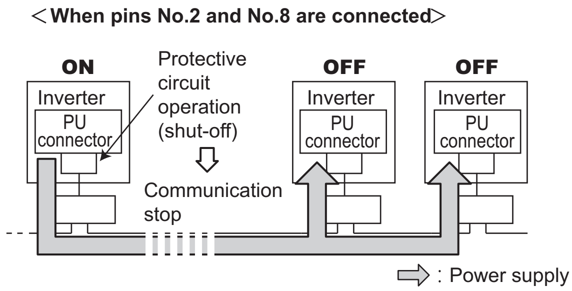
(1) PU connector pin-outs



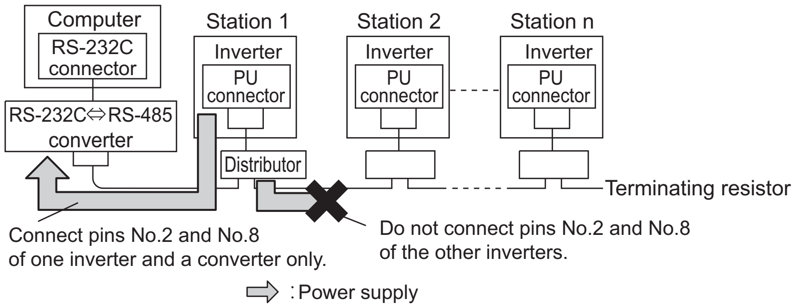
Pin Number	Name	Description
1)	SG	Earth (ground) (connected to terminal 5)
2)	—	Parameter unit power supply
3)	RDA	Inverter receive+
4)	SDB	Inverter send-
5)	SDA	Inverter send+
6)	RDB	Inverter receive-
7)	SG	Earth (ground) (connected to terminal 5)
8)	—	Parameter unit power supply

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 among the FR-F700PJ, FR-E500, FR-S500 and F500J 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.**
- **When multiple inverters are connected using pins No.2 and No.8, power is provided from the inverter which is powered ON to the inverters which are powered OFF in case inverters which are powered ON and OFF are mixed. In such case, a protective circuit of the inverter, which is ON, activates to stop communication.**
  When connecting multiple inverters for RS-485 communication, make sure to disconnect cables from No.2 and No.8 so that pins No.2 and No.8 are not connected between inverters.



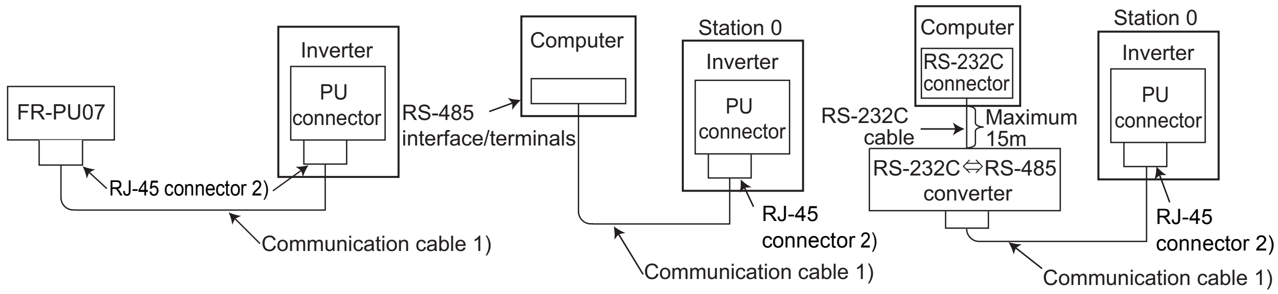
- **When using the RS-485 converter which receives power from the inverter, make sure that power is provided from one inverter only. (*Refer to the figure below.*)**



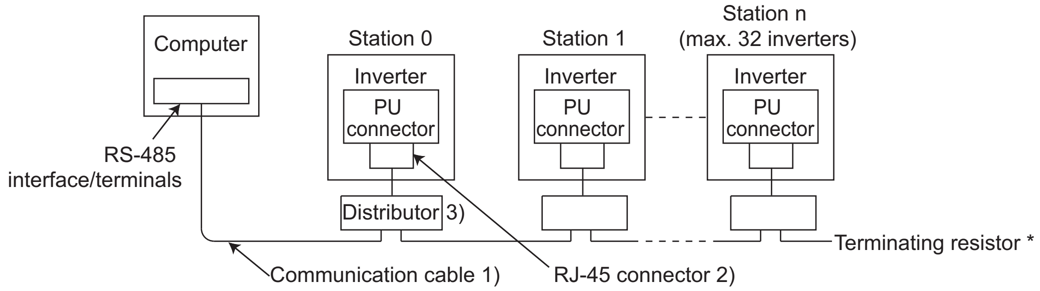
- **Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. The product could be damaged due to differences in electrical specifications.**

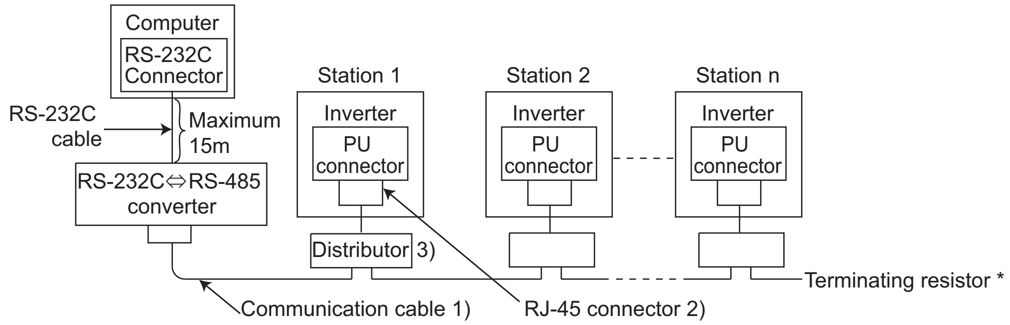
(2) PU connector communication system configuration

●Connection of a computer to the inverter (1:1 connection)



●Combination of computer and multiple inverters (1:n connection)





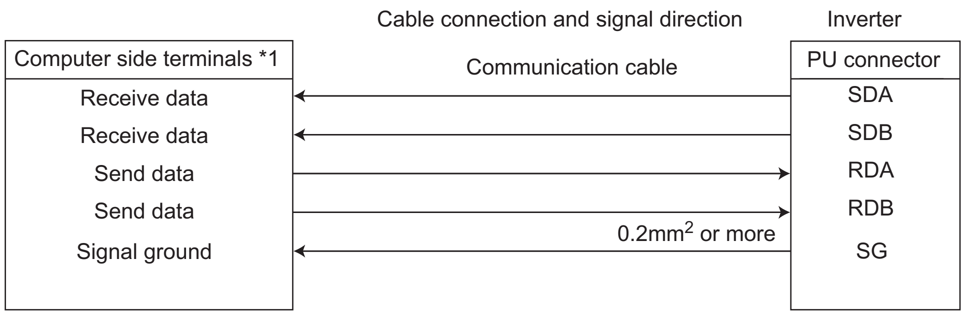
* The inverters may be affected by reflection depending on the transmission speed or transmission distance. If this reflection hinders communication, provide a terminating resistor. If the PU connector is used to make a connection, use a distributor since a terminating resistor cannot be fitted. Connect the terminating resistor to only the inverter remotest from the computer. (Terminating resistor: 100Ω)

REMARKS

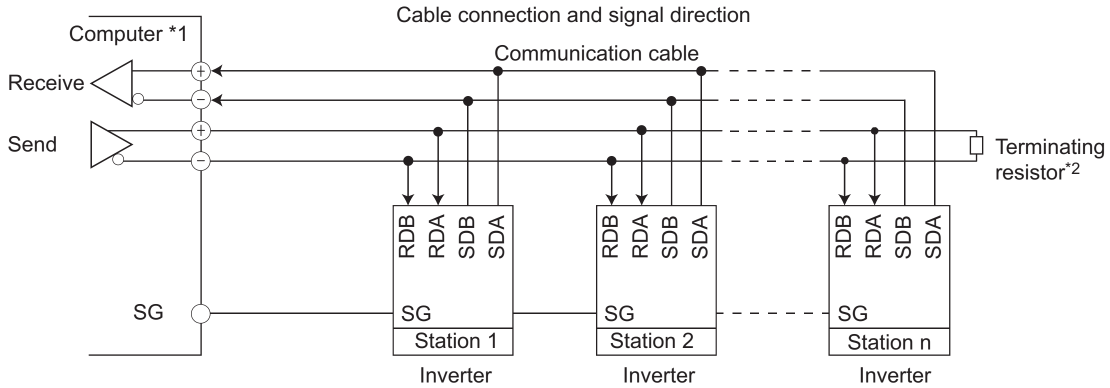
- Computer-inverter connection cable
  Refer to page 344 for the connection cable (RS232C⇔RS485 converter) between the computer with RS-232C interface and an inverter.
- *Refer to page 344* to make your own cable.

(3) Connection with RS-485 computer

●Wiring of one RS-485 computer and one inverter



●Wiring of one RS-485 computer and "n" (multiple) inverters



*1 Make connection in accordance with the Instruction Manual of the computer to be used with.
Fully check the terminal numbers of the computer since these vary with the model.

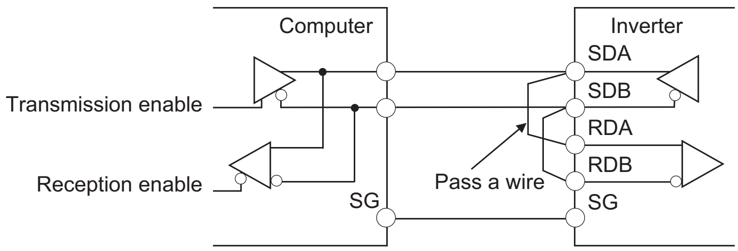
*2 The inverters may be affected by reflection depending on the transmission speed or transmission distance. If this reflection hinders communication, provide a terminating resistor. If the PU connector is used to make a connection, use a distributor since a terminating resistor cannot be fitted. Connect the terminating resistor to only the inverter remotest from the computer. (Terminating resistor: 100Ω)

NOTE

- **Do not use pins No. 2, 8 of the communication cable.** *(Refer to page 218)*
- **When making RS-485 communication among the FR-F700PJ, FR-E500, FR-S500, and FR-F500J 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.** *(Refer to page 218)*

(4) Two-wire type connection

If the computer is 2-wire type, a connection from the inverter can be changed to 2-wire type by passing wires across reception terminals and transmission terminals of the PU connector pin.



REMARKS

- A program should be created so that transmission is disabled (receiving state) when the computer is not sending and reception is disabled (sending state) during sending to prevent the computer from receiving its own data.
- The passed wiring length should be as short as possible.

4.20.2 Initial settings and specifications of RS-485 communication (Pr. 117 to Pr. 120, Pr. 123, Pr. 124, Pr. 549)

The following parameters are used to perform required settings for RS-485 communication between the inverter and personal computer.

- Use PU connector of the inverter for communication.
- You can perform parameter setting, monitoring, etc. using Mitsubishi inverter protocol or Modbus-RTU protocol.
- To make communication between the personal computer and inverter, setting of the communication specifications must be made to the inverter in advance.
  Data communication cannot be made if the initial settings are not made or there is any setting error.

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="2">Description</th></tr>
<tr><td>117</td><td>PU communication station number</td><td>0</td><td>0 to 31 (0 to 247) *1</td><td colspan="2">Inverter station number specification
Set the inverter station numbers when two or more inverters are connected to one personal computer.</td></tr>
<tr><td>118</td><td>PU communication speed</td><td>192</td><td>48, 96, 192, 384</td><td colspan="2">Communication speed
The setting value X 100 equals to the communication speed.
Example)19200bps if 192</td></tr>
<tr><td rowspan="5">119</td><td rowspan="5">PU communication stop bit length</td><td rowspan="5">1</td><td></td><td>Stop bit length</td><td>Data length</td></tr>
<tr><td>0</td><td>1 bit</td><td rowspan="2">8 bits</td></tr>
<tr><td>1</td><td>2 bits</td></tr>
<tr><td>10</td><td>1 bit</td><td rowspan="2">7 bits</td></tr>
<tr><td>11</td><td>2 bits</td></tr>
<tr><td rowspan="3">120</td><td rowspan="3">PU communication parity check</td><td rowspan="3">2</td><td>0</td><td colspan="2">Without parity check</td></tr>
<tr><td>1</td><td colspan="2">With odd parity check</td></tr>
<tr><td>2</td><td colspan="2">With even parity check</td></tr>
<tr><td rowspan="2">123</td><td rowspan="2">PU communication waiting time setting</td><td rowspan="2">9999</td><td>0 to 150ms</td><td colspan="2">Set the waiting time between data transmission to the inverter and response.</td></tr>
<tr><td>9999</td><td colspan="2">Set with communication data.</td></tr>
<tr><td rowspan="3">124</td><td rowspan="3">PU communication CR/LF selection</td><td rowspan="3">1</td><td>0</td><td colspan="2">Without CR/LF</td></tr>
<tr><td>1</td><td colspan="2">With CR</td></tr>
<tr><td>2</td><td colspan="2">With CR/LF</td></tr>
<tr><td rowspan="2">549</td><td rowspan="2">Protocol selection</td><td rowspan="2">0</td><td>0</td><td colspan="2">Mitsubishi inverter (computer link operation) protocol</td></tr>
<tr><td>1</td><td colspan="2">Modbus-RTU protocol</td></tr>
</table>

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

*1 When "1" (Modbus-RTU protocol) is set in *Pr. 549*, the setting range within parentheses is applied.

NOTE

- **Always reset the inverter after making the initial settings of the parameters. After you have changed the communication-related parameters, communication cannot be made until the inverter is reset.**

4.20.3 Operation selection at communication error occurrence (Pr. 121, Pr. 122, Pr. 502, Pr. 779)

You can select the inverter operation when a communication line error occurs during RS-485 communication from the PU connector.

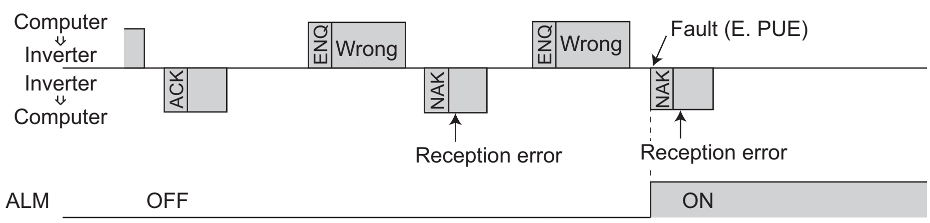
<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">121</td><td rowspan="2">Number of PU communication retries</td><td rowspan="2">1</td><td>0 to 10</td><td colspan="4">Number of retries at data receive error occurrence. If the number of consecutive errors exceeds the permissible value, the inverter will come to trip (depends on Pr. 502).
Valid only Mitsubishi inverter (computer link operation) protocol</td></tr>
<tr><td>9999</td><td colspan="4">If a communication error occurs, the inverter will not come to trip. (NET operation mode at initial value)</td></tr>
<tr><td rowspan="3">122</td><td rowspan="3">PU communication check time interval</td><td rowspan="3">0</td><td>0</td><td colspan="4">RS-485 communication can be made. Note that a communication fault (E.PUE) occurs as soon as the inverter is switched to the operation mode with command source. (NET operation mode at initial value)</td></tr>
<tr><td>0.1 to 999.8s</td><td colspan="4">Communication check (signal loss detection) time interval
If a no-communication state persists for longer than the permissible time, the inverter will come to trip (depends on Pr. 502).</td></tr>
<tr><td>9999</td><td colspan="4">No communication check (signal loss detection)</td></tr>
<tr><td rowspan="5">502</td><td rowspan="5">Stop mode selection at communication error</td><td rowspan="5">0</td><td></td><td>At fault occurrence</td><td>Indication</td><td>Fault output</td><td>At fault removal</td></tr>
<tr><td>0</td><td>Coasts to stop</td><td>E.PUE</td><td>Output</td><td>Stop (E.PUE)</td></tr>
<tr><td>1</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Output after stop</td><td>Stop (E.PUE)</td></tr>
<tr><td>2</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Without output</td><td>Automatic restart functions</td></tr>
<tr><td>3</td><td>Continues running at Pr. 779</td><td>—</td><td>Without output</td><td>Operates normally</td></tr>
<tr><td rowspan="2">779</td><td rowspan="2">Operation frequency during communication error</td><td rowspan="2">9999</td><td>0 to 400Hz</td><td colspan="4">Motor runs at the specified frequency at a communication error.</td></tr>
<tr><td>9999</td><td colspan="4">Motor runs at the frequency used before the communication error.</td></tr>
</table>

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

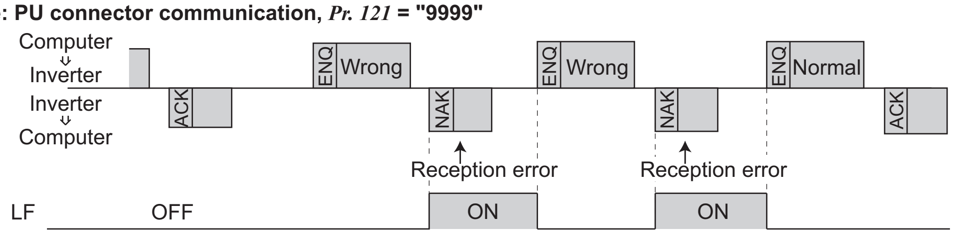
(1) Retry count setting *(Pr. 121)*

- Set the permissible number of retries at data receive error occurrence. (Refer to *page 230* for data receive error for retry)
- When data receive errors occur consecutively and exceed the permissible number of retries set, an inverter trips (E.PUE) and a motor stops (as set in *Pr. 502*).
- When "9999" is set, an inverter fault is not provided even if data receive error occurs but an alarm signal (LF) is output.
  For the terminal used for the LF signal output, assign the function by setting "98 (positive logic) or 198 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)*.

Example: PU connector communication, *Pr. 121* = "1" (initial value)



Example: PU connector communication, *Pr. 121* = "9999"



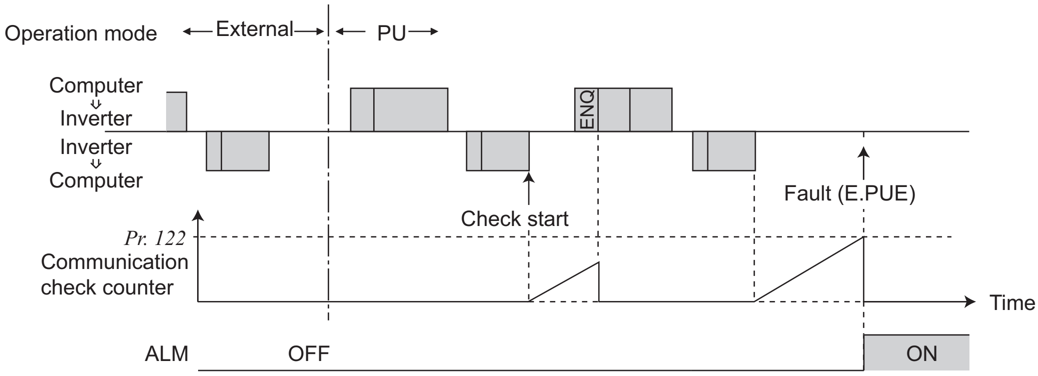
REMARKS

- *Pr. 121* is valid only when Mitsubishi inverter (computer link operation) protocol is selected. *Pr. 121* is not valid when Modbus-RTU communication protocol is selected.
- How the inverter operates at a communication error differs according to the *Pr. 502 Stop mode selection at communication error* setting.

(2) Signal loss detection *(Pr. 122)*

- If a signal loss (communication stop) is detected between the inverter and computer as a result of a signal loss detection, a communication fault (E.PUE) occurs and the inverter trips. (as set in *Pr. 502*).
- When the setting is "9999", communication check (signal loss detection) is not made.
- When the setting value is "0" (initial value), RS-485 communication can be made. However, a communication fault (E.PUE) occurs as soon as the inverter is switched to the operation mode (Network operation mode in the initial setting) with the control.
- A signal loss detection is made when the setting is any of "0.1s to 999.8s". To make a signal loss detection, it is necessary to send data (refer to Mitsubishi inverter protocol control code *(page 229)*, Modbus-RTU communication protocol *(page 239)*) from the computer within the communication check time interval. (The inverter makes communication check (clearing of communication check counter) regardless of the station number setting of the data sent from the master).
- Communication check is made from the first communication in the operation mode with control source valid (Network operation mode in the initial setting).

Example: PU connector communication, *Pr. 122* = "0.1 to 999.8s"



⚠ CAUTION

⚠ **Always set the communication check time interval before starting operation to prevent hazardous conditions. Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter trips (E.PUE).**
The motor can be coasted to a stop by turning ON its RES signal or by switching power OFF.

⚠ **If communication is broken due to signal cable breakage, computer fault, etc, the inverter does not detect such a fault. This should be fully noted.**

4

PARAMETERS

(3) Stop operation selection at occurrence of communication fault *(Pr. 502)*

•Stop operation when retry count exceeds (Mitsubishi inverter protocol only) or signal loss detection error occurs can be selected.

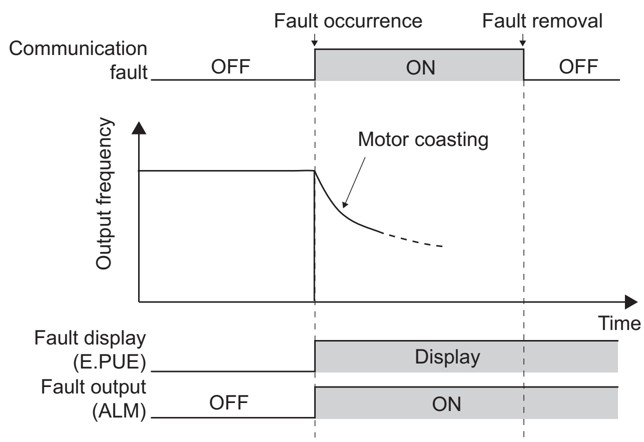
Operation at fault occurrence

Pr. 502 Setting	Operation	Indication	Fault Output
0 (initial value)	Coasts to stop	E. PUE lit	Provided
1	Decelerates to stop	E. PUE lit after stop	Provided after stop
2			Not provided
3	Operates at the frequency set in *Pr. 779*	Normal display	Not provided

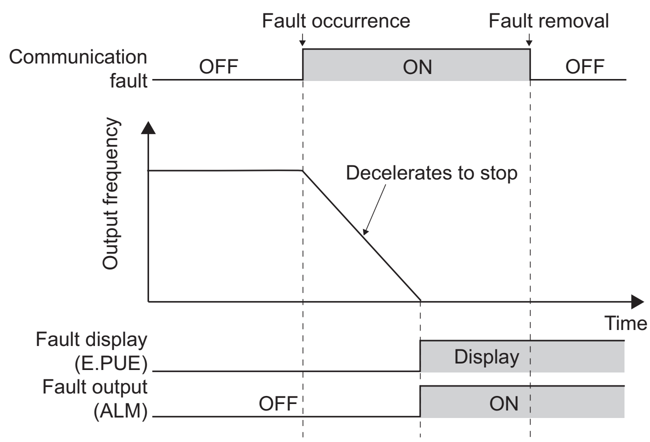
Operation at fault removal

Pr.502 Setting	Operation	Indication	Fault Output
0 (initial value)	Kept stopped	E. PUE	Kept provided
1			
2	Automatic restart functions	Normal display	Not provided
3	Normal operation	Normal display	Not provided

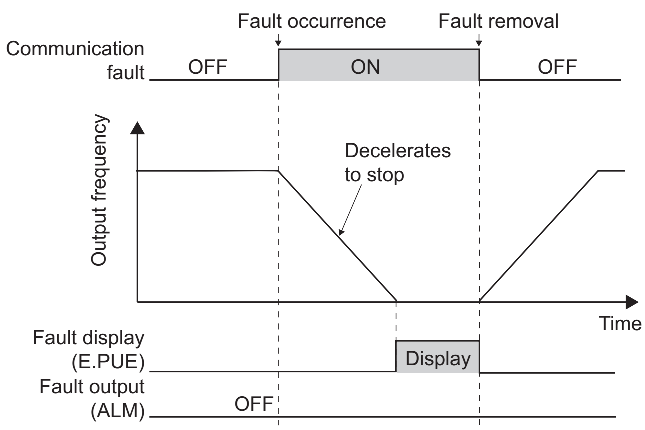
●*Pr. 502* setting "0" (initial value)



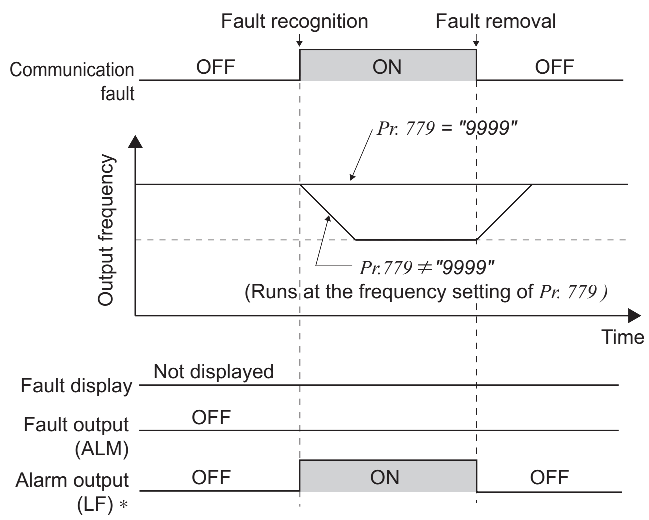
●*Pr. 502* setting "1"



●*Pr. 502* setting "2"



●*Pr. 502* ="3"



* When a communication error is detected while *Pr.502* = "3," the alarm (LF) is output to an output terminal of the inverter. To use the LF signal, assign the function to an output terminal by setting "98 (positive logic) or 198 (negative logic)" in *Pr. 190 or Pr. 192 (Output terminal function selection)*.

REMARKS

- The fault output indicates fault output signal (ALM signal) or alarm bit output.
- When the setting was made to provide a fault output, the fault description is stored into the faults history. (The fault description is written to the faults history when a fault output is provided.)
  When no fault output is provided, the fault record overwrites the fault indication of the faults history temporarily, but is not stored.
  After the fault is removed, the fault indication returns to the ordinary monitor, and the faults history returns to the preceding fault indication.
- When the *Pr. 502* setting is "1, 2 or 3", the deceleration time is the ordinary deceleration time setting (e.g. *Pr. 8, Pr. 44, Pr. 45*). In addition, acceleration time for restart is the normal acceleration time (e.g. *Pr. 7, Pr. 44*).
- When "2 or 3" is set in *Pr. 502*, run command/speed command at restart follows the command before an fault occurrence.
- When "2" is set in *Pr. 502* at occurrence of a communication error and the error is removed during deceleration, the inverter accelerates again at that point.
- If the communication error setting is disabled with *Pr. 502* = "3," *Pr. 121* = "9999," and *Pr. 122* = "9999," the inverter does not continue its operation with the frequency set by *Pr. 779* at a communication error.
- If a communication error occurs while continuous operation at *Pr. 779* is selected with *Pr. 502* = "3," the inverter operates at the frequency set in *Pr. 779* even though the speed command source is at the external terminals.
  Example) If a communication error occurs while *Pr. 339* = "2" and the external terminal RL is ON, the operation is continued at the frequency set in *Pr. 779*.
- After a communication error has been removed while *Pr. 502* = "3," the inverter starts its operation in accordance with the start and speed commands which were set before the error.

Parameters referred to

Pr. 7 Acceleration time, Pr. 8 Deceleration time ☞ *Refer to page 113*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*

4.20.4 Communication EEPROM write selection (Pr. 342)

When parameter write is performed from RS-485 communication with the inverter PU connector, parameters storage device can be changed from EEPROM + RAM to RAM only. Set when a frequent parameter change is necessary.

Parameter Number	Name	Initial Value	Setting Range	Description
342	**Communication EEPROM write selection**	0	0	Parameter values written by communication are written to the EEPROM and RAM.
			1	Parameter values written by communication are written to RAM.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

- When changing the parameter values frequently, set "1" in *Pr. 342* to write them to the RAM only.
  The life of the EEPROM will be shorter if parameter write is performed frequently with the setting unchanged from "0 (initial value)" (EEPROM write).

REMARKS

- When "1" (write to RAM only) is set in *Pr. 342*, powering OFF the inverter will erase the changed parameter values. Therefore, the parameter values available when power is switched ON again are the values stored in EEPROM previously.

4.20.5 Mitsubishi inverter protocol (computer link communication)

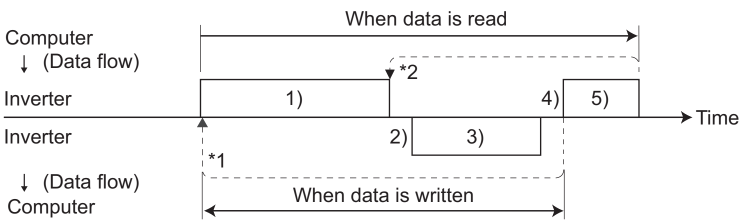
You can perform parameter setting, monitoring, etc. from the PU connector of the inverter using the Mitsubishi inverter protocol (computer link communication).

(1) Communication

• The communication specifications are given below.

Item		Description	Related Parameter
Communication protocol		Mitsubishi protocol (computer link)	Pr. 549
Conforming standard		EIA-485 (RS-485)	—
Number of connectable devices		1:N (maximum 32 units), setting is 0 to 31 stations	Pr. 117
Communication speed	**PU connector**	Selected among 4800/9600/19200/38400bps	Pr. 118
Control procedure		Asynchronous	—
Communication method		Half-duplex	—
Communication	**Character system**	ASCII (7 bits or 8 bits can be selected)	Pr. 119
	Start bit	1 bit	—
	Stop bit length	1 bit or 2 bits can be selected	Pr. 119
	Parity check	Check (with even or odd parity) or no check can be selected	Pr. 120
	Error check	Sum code check	—
	Terminator	CR/LF (presence/absence selectable)	Pr. 124
Waiting time setting		Selectable between presence and absence	Pr. 123

(2) Communication procedure



• Data communication between the computer and inverter is made in the following procedure.
  1) Request data is sent from the computer to the inverter. (The inverter will not send data unless requested.)
  2) After waiting for the waiting time
  3) The inverter sends reply data to the computer in response to the computer request.
  4) After waiting for the inverter data processing time
  5) Answer from the computer in response to reply data 3) of the inverter is transmitted. (Even if 5) is not sent, subsequent communication is made properly.)

*1 If a data error is detected and a retry must be made, execute retry operation with the user program. The inverter trips if the number of consecutive retries exceeds the parameter setting.

*2 On receipt of a data error occurrence, the inverter returns reply data 3) to the computer again. The inverter trips if the number of consecutive data errors reaches or exceeds the parameter setting.

(3) Communication operation presence/absence and data format types

•Data communication between the computer and inverter is made in ASCII code (hexadecimal code).
•Communication operation presence/absence and data format types are as follows:

No.	Operation		Run Command	Operation Frequency	Multi command	Parameter Write	Inverter Reset	Monitor	Parameter Read
1)	Communication request is sent to the inverter in accordance with the user program in the computer.		A1	A, A2 *3	A3	A, A2 *3	A	B	B
2)	Inverter data processing time		Present	Present	Present	Present	Present	Present	Present
3)	Reply data from the inverter (Data 1) is checked for error)	No error *1 (Request accepted)	C	C	C1*4	C	C *2	E, E1, E2, E3 *3	E, E2 *3
		With error (Request rejected)	D	D	D	D	D *2	D	D
4)	Computer processing delay time		10ms or more						
5)	Answer from computer in response to reply data 3). (Data 3) is checked for error)	No error *1 (No inverter processing)	Absent	Absent	Absent (C)	Absent	Absent	Absent (C)	Absent (C)
		With error (Inverter outputs 3) again.)	Absent	Absent	F	Absent	Absent	F	F

*1 In the communication request data from the computer to the inverter, 10ms or more is also required after "no data error (ACK)". (*Refer to page 229)*
*2 Reply from the inverter to the inverter reset request can be selected. *(Refer to page 233)*
*3 When any of "0.01 to 9998" is set in *Pr. 37* and "01" in instruction code, HFF sets data format to A2 or E2. In addition, data format is always A2 and E2 for read or write of *Pr. 37*.
*4 At mode error, and data range error, C1 data contains an error code. *(Refer to page 237)* Except for those errors, the error is returned with data format D.

•Data writing format

Communication request data from the computer to the inverter 1)

Format	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	ENQ *1	Inverter station number *2		Instruction code		*3	Data				Sum check		*4						
A1	ENQ *1	Inverter station number *2		Instruction code		*3	Data		Sum check		*4								
A2	ENQ *1	Inverter station number *2		Instruction code		*3	Data						Sum check		*4				
A3	ENQ *1	Inverter station number *2		Instruction code		*3	Send data type	Receive data type	Data1				Data2				Sum check		*4

Reply data from the inverter to the computer 3) (No data error detected)

Format	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
C	ACK *1	Inverter station number *2		*4															
C1	STX *1	Inverter station number *2		Send data type	Receive data type	Error code 1	Error code 2	Data1				Data2				ETX *1	Sum check		*4

Reply data from the inverter to the computer 3) (With data error)

Format	1	2	3	4	5
D	NAK *1	Inverter station number *2		Error code	*4

*1 Indicate a control code
*2 Specify the inverter station numbers between H00 and H1F (stations 0 to 31) in hexadecimal.
*3 Set waiting time. When the *Pr. 123 PU communication waiting time setting* is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
*4 CR, LF code
When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the inverter according to the computer. Whether the CR and LF codes will be present or absent can be selected using *Pr. 124 PU communication CR/LF selection*.

•Data reading format

Communication request data from the computer to the inverter 1)

Format	Number of Characters								
	1	2	3	4	5	6	7	8	9
B	ENQ *1	Inverter station number *2		Instruction code		*3	Sum check		*4

Reply data from the inverter to the computer 3) (No data error detected)

Format	Number of Characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
E	STX *1	Inverter station number *2		Read data				ETX *1	Sum check		*4		
E1	STX *1	Inverter station number *2		Read data		ETX *1	Sum check		*4				
E2	STX *1	Inverter station number *2		Read data						ETX *1	Sum check		*4

Format	Number of Characters							
	1	2	3	4 to 23	24	25	26	27
E3	STX *1	Inverter station number *2		Read data (Inverter model information)	ETX *1	Sum check		*4

Reply data from the inverter to the computer 3) (With data error)

Format	Number of Characters				
	1	2	3	4	5
D	NAK *1	Inverter station number *2		Error code	*4

Send data from the computer to the inverter 5)

Format	Number of Characters			
	1	2	3	4
C (Without data error)	ACK *1	Inverter station number *2		*4
F (With data error)	NAK *1	Inverter station number *2		*4

*1 Indicate a control code

*2 Specify the inverter station numbers between H00 and H1F (stations 0 to 31) in hexadecimal.

*3 Set waiting time. When the *Pr. 123 PU communication waiting time setting* is other than 9999, create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

*4 CR, LF code
When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the inverter according to the computer. Whether the CR and LF codes will be present or absent can be selected using *Pr. 124 PU communication CR/LF selection*.

(4) Data definitions

1) Control code

Signal	ASCII Code	Description
STX	H02	Start of Text (Start of data)
ETX	H03	End of Text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (Data error detected)

2) Inverter station number

Specify the station number of the inverter which communicates with the computer.

3) Instruction code

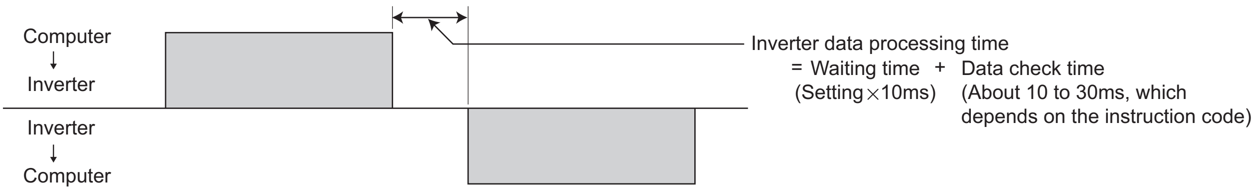
Specify the processing request, for example, operation or monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. *(Refer to page 64)*

4) Data

Indicates the data such as frequency and parameters transferred to and from the inverter. The definitions and ranges of set data are determined in accordance with the instruction codes. *(Refer to page 64)*

5) Waiting time

Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments. (example: 1 = 10ms, 2 = 20ms).



REMARKS

- When the *Pr. 123 PU communication waiting time setting* setting is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
- The data check time changes depending on the instruction code. *(Refer to page 230)*

6) Sum check code

Sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum (binary) derived from the checked ASCII data.

(Example 1)

Computer → Inverter

	ENQ	Station number		Instruction code		*Waiting time	Data				Sum check code		
		0	1	E	1	1	0	7	A	D	F	4	← Binary code
ASCII Code →	H05	H30	H31	H45	H31	H31	H30	H37	H41	H44	H46	H34	

H30+H31+H45+H31+H31+H30+H37+H41+H44

=H1F4

Sum

* When the *Pr. 123 Waiting time setting* ≠ "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

(Example 2)

Inverter→Computer

	STX	Station number		Data read				ETX	Sum check code		
		0	1	1	7	7	0		3	0	← Binary code
ASCII Code →	H02	H30	H31	H31	H37	H37	H30	H03	H33	H30	

H30+H31+H31+H37+H37+H30

= H130

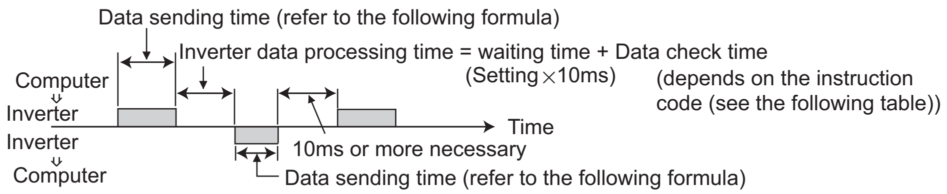
Sum

7) Error code

If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code.

Error Code	Error Item	Error Description	Inverter Operation
H0	Computer NAK error	The number of errors detected consecutively in communication request data from the computer is greater than allowed number of retries.	Brought to trip (E. PUE) if error occurs continuously more than the allowable number of retry times.
H1	Parity error	The parity check result does not match the specified parity	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	
H3	Protocol error	The data received by the inverter has a grammatical mistake. Alternatively, data reception is not completed within the predetermined time. CR or LF is not as set in the parameter.	
H4	Framing error	The stop bit length differs from the initial setting.	
H5	Overrun error	New data has been sent by the computer before the inverter completes receiving the preceding data.	
H6	—	—	—
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data but is not brought to trip.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted in other than the computer link operation mode, when operation command source is not selected or during inverter operation.	Does not accept received data but alarm does not occur.
HB	Instruction code error	The specified command does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	
HD	—	—	—
HE	—	—	—
HF	Normal (no error)	—	—

(5) Response time



[Formula for data sending time]

$$\frac{1}{\text{Communication speed (bps)}} \times \underset{\textit{(Refer to page 227)}}{\text{Number of data characters}} \times \underset{\textit{(Refer to the following.)}}{\text{Communication (Total number of bits)}} = \text{data sending time (s)}$$

●Communication specifications

Name		Number of Bits
Stop bit length		1 bits 2 bits
Data length		7 bits 8 bits
Parity check	Present	1 bit
	Absent	0

In addition to the above, 1 start bit is necessary.
Minimum number of total bits .... 9 bits
Maximum number of total bits .... 12 bits

●Data check time

Item	Check Time
Various monitors, operation command, frequency setting (RAM)	< 12ms
Parameter read/write, frequency setting (EEPROM)	< 30ms
Parameter clear/all clear	< 5s
Reset command	No answer

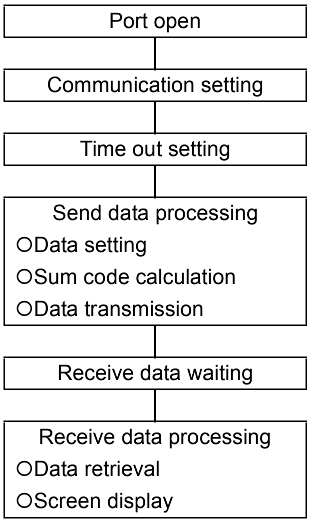
(6) Instructions for the program

1) When data from the computer has any error, the inverter does not accept that data. Hence, in the user program, always insert a retry program for data error.
2) All data communication, for example, run command or monitoring, are started when the computer gives a communication request. The inverter does not return any data without the computer's request. Hence, design the program so that the computer gives a data read request for monitoring, etc. as required.
3) Program example
   To change the operation mode to computer link operation

Programming example of Microsoft® Visual C++® (Ver.6.0)

```
#include <stdio.h>
#include <windows.h>

void main(void){
        HANDLE          hCom;           //Communication handle
        DCB             hDcb;           //Structure for communication setting
        COMMTIMEOUTS            hTim;   // Structure for time out setting

        char            szTx[0x10];             // Send buffer
        char            szRx[0x10];             // Receive buffer
        char            szCommand[0x10];// Command
        int             nTx,nRx;                // For buffer size storing
        int             nSum;                   // For sum code calculation
        BOOL            bRet;
        int             nRet;
        int             i;

        //**** Opens COM1 port****
        hCom = CreateFile ("COM1", (GENERIC_READ | GENERIC_WRITE), 0, NULL, OPEN_EXISTING, FILE_ATTRIBUTE_NORMAL, NULL);
        if (hCom != NULL) {
                //**** Makes a communication setting of COM1 port****
                GetCommState(hCom,&hDcb);                               // Retrieves current communication information
                hDcb.DCBlength = sizeof(DCB);                           // Structure size setting
                hDcb.BaudRate  = 19200;                                 // Communication speed=19200bps
                hDcb.ByteSize  = 8;                                     // Data length=8 bits
                hDcb.Parity    = 2;                                     // Even parity
                hDcb.StopBits  = 2;                                     // Stop bit=2 bits
                bRet = SetCommState(hCom,&hDcb);                        // Sets the changed communication data
                if (bRet == TRUE) {
                        //**** Makes a time out setting of COM1 port****
                        Get CommTimeouts(hCom,&hTim);                   // Obtains the current time out value
                        hTim.WriteTotalTimeoutConstant = 1000;          // Write time out 1s
                        hTim.ReadTotalTimeoutConstant  = 1000;          // Read time out 1s
                        SetCommTimeouts(hCom,&hTim);                    // Changed time out value setting
                        //**** Sets the command to switch the operation mode of the station 1 inverter to the Network operation mode ****
                        sprintf(szCommand,"01FB10000");                 // Send data (NET operation write)
                        nTx = strlen(szCommand);                        //Send data size
                        //**** Generates sum code****
                        nSum = 0;                                       // Initialization of sum data
                        for (i = 0;i < nTx;i++) {
                                nSum += szCommand[i];                   // Calculates sum code
                                nSum &= (0xff);                         // Masks data
                        }

                        //**** Generates send data****
                        memset(szTx,0,sizeof(szTx));                    // Initialization of send buffer
                        memset(szRx,0,sizeof(szRx));                    // Initialization of receive buffer
                        sprintf(szTx,"\5%s%02X",szCommand,nSum);// ENQ code+send data+sum code
                        nTx = 1 + nTx + 2;                              // Number of ENQ code+number of send data+number of sum code

                        nRet = WriteFile(hCom,szTx,nTx,&nTx,NULL);
                        //**** Sending ****
                        if(nRet != 0) {
                                nRet = ReadFile(hCom,szRx,sizeof(szRx),&nRx,NULL);
                        //**** Receiving ****
                                if(nRet != 0) {
                                        //**** Displays the receive data ****
                                        for(i = 0;i < nRx;i++) {
                                                printf("%02X ",(BYTE)szRx[i]);// Consol output of receive data
                                                // Displays ASCII coder in hexadecimal. Displays 30 when "0"
                                        }
                                        printf("\n\r");
                                }
                        }
                }
                CloseHandle(hCom);                                      // Close communication port
        }
}
```

General flowchart



⚠ CAUTION

⚠ **Always set the communication check time interval before starting operation to prevent hazardous conditions. Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to trip (E.PUE).**
The motor can be coasted to a stop by switching ON its RES signal or by switching power OFF.

⚠ **If communication is broken due to signal cable breakage, computer fault etc., the inverter does not detect such a fault. This should be fully noted.**

(7) Setting items and set data

After completion of parameter settings, set the instruction codes and data then start communication from the computer to allow various types of operation control and monitoring.

Item		Read/ Write	Instruction Code	Data Definition	Number of Data Digits (Format)
Operation mode		Read	H7B	H0000: Network operation mode H0001: External operation mode, External JOG operation mode H0002: PU operation mode, External/PU combined operation mode 1 and 2, PUJOG operation mode	4 digits (B, E/D)
		Write	HFB	H0000: Network operation mode H0001: External operation mode H0002: PU operation mode (*Pr. 79* = "6")	4 digits (A, C/D)
Monitor	Output frequency /speed	Read	H6F	H0000 to HFFFF: Output frequency in 0.01Hz increments Speed increments 1/0.001 (when *Pr. 37* = 0.01 to 9998)*2 When "100" is set in *Pr. 52*, the monitor value is different depending on whether the inverter is at a stop or running. *(Refer to page 152)*	4 digits (B, E/D), 6 digits (B, E2/D)
	Output current	Read	H70	H0000 to HFFFF: Output current (hexadecimal) in 0.01A increments	4 digits (B, E/D)
	Output voltage	Read	H71	H0000 to HFFFF: Output voltage (hexadecimal) in 0.1V increments	4 digits (B, E/D)
	Special monitor	Read	H72	H0000 to HFFFF: Monitor data selected in instruction code HF3*2	4 digits (B, E/D), 6 digits (B, E2/D)
	Special monitor Selection No.	Read	H73	H01 to H50: Monitor selection data Refer to the special monitor No. table *(page 235)*	2 digits (B, E1/D)
		Write	HF3		2 digits (A1, C/D)
	Fault description	Read	H74 to H77	H0000 to HFFFF: Two latest fault records b15 … b8b7 … b0 H74: First fault in past | Latest fault H75: Third fault in past | Second fault in past H76: Fifth fault in past | Fourth fault in past H77: Seventh fault in past | Sixth fault in past Refer to the alarm data table *(page 236)*	4 digits (B, E/D)
Run command (extended)		Write	HF9	Control input commands such as forward rotation signal (STF) and reverse rotation signal (STR). (For details, *refer to page 236*)	4 digits (A, C/D)
Run command		Write	HFA		2 digits (A1, C/D)
Inverter status monitor (extended)		Read	H79	Monitor the states of the output signals such as forward rotation, reverse rotation and inverter running (RUN). (For details, *refer to page 236*)	4 digits (B, E/D)
Inverter status monitor		Read	H7A		2 digits (B, E1/D)
Set frequency (RAM)		Read	H6D	Read set frequency/speed from RAM or EEPROM. H0000 to HFFFF: Set frequency in 0.01Hz increments Speed increments 1/0.001 (when *Pr. 37* = 0.01 to 9998) *2	4 digits (B, E/D), 6 digits (B, E2/D)
Set frequency (EEPROM)			H6E		
Set frequency (RAM)		Write	HED	Write set frequency/speed to RAM or EEPROM. H0000 to H9C40 (0 to 400.00Hz): Frequency increments 0.01Hz Speed increments 1/0.001 (when *Pr. 37* = 0.01 to 9998) *2 • To change the set frequency consecutively, write data to the inverter RAM. (instruction code: HED)	4 digits (A, C/D), 6 digits (A2, C/D)
Set frequency (RAM, EEPROM)			HEE		
Inverter reset		Write	HFD	H9696: Resets the inverter • As the inverter is reset at start of communication by the computer, the inverter cannot send reply data back to the computer.	4 digits (A, C/D)
				H9966: Resets the inverter • When data is sent normally, ACK is returned to the computer and then the inverter is reset.	4 digits (A, D)

*1 *Refer to page 227* for data format (A, A1, A2, A3, B, C, C1, D, E, E1, E2, E3)
*2 The increment is 0.001 and the data format is E2 or A2 when the following conditions are met: *Pr. 37* = "0.01 to 9998," *Pr. 144* = "2 to 10," and the instruction code HFF = "01."

4
PARAMETERS

<table>
<tr><th colspan="2">Item</th><th>Read/
Write</th><th>Instruction
Code</th><th>Data Definition</th><th>Number of
Data Digits
(Format)</th></tr>
<tr><td colspan="2">Fault history batch clear</td><td>Write</td><td>HF4</td><td>H9696: Clears the fault history as a batch</td><td>4 digits
(A, C/D)</td></tr>
<tr><td colspan="2">Parameter clear
All clear</td><td>Write</td><td>HFC</td><td>All parameters return to the initial values.
Whether to clear communication parameters or not can be selected according to data. (○: Clear, ×: Not clear)
Refer to page 64 for parameter clear, all clear, and communication parameters.
<table>
<tr><th>Clear Type</th><th>Data</th><th>Communication Pr.</th></tr>
<tr><td rowspan="2">Parameter clear</td><td>H9696</td><td>○</td></tr>
<tr><td>H5A5A</td><td>×*</td></tr>
<tr><td rowspan="2">All parameter clear</td><td>H9966</td><td>○</td></tr>
<tr><td>H55AA</td><td>×*</td></tr>
</table>
When clear is executed for H9696 or H9966, communication-related parameter settings also return to the initial values. When resuming operation, set the parameters again.
Executing clear will clear the instruction code HEC, HF3, and HFF settings. Only H9966 and H55AA (all parameter clear) are valid during the password lock.
* Turning OFF the power supply while clearing parameters with H5A5A or H55AA also clears the communication parameter settings back to the initial settings.</td><td>4 digits
(A, C/D)</td></tr>
<tr><td colspan="2" rowspan="2">Parameter</td><td>Read</td><td>H00 to H63</td><td rowspan="2">Refer to the instruction code (Refer to page 64) and write and/or read parameter values as required.
When setting Pr. 100 and later, link parameter extended setting must be set.
Data format of Pr. 37 read and write is E2 and A2</td><td>4 digits
(B, E/D),
6 digits
(B, E2/D)</td></tr>
<tr><td>Write</td><td>H80 to HE3</td><td>4 digits
(A, C/D),
6 digits
(A2, C/D)</td></tr>
<tr><td colspan="2" rowspan="2">Link parameter extended setting</td><td>Read</td><td>H7F</td><td rowspan="2">Parameter description is changed according to the H00 to H09 settings.
For details of the settings, refer to the parameter instruction code (Refer to page 64).</td><td>2 digits
(B, E1/D)</td></tr>
<tr><td>Write</td><td>HFF</td><td>2 digits
(A1, C/D)</td></tr>
<tr><td colspan="2" rowspan="2">Second parameter changing
(instruction code HFF = 1, 9)</td><td>Read</td><td>H6C</td><td rowspan="2">Calibration parameters are set. (Refer to the list of calibration parameters on the next page.)
H00: Frequency (Writing of the gain frequency is available with Pr. 125 (instruction code H99) and Pr. 126 (instruction code H9A).)
H01: Parameter-set analog value
H02: Analog value input from terminal</td><td>2 digits
(B, E1/D)</td></tr>
<tr><td>Write</td><td>HEC</td><td>2 digits
(A1, C/D)</td></tr>
<tr><td colspan="2">Multi command</td><td>Write/
Read</td><td>HF0</td><td>Available for writing 2 commands, and monitoring 2 items for reading data (Refer to page 237 for detail)</td><td>10 digits
(A3, C1/D)</td></tr>
<tr><td rowspan="2">Inverter model monitor</td><td>Inverter model</td><td>Read</td><td>H7C</td><td>Reading inverter model in ASCII code.
"H20" (blank code) is set for blank area
Example of FR-F740PJ
H46, H52, H2D, H46, H37, H34, H30, H50, H4A, H20 ... H20</td><td>20 digits
(B, E3/D)</td></tr>
<tr><td>Capacity</td><td>Read</td><td>H7D</td><td>Reading inverter capacity in ASCII code.
Data is read in increments of 0.1kW, and rounds down to 0.01kW increments
"H20" (blank code) is set for blank area
Example
0.4K................ "   4" (H20, H20, H20, H20, H20, H34)
0.75K.............. "   7" (H20, H20, H20, H20, H20, H37)</td><td>6 digits
(B, E2/D)</td></tr>
</table>

*1 *Refer to page 227* for data format (A, A1, A2, A3, B, C, C1, D, E, E1, E2, E3)

*2 The increment is 0.001 and the data format is E2 or A2 when the following conditions are met: *Pr. 37* = "0.01 to 9998," *Pr. 144* = "2 to 10," and the instruction code HFF = "01."

REMARKS

- Set 65520 (HFFF0) as a parameter value "8888" and 65535 (HFFFF) as "9999".
- For the instruction codes HFF, HEC and HF3, their values are held once written but cleared to zero when an inverter reset or all clear is performed.

Example) When reading the *C3 (Pr. 902)* and *C6 (Pr. 904)* settings from the inverter of station 0

	Computer Send Data	Inverter Send Data	Description
1)	ENQ 00 FF 0 01 82	ACK 00	Set "H01" to the extended link parameter.
2)	ENQ 00 EC 0 01 7E	ACK 00	Set "H01" to second parameter changing.
3)	ENQ 00 5E 0 0F	STX 00 0000 ETX 25	*C3 (Pr. 902)* is read. 0% is read.
4)	ENQ 00 60 0 FB	STX 00 0000 ETX 25	*C6 (Pr. 904)* is read. 0% is read.

To read/write *C3 (Pr. 902)* and *C6 (Pr. 904)* after inverter reset or parameter clear, execute from 1) again.

● **List of calibration parameters**

Parameter	Name	Instruction Code		
		Read	Write	Extended
C2 (902)	Terminal 2 frequency setting bias frequency	5E	DE	1
C3 (902)	Terminal 2 frequency setting bias	5E	DE	1
125 (903)	Terminal 2 frequency setting gain frequency	5F	DF	1
C4 (903)	Terminal 2 frequency setting gain	5F	DF	1
C5 (904)	Terminal 4 frequency setting bias frequency	60	E0	1
C6 (904)	Terminal 4 frequency setting bias	60	E0	1
126 (905)	Terminal 4 frequency setting gain frequency	61	E1	1
C7 (905)	Terminal 4 frequency setting gain	61	E1	1

Parameter	Name	Instruction Code		
		Read	Write	Extended
C22(922)	Frequency setting voltage bias frequency (built-in potentiometer)	16	96	9
C23(922)	Frequency setting voltage bias (built-in potentiometer)	16	96	9
C24(923)	Frequency setting voltage gain frequency (built-in potentiometer)	17	97	9
C25(923)	Frequency setting voltage gain (built-in potentiometer)	17	97	9

[Special monitor selection No.]

Refer to *page 152* for details of the monitor description.

Data	Description	Unit
H01	Output frequency/speed/ Machine speed *1*4	0.01Hz/ 1/0.001
H02	Output current*4	0.01A
H03	Output voltage/Machine speed *2*4	0.1V
H05	Frequency setting/speed setting/ Machine speed *1	0.01Hz/ 1/0.001
H08	Converter output voltage	0.1V
H09	Regenerative brake duty	0.1%
H0A	Electronic thermal relay function load factor	0.1%
H0B	Output current peak value	0.01A
H0C	Converter output voltage peak value	0.1V
H0E	Output power	0.01kW
H0F	Input terminal status *2	—
H10	Output terminal status *3	—
H14	Cumulative energization time	1h
H17	Actual operation time	1h

Data	Description	Unit
H18	Motor load factor	0.1%
H19	Cumulative power	1kWh
H32	Power saving effect	Variable
H33	Cumulative power saving	Variable
H34	PID set point	0.1%
H35	PID measured value	0.1%
H36	PID deviation	0.1%
H3D	Motor thermal load factor	0.1%
H3E	Inverter thermal load factor	0.1%
H3F	Cumulative power 2	0.01kWh
H40	PTC thermistor resistance	0.01kΩ
H4D	32-bit cumulative power (lower 16-bit)	1kWh
H4E	32-bit cumulative power (upper 16-bit)	1kWh
H4F	32-bit cumulative power (lower 16-bit)	0.01kWh
H50	32-bit cumulative power (upper 16-bit)	0.01kWh

*1 The data format is 6 digits (E2) when the following conditions are met: *Pr.37* = "0.01 to 9998," *Pr.144* = "2 to 10," and the instruction code HFF = "01." (*Refer to page 150* for *Pr.37* and *Pr.144*.)

*2 Input terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15															b0
—	—	—	—	—	—	—	—	—	RH	RM	AU	—	—	STR	STF

*3 Output terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15															b0
—	—	—	—	—	—	—	—	—	—	ABC	—	—	—	—	RUN

*4 The monitored values are retrained even if an inverter fault occurs. Resetting will clear the retained values.

4

PARAMETERS

[Fault data]

Refer to *page 297* for details of fault description

Data	Definition
H00	No fault present
H10	E.OC1
H11	E.OC2
H12	E.OC3
H20	E.OV1
H21	E.OV2
H22	E.OV3
H30	E.THT
H31	E.THM
H40	E.FIN

Data	Definition
H51	E.UVT
H52	E.ILF
H60	E.OLT
H61	E.SOT
H70	E.BE
H80	E.GF
H81	E.LF
H90	E.OHT
H91	E.PTC
HB0	E.PE
HB1	E.PUE

Data	Definition
HB2	E.RET
HC0	E.CPU
HC4	E.CDO
HC5	E.IOH
HC7	E.AIE
HC9	E.SAF
HD0	E.OS
HE6	E.PID
HF5	E.5

Fault record display example (instruction code H74)

For read data H3010
(Previous fault ...... THT)
(Latest fault...OC1)

b15							b8	b7							b0
0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0

Previous fault (H30) — b15 to b8; Latest fault (H10) — b7 to b0

[Run command]

Item	Instruction Code	Bit Length	Description	Example
Run command	HFA	8 bits	b0: terminal 4 input selection (Fixed) *2 b1: forward rotation command (Fixed) b2: reverse rotation command (Fixed) b3: AU (terminal 4 input selection *1 (Variable)) *2 b4: RM (middle-speed operation command *1 (Variable)) *2 b5: RH (high-speed operation command *1 (Variable)) *2 b6: second function selection (Fixed) *2 b7: output stop (Fixed) *2	[Example 1] H02... Forward rotation b7 → b0: 0 0 0 0 0 0 1 0 [Example 2] H00... Stop b7 → b0: 0 0 0 0 0 0 0 0
Run command (extended)	HF9	16 bits	b0: terminal 4 input selection (Fixed) *2 b1: forward rotation command (Fixed) b2: reverse rotation command (Fixed) b3: AU (terminal 4 input selection *1 (Variable)) *2 b4: RM (middle-speed operation command *1 (Variable)) *2 b5: RH (high-speed operation command *1 (Variable)) *2 b6: second function selection (Fixed) *2 b7: output stop (Fixed) *2 b8 to b15: —	[Example 1] H0002... Forward rotation b15 → b0: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 [Example 2] H0020... Low speed operation (When *Pr. 182 RH terminal function selection* is set to "0") b15 → b0: 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0

*1 The signal is the initial setting. The description changes depending on the setting of *Pr. 180 to Pr. 182 (input terminal function selection) (page 134)*.
*2 When *Pr. 551* = "2" (PU mode control source is PU connector), only forward rotation and reverse rotation can be used.

[Inverter status monitor]

Item	Instruction Code	Bit Length	Description	Example
Inverter status monitor	H7A	8 bits	b0: RUN (inverter running * (Variable)) b1: Forward rotation (Fixed) b2: Reverse rotation (Fixed) b3: up-to-frequency (Fixed) b4: overload (Fixed) b5: — b6: frequency detection (Fixed) b7: ABC (fault * (Variable))	[Example 1] H02... During forward rotation b7 → b0: 0 0 0 0 0 0 1 0 [Example 2] H80... Stop at fault occurrence b7 → b0: 1 0 0 0 0 0 0 0
Inverter status monitor (extended)	H79	16 bits	b0: RUN (inverter running * (Variable)) b1: Forward rotation (Fixed) b2: Reverse rotation (Fixed) b3: up-to-frequency (Fixed) b4: overload (Fixed) b5: — b6: frequency detection (Fixed) b7: ABC (fault * (Variable)) b8 to b14: — b15: Fault occurrence	[Example 1] H0002... During forward rotation b15 → b0: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 [Example 2] H8080... Stop at fault occurrence b15 → b0: 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0

* The signal is the initial setting. The description changes depending on the *Pr. 190, Pr. 192 (output terminal function selection)*.

[Multi command (HF0)]

Sending data format from computer to inverter

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A3	ENQ	Inverter station number		Instruction Code (HF0)		Waiting time	Send data type∗1	Receive data type∗2	Data1∗3				Data2 ∗3				Sum check		CR/LF

Reply data format from inverter to computer (No data error detected)

Format	Number of Characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
C1	STX	Inverter station number		Send data type∗1	Receive data type∗2	Error code 1 ∗5	Error code 2 ∗5	Data1∗4				Data2 ∗4				ETX	Sum check		CR/LF

∗1 Specify the data type of sending data (from computer to inverter).
∗2 Specify the data type of reply data (from inverter to computer).
∗3 Combination of data 1 and data 2 for sending

Data Type	Data 1	Data 2	Remarks
0	Run command (extended)	Set frequency (RAM)	Run command (extended) is same as instruction code HF9 (*Refer to page 236*) The unit of set frequency is always by four digits, even when "0.01 to 9998" is set in *Pr. 37* and "01" is set in instruction code HFF.
1	Run command (extended)	Set frequency (RAM, EEPROM)	

∗4 Combination of data 1 and data 2 for reply

Data Type	Data 1	Data 2	Remarks
0	Inverter status monitor (extended)	Output frequency (speed)	Inverter status monitor (extended) is same as instruction code H79 (*Refer to page 236*) The unit of speed monitor is always by four digits (rounds down after the decimal point), even when "0.01 to 9998" is set in *Pr. 37* and "01" is set in instruction code HFF. Replies the monitor item specified in instruction code HF3 for special monitor.(*Refer to page 235*)
1	Inverter status monitor (extended)	Special monitor	

∗5 Error code for sending data 1 is set in error code 1, and error code for sending data 2 is set in error code 2.
Mode error (HA), instruction code error (HB), data range error (HC) or no error (HF) is replied. (Refer to *page 230* for more details of the error codes.)

4

PARAMETERS

4.20.6 Modbus-RTU communication specifications (Pr. 117, Pr. 118, Pr. 120, Pr. 122, Pr. 343, Pr. 502, Pr. 549, Pr. 779)

Using the Modbus-RTU communication protocol, communication operation or parameter setting can be performed from the PU connector of the inverter.

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">117</td><td rowspan="2">PU communication station number</td><td rowspan="2">0</td><td>0</td><td colspan="4">No reply to the master *</td></tr>
<tr><td>1 to 247</td><td colspan="4">Inverter station number specification
Set the inverter station numbers when two or more inverters are connected to one personal computer.</td></tr>
<tr><td>118</td><td>PU communication speed</td><td>192</td><td>48, 96, 192, 384</td><td colspan="4">Communication speed
The setting value × 100 equals the communication speed.
Example) 9600bps if 96</td></tr>
<tr><td rowspan="3">120</td><td rowspan="3">PU communication parity check</td><td rowspan="3">2</td><td>0</td><td colspan="4">Without parity check
Stop bit length 2 bits</td></tr>
<tr><td>1</td><td colspan="4">With odd parity check
Stop bit length 1 bit</td></tr>
<tr><td>2</td><td colspan="4">With even parity check
Stop bit length 1 bit</td></tr>
<tr><td rowspan="3">122</td><td rowspan="3">PU communication check time interval</td><td rowspan="3">0</td><td>0</td><td colspan="4">RS-485 communication can be made. Note that a communication fault (E.PUE) occurs as soon as the inverter is switched to the operation mode with command source.</td></tr>
<tr><td>0.1 to 999.8s</td><td colspan="4">Communication check (signal loss detection) time interval
If a no-communication state persists for longer than the permissible time, the inverter will come to trip (depends on Pr. 502).</td></tr>
<tr><td>9999</td><td colspan="4">No communication check (signal loss detection)</td></tr>
<tr><td>343</td><td>Communication error count</td><td>0</td><td>—</td><td colspan="4">Displays the number of communication errors during Modbus-RTU communication (reading only)</td></tr>
<tr><td rowspan="5">502</td><td rowspan="5">Stop mode selection at communication error</td><td rowspan="5">0</td><td></td><th>At Fault Occurrence</th><th>Indication</th><th>Fault Output</th><th>At Fault Removal</th></tr>
<tr><td>0</td><td>Coasts to stop.</td><td>E.PUE</td><td>Output</td><td>Stop (E.PUE)</td></tr>
<tr><td>1</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Output after stop</td><td>Stop (E.PUE)</td></tr>
<tr><td>2</td><td>Decelerates to stop</td><td>After stop E.PUE</td><td>Without output</td><td>Automatic restart functions</td></tr>
<tr><td>3</td><td>Continues running at Pr.779</td><td>—</td><td>Without output</td><td>Operates in normal condition</td></tr>
<tr><td rowspan="2">549</td><td rowspan="2">Protocol selection</td><td rowspan="2">0</td><td>0</td><td colspan="4">Mitsubishi inverter (computer link operation) protocol</td></tr>
<tr><td>1</td><td colspan="4">Modbus-RTU protocol</td></tr>
<tr><td rowspan="2">779</td><td rowspan="2">Operation frequency during communication error</td><td rowspan="2">9999</td><td>0 to 400Hz</td><td colspan="4">Motor runs at the specified frequency at a communication error.</td></tr>
<tr><td>9999</td><td colspan="4">Motor runs at the frequency used before the communication error.</td></tr>
</table>

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 197*)

* When Modbus-RTU communication is performed from the master with address 0 (station number 0) set, broadcast communication is selected and the inverter does not send a response message. When response from the inverter is necessary, set a value other than "0" (initial value is 0) in *Pr. 117 PU communication station number*.
Some functions are invalid for broadcast communication. (*Refer to page 241*)

NOTE

- **When "1" (Modbus-RTU protocol) is set in *Pr. 549* and "384" (38400bps) in *Pr. 118*, parameter unit (FR-PU04/FR-PU07) is disabled. When using the parameter unit (FR-PU04/FR-PU07), change parameter using the operation panel.**

REMARKS

- Set *Pr. 549 Protocol selection* to "1" to use the Modbus-RTU protocol.
- When PU connector is selected as NET mode operation source (when *Pr. 551 PU mode operation command source selection* ≠"2"), Modbus-RTU communication operation can be performed. *(Refer to page 214)*

Parameters referred to

Pr. 502 Stop mode selection at communication error Refer to page 222
Pr. 779 Operation frequency during communication error Refer to page 222

(1) Communication specification

•The communication specifications are given below.

<table>
<tr><th colspan="2">Item</th><th>Description</th><th>Related Parameter</th></tr>
<tr><td colspan="2">Communication protocol</td><td>Modbus-RTU protocol</td><td>Pr. 549</td></tr>
<tr><td colspan="2">Conforming standard</td><td>EIA-485(RS-485)</td><td>—</td></tr>
<tr><td colspan="2">Number of connectable devices</td><td>1:N (maximum 32 units), setting is 0 to 247 stations</td><td>Pr. 117</td></tr>
<tr><td colspan="2">Communication speed</td><td>Selected among 4800/9600/19200 and 38400bps</td><td>Pr. 118</td></tr>
<tr><td colspan="2">Control procedure</td><td>Asynchronous</td><td>—</td></tr>
<tr><td colspan="2">Communication method</td><td>Half-duplex</td><td>—</td></tr>
<tr><td rowspan="6">Communication</td><td>Character system</td><td>Binary (always 8 bits)</td><td>—</td></tr>
<tr><td>Start bit</td><td>1 bit</td><td>—</td></tr>
<tr><td>Stop bit length</td><td rowspan="2">Select from the following three types
•No parity, stop bit length 2 bits
•No odd parity, stop bit length 1 bit
•Even parity, stop bit length 1 bit</td><td rowspan="2">Pr. 120</td></tr>
<tr><td>Parity check</td></tr>
<tr><td>Error check</td><td>CRC code check</td><td>—</td></tr>
<tr><td>Terminator</td><td>Not used</td><td>—</td></tr>
<tr><td colspan="2">Waiting time setting</td><td>Not used</td><td>—</td></tr>
</table>

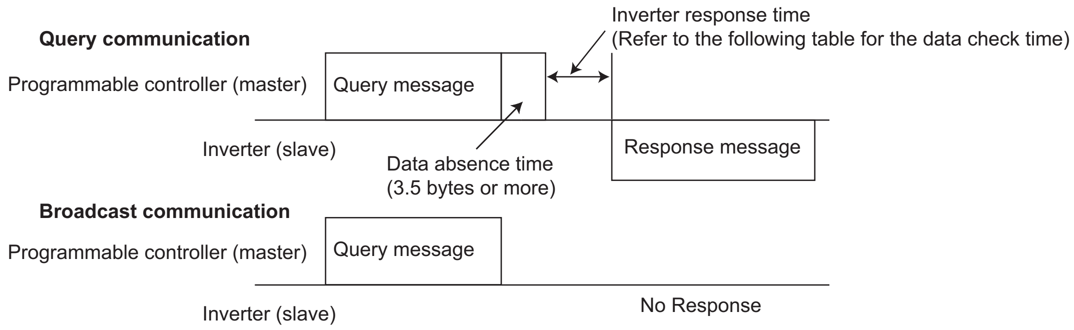
(2) Outline

The Modbus protocol is the communication protocol developed by Modicon for PLC.
The Modbus protocol performs serial communication between the master and slave using the dedicated message frame. The dedicated message frame has the functions that can perform data read and write. Using the functions, you can read and write the parameter values from the inverter, write the input command of the inverter, and check the operating status. In this product, the inverter data are classified in the holding register area (register addresses 40001 to 49999). By accessing the assigned holding register address, the master can communicate with the inverter which is a slave.

REMARKS

There are two different serial transmission modes: ASCII (American Standard Code for Information Interchange) mode and RTU (Remote Terminal Unit) mode. This product supports only the RTU mode in which 1-byte (8-bit) data is transmitted as it is.
Only the communication protocol is defined by the Modbus protocol, and the physical layer is not stipulated.

(3) Message format



●Data check time

Item	Check Time
Various monitors, operation command, frequency setting (RAM)	<20ms
Parameter read/write, frequency setting (EEPROM)	<50ms
Parameter clear/all clear	<5s
Reset command	No answer

1) Query

The master sends a message to the slave (= inverter) at the specified address.

2) Normal Response

After receiving the query from the master, the slave executes the requested function and returns the corresponding normal response to the master.

3) Error Response

If an invalid function code, address or data is received, the slave returns it to the master.

When a response description is returned, the error code indicating that the request from the master cannot be executed is added.

No response is returned for the hardware-detected error, frame error and CRC check error.

4) Broadcast

By specifying address 0, the master can send a message to all slaves. All slaves that received the message from the master execute the requested function. In this communication, the slaves do not return a response to the master.

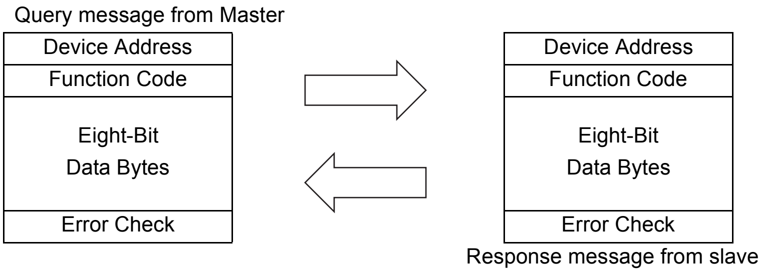
REMARKS

The inverter performs the function independently of the inverter station number setting *(Pr. 117)* during broadcast communication.

(4) Message frame (protocol)

●Communication method

Basically, the master sends a query message (question) and the slave returns a response message (response). When communication is normal, Device Address and Function Code are copied, and when communication is abnormal (function code or data code is illegal), bit 7 (= 80h) of Function Code is turned ON and the error code is set to Data Bytes.



The message frame consists of the four message fields as shown above.

By adding the no-data time (T1: Start, End) of 3.5 characters to the beginning and end of the message data, the slave recognizes it as one message.

●Protocol details

The four message fields will be explained below.

Start	1) ADDRESS	2) FUNCTION	3) DATA	4) CRC CHECK		End
				L	H	
T1	8 bits	8 bits	n×8 bits	8 bits	8 bits	T1

<table>
<tr><th>Message Field</th><th>Description</th></tr>
<tr><td>1) ADDRESS field</td><td>The address code is 1 byte long (8 bits) and any of 0 to 247 can be set. Set 0 to send a broadcast message (all-address instruction) or any of 1 to 247 to send a message to each slave.
When the slave responds, it returns the address set from the master.
The value set to Pr. 117 PU communication station number is the slave address.</td></tr>
<tr><td>2) FUNCTION field</td><td>The function code is 1 byte long (8 bits) and any of 1 to 255 can be set. The master sets the function that it wants to request to the slave, and the slave performs the requested operation. The following table gives the supported function codes. An error response is returned if the set function code is other than those in the following table.
When the slave returns a normal response, it returns the function code set by the master. When the slave returns an error response, it returns H80 + function code.
<table>
<tr><th>Code</th><th>Function Name</th><th>Outline</th><th>Broadcast Communication</th></tr>
<tr><td>H03</td><td>Read Holding Register</td><td>Reads the holding register data.</td><td>Not allowed</td></tr>
<tr><td>H06</td><td>Preset Single Register</td><td>Writes data to the holding register.</td><td>Allowed</td></tr>
<tr><td>H08</td><td>Diagnostics</td><td>Function diagnosis (communication check only)</td><td>Not allowed</td></tr>
<tr><td>H10</td><td>Preset Multiple Registers</td><td>Writes data to multiple consecutive holding registers.</td><td>Allowed</td></tr>
<tr><td>H46</td><td>Read Holding Register Access Log</td><td>Reads the number of registers that succeeded in communication last time.</td><td>Not allowed</td></tr>
</table>
Table 1:Function code list</td></tr>
<tr><td>3) DATA field</td><td>The format changes depending on the function code (Refer to page 242). Data includes the byte count, number of bytes, description of access to the holding register, etc.</td></tr>
<tr><td>4) CRC CHECK field</td><td>The received message frame is checked for error. CRC check is performed, and 2 byte long data is added to the end of the message. When CRC is added to the message, the low-order byte is added first and is followed by the high-order byte.
The CRC value is calculated by the sending side that adds CRC to the message. The receiving side recalculates CRC during message receiving, and compares the result of that calculation and the actual value received in the CRC CHECK field. If these two values do not match, the result is defined as error.</td></tr>
</table>

(5) Message format types

The message formats corresponding to the function codes in Table 1 on *page 241* will be explained.

- **Read holding register data (H03 or 03)**

  Can read the description of **1)** system environment variables, **2)** real-time monitor, **3)** faults history, and **4)** inverter parameters assigned to the holding register area (refer to the register list *(page 247)*)

Query message

1) Slave Address	2) Function	Starting Address		No. of Points		CRC Check	
(8 bits)	H03 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	Byte Count	Data			CRC Check	
(8 bits)	H03 (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n × 16 bits)	L (8 bits)	H (8 bits)

•Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Broadcast communication cannot be made (0 is invalid).
2) Function	Set H03.
3) Starting Address	Set the address at which holding register data read will be started. Starting address = Starting register address (decimal)-40001 For example, setting of the starting address 0001 reads the data of the holding register 40002.
4) No. of Points	Number of holding registers from which data will be read The number of registers from which data can be read is a maximum of 125.

•Description of normal response

Message	Setting Description
5) Byte Count	The setting range is H02 to HFA (2 to 250). Twice greater than the No. of Point specified at 4) is set.
6) Data: Read data	The number of data specified at **4)** is set. Data are read in order of Hi byte and Lo byte, and set in order of starting address data, starting address + 1 data, starting address + 2 data,

Example: To read the register values of 41004 *(Pr. 4)* to 41006 *(Pr. 6)* from the slave address 17 (H11)

Query message

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H11 (8 bits)	H03 (8 bits)	H03 (8 bits)	HEB (8 bits)	H00 (8 bits)	H03 (8 bits)	H77 (8 bits)	H2B (8 bits)

Normal response (Response message)

Slave Address	Function	Byte Count	Data						CRC Check	
H11 (8 bits)	H03 (8 bits)	H06 (8 bits)	H17 (8 bits)	H70 (8 bits)	H0B (8 bits)	HB8 (8 bits)	H03 (8 bits)	HE8 (8 bits)	H2C (8 bits)	HE6 (8 bits)

Read value

Register 41004*(Pr. 4)*: H1770 (60.00Hz)

Register 41005*(Pr. 5)*: H0BB8 (30.00Hz)

Register 41006*(Pr. 6)*: H03E8 (10.00Hz)

- **Write holding register data (H06 or 06)**

Can write the description of 1) system environment variables and 4) inverter parameters assigned to the holding register area (refer to the register list *(page 247)*).

Query message

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

•Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Setting of address 0 enables broadcast communication
2) Function	Set H06.
3) Register Address	Address of the holding register to which data will be written Register address = Holding register address (decimal)-40001 For example, setting of register address 0001 writes data to the holding register address 40002.
4) Preset Data	Data that will be written to the holding register The written data is always 2 bytes.

•Description of normal response

1) to 4) (including CRC check) of the normal response are the same as those of the query message.

No response is made for broadcast communication.

Example: To write 60Hz (H1770) to 40014 (running frequency RAM) at slave address 5 (H05).

Query message

Slave Address	Function	Register Address		Preset Data		CRC Check	
H05 (8 bits)	H06 (8 bits)	H00 (8 bits)	H0D (8 bits)	H17 (8 bits)	H70 (8 bits)	H17 (8 bits)	H99 (8 bits)

Normal response (Response message)

Same data as the query message

NOTE

For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the inverter processing time has elapsed after the previous query.

- **Function diagnosis (H08 or 08)**

A communication check can be made since the query message sent is returned unchanged as a response message (function of sub function code H00).

Sub function code H00 (Return Query Data)

Query message

1) Slave Address	2) Function	3) Subfunction		4) Date		CRC Check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	3) Subfunction		4) Date		CRC Check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

•Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Broadcast communication cannot be made (0 is invalid).
2) Function	Set H08.
3) Subfunction	Set H0000.
4) Data	Any data can be set if it is 2 bytes long. The setting range is H0000 to HFFFF

• Description of normal response

1) to 4) (including CRC check) of the normal response are the same as those of the query message.

NOTE

For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the inverter processing time has elapsed after the previous query.

- **Write multiple holding register data (H10 or 16)**

You can write data to multiple holding registers.

Query message

1)Slave Address	2) Function	3) Starting Address		4) No. of Registers		5) ByteCount	6) Data			CRC Check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n×2×8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1)Slave Address	2)Function	3)Starting Address		4)No. of Registers		CRC Check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

• Query message setting

Message	Setting Description
1) Slave Address	Address to which the message will be sent Setting of address 0 enables broadcast communication
2) Function	Set H10.
3) Starting Address	Address where holding register data write will be started Starting address = Starting register address (decimal)-40001 For example, setting of the starting address 0001 reads the data of the holding register 40002.
4) No. of Points	Number of holding registers where data will be written The number of registers where data can be written is a maximum of 125.
5) Byte Count	The setting range is H02 to HFA (2 to 250). Set a value twice greater than the value specified at 4).
6) Data	Set the data specified by the number specified at 4). The written data are set in order of Hi byte and Lo byte, and arranged in order of the starting address data, starting address + 1 data, starting address + 2 data

• **Description of normal response**

1) to 4) (including CRC check) of the normal response are the same as those of the query message.

Example: To write 0.5s (H05) to 41007 *(Pr. 7)* at the slave address 25 (H19) and 1s (H0A) to 41008 *(Pr. 8)*.

Query message

Slave Address	Function	Starting Address		No. of Points		Byte Count	Data				CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H04 (8 bits)	H00 (8 bits)	H05 (8 bits)	H00 (8 bits)	H0A (8 bits)	H86 (8 bits)	H3D (8 bits)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H22 (8 bits)	H61 (8 bits)

● Read holding register access log (H46 or 70)

A response can be made to a query made by the function code H03 or H10.

The starting address of the holding registers that succeeded in access during previous communication and the number of successful registers are returned.

In response to the query for other than the above function code, 0 is returned for the address and number of registers.

Query message

1) Slave Address	2) Function	CRC Check	
(8 bits)	H46 (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

1) Slave Address	2) Function	3) Starting Address		4) No. of Points		CRC Check	
(8 bits)	H46 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

• **Query message setting**

Message	Setting Description
1) Slave Address	Address to which the message will be sent Broadcast communication cannot be made (0 is invalid).
2) Function	Set H46.

• **Description of normal response**

Message	Setting Description
3) Starting Address	The starting address of the holding registers that succeeded in access is returned. Starting address = Starting register address (decimal)-40001 For example, when the starting address 0001 is returned, the address of the holding register that succeeded in access is 40002.
4) No. of Points	The number of holding registers that succeeded in access is returned.

Example: To read the successful register starting address and successful count from the slave address 25 (H19).

Query message

Slave Address	Function	CRC Check	
H19 (8 bits)	H46 (8 bits)	H8B (8 bits)	HD2 (8 bits)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H22 (8 bits)	H61 (8 bits)

Success of two registers at starting address 41007 *(Pr. 7)* is returned.

- **Error response**

  An error response is returned if the query message received from the master has an illegal function, address or data. No response is returned for a parity, CRC, overrun, framing or busy error.

NOTE

No response message is sent in the case of broadcast communication also.

Error response (Response message)

1) Slave Address	2) Function	3) Exception Code	CRC Check	
(8 bits)	H80 + Function (8 bits)	(8 bits)	L (8 bits)	H (8 bits)

Message	Setting Description
1) Slave Address	Address received from the master
2) Function	Master-requested function code + H80
3) Exception Code	Code in the following table

Error code list

Code	Error Item	Error Description
01	ILLEGAL FUNCTION	The set function code in the query message from the master cannot be handled by the slave.
02	ILLEGAL DATA ADDRESS *1	The set register address in the query message from the master cannot be handled by the inverter. (No parameter, parameter read disabled, parameter write disabled)
03	ILLEGAL DATA VALUE	The set data in the query message from the master cannot be handled by the inverter. (Out of parameter write range, mode specified, other error)

*1 An error will not occur in the following cases.

1) Function code H03 (Read holding register data)
   When the No. of Points is 1 or more and there is one or more holding registers from which data can be read
2) Function code H10 (Write multiple holding register data)
   When the No. of Points is 1 or more and there is 1 or more holding registers to which data can be written

Namely, when the function code H03 or H10 is used to access multiple holding registers, an error will not occur if a non-existing holding register or read disabled or write disabled holding register is accessed.

REMARKS

An error will occur if all accessed holding registers do not exist.
Data read from a non-existing holding register is 0, and data written there is invalid.

- **Message data mistake detection**

  To detect the mistakes of message data from the master, error item are checked for the following errors.
  If an error is detected, a trip will not occur.

Error check item

Error Item	Error Description	Inverter Operation
Parity error	The data received by the inverter differs from the specified parity (*Pr. 120* setting).	1) *Pr. 343* is increased by 1 at error occurrence. 2)The terminal LF is output at error occurrence.
Framing error	The data received by the inverter differs from the specified stop bit length *(Pr. 120)*.	
Overrun error	The following data was sent from the master before the inverter completes data receiving.	
Message frame error	The message frame data length is checked, and the received data length of less than 4 bytes is regarded as an error.	
CRC check error	A mismatch found by CRC check between the message frame data and calculation result is regarded as an error.	

(6) Modbus registers

- System environment variable

Register	Definition	Read/write	Remarks
40002	Inverter reset	Write	Any value can be written.
40003	Parameter clear	Write	Set H965A as a written value.
40004	All parameter clear	Write	Set H99AA as a written value.
40006	Parameter clear *1	Write	Set H5A96 as a written value.
40007	All parameter clear *1	Write	Set HAA99 as a written value.
40009	Inverter status/control input instruction*2	Read/write	See below.
40010	Operation mode/inverter setting *3	Read/write	See below.
40014	Running frequency (RAM value)	Read/write	According to the *Pr. 37* settings, the frequency and selectable speed are in 1r/min increments.
40015	Running frequency (EEPROM value)	Write	

*1 The communication parameter values are not cleared.
*2 For write, set the data as a control input instruction.
For read, data is read as an inverter operating status.
*3 For write, set data as the operation mode setting.
For read, data is read as the operation mode status.

<Inverter status/control input instruction>

Bit	Definition: Control input instruction	Definition: Inverter status
0	Stop command	RUN (inverter running) *2
1	Forward rotation command	Forward rotation
2	Reverse rotation command	During reverse rotation
3	RH (high-speed operation command)*1	SU (up-to-frequency)
4	RM (middle-speed operation command)*1	OL (overload)
5	AU (terminal 4 input selection)*1	0
6	0	FU (frequency detection)
7	RT (second function selection)	ABC (fault) *2
8	AU (terminal 4 input selection)	0
9	0	0
10	MRS (output stop)	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	Fault occurrence

<Operation mode/inverter setting>

Mode	Read Value	Written Value
EXT	H0000	H0010
PU	H0001	—
EXT JOG	H0002	—
NET	H0004	H0014
PU+EXT	H0005	—

The restrictions depending on the operation mode changes according to the computer link specifications.

*1 The signal within parentheses is the initial setting. Definitions change according to the *Pr. 180 to Pr. 182 (input terminal function selection) (refer to page 134)*. Each assigned signal is valid or invalid depending on NET. *(Refer to page 214)*
*2 The signal within parentheses is the initial setting. Definitions change according to the *Pr. 190, Pr. 192 (output terminal function selection) (refer to page140)*.

- Real time monitor

Refer to page 152 for details of the monitor description.

Register	Description	Unit
40201	Output frequency/speed, machine speed *1*4	0.01Hz/1 *1
40202	Output current *4	0.01A
40203	Output voltage *4	0.1V
40205	Output frequency setting/speed setting, machine speed *1	0.01Hz/1 *1
40208	Converter output voltage	0.1V
40209	Regenerative brake duty	0.1%
40210	Electronic thermal relay function load factor	0.1%
40211	Output current peak value	0.01A
40212	Converter output voltage peak value	0.1V
40214	Output power	0.01kW
40215	Input terminal status *2	—
40216	Output terminal status *3	—
40220	Cumulative energization time	1h
40223	Actual operation time	1h
40224	Motor load factor	0.1%

Register	Description	Unit
40225	Cumulative power	1kWh
40250	Power saving effect	Variable
40251	Cumulative power saving	Variable
40252	PID set point	0.1%
40253	PID measured value	0.1%
40254	PID deviation	0.1%
40261	Motor thermal load factor	0.1%
40262	Inverter thermal load factor	0.1%
40263	Cumulative power 2	0.01kWh
40264	PTC thermistor resistance	0.01kΩ
40277	32-bit cumulative power (lower 16-bit)	1kWh
40278	32-bit cumulative power (upper 16-bit)	1kWh
40279	32-bit cumulative power (lower 16-bit)	0.01kWh/ 0.1kWh *1
40280	32-bit cumulative power (upper 16-bit)	0.01kWh/ 0.1kWh *1

*1 When *Pr .37* = "0.01 to 9998", displayed in integral number. (*Refer to page 150* for *Pr. 37.*)
*2 Input terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15															b0
—	—	—	—	—	—	—	—	—	RH	RM	AU	—	—	STR	STF

*3 Output terminal monitor details (when the terminal is ON: 1, when the terminal is OFF: 0, —: undetermined value)

b15															b0
—	—	—	—	—	—	—	—	—	—	ABC	—	—	—	—	RUN

*4 The monitored values are retrained even if an inverter fault occurs. Resetting will clear the retained values.

- Parameter

Parameter	Register	Parameter Name	Read/ Write	Remarks
0 to 999	**41000 to 41999**	Refer to the parameter list *(page 64)* for the parameter names.	Read/write	The parameter number + 41000 is the register number.
C2(902)	**41902**	Terminal 2 frequency setting bias frequency	Read/write	
C3(902)	**42092**	Terminal 2 frequency setting bias (Analog value)	Read/write	The analog value (%) set to *C3 (902)* is read.
	43902	Terminal 2 frequency setting bias (Terminal analog value)	Read	The analog value (%) of the voltage applied to the terminal 2 is read.
125(903)	**41903**	Terminal 2 frequency setting gain frequency	Read/write	
C4(903)	**42093**	Terminal 2 frequency setting gain (Analog value)	Read/write	The analog value (%) set to *C4 (903)* is read.
	43903	Terminal 2 frequency setting gain (Terminal analog value)	Read	The analog value (%) of the voltage applied to the terminal 2 is read.
C5(904)	**41904**	Terminal 4 frequency setting bias frequency	Read/write	
C6(904)	**42094**	Terminal 4 frequency setting bias (Analog value)	Read/write	The analog value (%) set to *C6 (904)* is read.
	43904	Terminal 4 frequency setting bias (Terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.
126(905)	**41905**	Terminal 4 frequency setting gain frequency	Read/write	
C7(905)	**42095**	Terminal 4 frequency setting gain (Analog value)	Read/write	The analog value (%) set to *C7 (905)* is read.
	43905	Terminal 4 frequency setting gain (Terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.
C22(922)	**41922**	Frequency setting voltage bias frequency (built-in potentiometer)	Read/write	
C23(922)	**42112**	Frequency setting voltage bias (built-in potentiometer)	Read/write	The analog value (%) set to *C23 (922)* is read.
C24(923)	**41923**	Frequency setting voltage gain frequency (built-in potentiometer)	Read/write	
C25(923)	**42113**	Frequency setting voltage gain (built-in potentiometer)	Read/write	The analog value (%) set to *C25(923)* is read.
C42(934)	**41934**	PID display bias coefficient	Read/write	
C43(934)	**42124**	PID display bias analog value	Read/write	The analog value (%) set to *C43 (934)* is read.
	43934	PID display bias analog value (terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.
C44(935)	**41935**	PID display gain coefficient	Read/write	
C45(935)	**42125**	PID display gain analog value	Read/write	The analog value (%) set to *C45 (935)* is read.
	43935	PID display gain analog value (terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.

- Faults history

Register	Definition	Read/write	Remarks
40501	Fault history 1	Read/write	Being 2 bytes in length, the data is stored as "H00○○". Refer to the lowest 1 byte for the error code. Performing write using the register 40501 batch-clears the faults history. Set any value as data.
40502	Fault history 2	Read	
40503	Fault history 3	Read	
40504	Fault history 4	Read	
40505	Fault history 5	Read	
40506	Fault history 6	Read	
40507	Fault history 7	Read	
40508	Fault history 8	Read	

Fault code list

Data	Definition	Data	Definition	Data	Definition
H00	No fault present	H51	E.UVT	HB2	E.RET
H10	E.OC1	H52	E.ILF	HC0	E.CPU
H11	E.OC2	H60	E.OLT	HC4	E.CDO
H12	E.OC3	H61	E.SOT	HC5	E.IOH
H20	E.OV1	H70	E.BE	HC7	E.AIE
H21	E.OV2	H80	E.GF	HC9	E.SAF
H22	E.OV3	H81	E.LF	HD0	E.OS
H30	E.THT	H90	E.OHT	HE6	E.PID
H31	E.THM	H91	E.PTC	HF5	E.5
H40	E.FIN	HB0	E.PE		
		HB1	E.PUE		

* *Refer to page 297* for details of fault records.

- Model information monitor

Register	Definition	Read/Write	Remarks
44001 to 44010	Inverter model	Read	Reading inverter model in ASCII code. "H20" (blank code) is set for blank area Example of FR-F740PJ H46, H52, H2D, H46, H37, H34, H30, H50, H4A, H20................ H20
44011 to 44013	Capacity	Read	Reading inverter capacity in ASCII code. Data is read in increments of 0.1kW, and rounds down to 0.01kW increments "H20" (blank code) is set for blank area Example 0.75K ...." 7" (H20, H20, H20, H20, H20, H37)

(7) *Pr. 343 Communication error count*

You can check the cumulative number of communication errors.

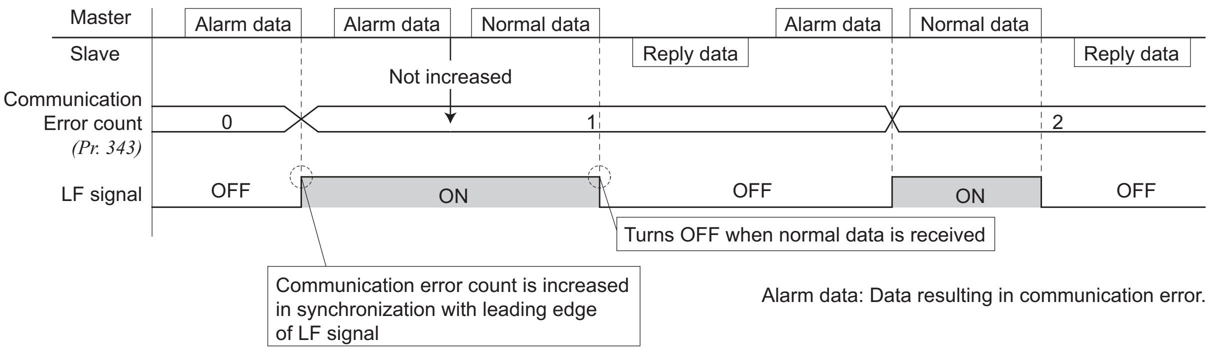
Parameter	Setting Range	Minimum Setting Range	Initial Value
343	(Reading only)	1	0

NOTE

The number of communication errors is temporarily stored into the RAM. As it is not stored into the EEPROM performing a power supply reset or inverter reset clears the value to 0.

(8) Output terminal LF "alarm output (communication error warnings)"

During a communication error, the alarm signal (LF signal) is output by open collector output. Assign the used terminal using *Pr. 190 or Pr. 192 (output terminal function selection)*.



NOTE

The LF signal can be assigned to the output terminal using *Pr. 190 or Pr. 192*. Changing the terminal assignment may affect the other functions. Set parameters after confirming the function of each terminal.

4.21 Special operation and frequency control

Purpose	Parameter that should be Set		Refer to Page
Perform process control such as pump and air volume.	PID control	Pr. 127 to Pr. 134, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45	250
Avoid overvoltage alarm due to regeneration by automatic adjustment of output frequency	Regeneration avoidance function	Pr. 882, Pr. 883, Pr. 885, Pr. 886	262

4.21.1 PID control (Pr. 127 to Pr. 134, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 to C45)

The inverter can be used to perform process control, e.g. flow rate, air volume or pressure.
The terminal 2 input signal or parameter setting is used as a set point and the terminal 4 input signal used as a feedback value to constitute a feedback system for PID control.

Parameter Number	Name	Initial Value	Setting Range	Description	
127	PID control automatic switchover frequency	9999	0 to 400Hz	Frequency at which the control is automatically changed to PID control.	
			9999	Without PID automatic switchover function	
128	PID action selection	0	0	PID action is not performed	
			20	PID reverse action	Measured value (terminal 4)
			21	PID forward action	Set value (terminal 2 or *Pr. 133*)
129 *1	PID proportional band	100%	0.1 to 1000%	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the measured value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, for example, hunting occurs. Gain Kp= 1/proportional band	
			9999	No proportional control	
130 *1	PID integral time	1s	0.1 to 3600s	When deviation step is input, time (Ti) is the time required for integral (I) action to provide the same manipulated variable as the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily.	
			9999	No integral control.	
131	PID upper limit	9999	0 to 100% *2	Maximum value If the feedback value exceeds the setting, the FUP signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	
			9999	No function	
132	PID lower limit	9999	0 to 100% *2	Minimum frequency If the measured value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	
			9999	No function	
133 *1	PID action set point	9999	0 to 100%*2	Used to set the set point for PID control.	
			9999	Terminal 2 input is the set point.	
134 *1	PID differential time	9999	0.01 to 10s	For deviation ramp input, time (Td) is required for providing only the manipulated variable for the proportional (P) action. As the differential time increases, greater response is made to a deviation change.	
			9999	No differential control.	
553	PID deviation limit	9999	0 to 100.0% *2	Y48 signal is output when the absolute value of deviation amount exceeds the deviation limit value.	
			9999	No function	
554	PID signal operation selection	0	0 to 3, 10 to 13	Select the operation to be performed at the detection of upper, lower, and deviation limit for the measured value input. The operation for PID output suspension function can be selected.	
575	Output interruption detection time	1s	0 to 3600s	The inverter stops operation if the output frequency after PID operation remains at less than the *Pr. 576* setting for longer than the time set in *Pr. 575*.	
			9999	Without output interruption function	
576	Output interruption detection level	0Hz	0 to 400Hz	Set the frequency at which the output interruption processing is performed.	
577	Output interruption cancel level	1000% *2	900 to 1100% *2	Set the level (*Pr. 577* minus 1000%) at which the PID output interruption function is canceled.	

Parameter Number	Name	Initial Value	Setting Range	Description
C42 (934) *3	**PID display bias coefficient**	9999	0 to 500.00	Set the coefficient on bias (minimum) side of terminal 4 input.
			9999	Displayed in %.
C43 (934) *3	**PID display bias analog value**	20%	0 to 300.0%	Set the converted % on bias (minimum) side current /voltage of terminal 4 input.
C44 (935) *3	**PID display gain coefficient**	9999	0 to 500.00	Set the coefficient on gain (maximum) side of the terminal 4 input.
			9999	Displayed in %.
C45 (935) *3	**PID display gain analog value**	100%	0 to 300.0%	Set the converted % on gain (maximum) side of current/voltage of terminal 4 input.

The above parameters can be set when *Pr. 160 Extended function display selection* ="0". *(Refer to page 197)*

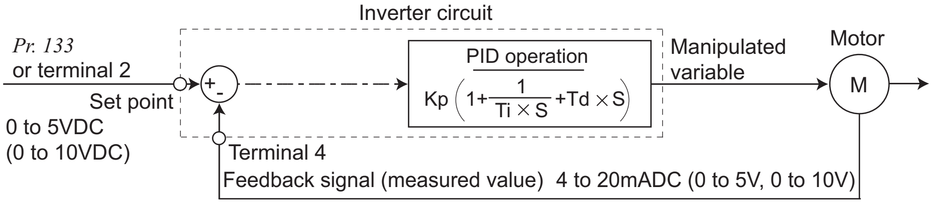
*1 *Pr. 129, Pr. 130, Pr. 133 and Pr. 134* can be set during operation. These can also be set independently of the operation mode.

*2 If *C42(Pr.934)* and *C44(Pr.935)* are both set to values other than "9999," the setting range for *Pr. 131* to *Pr. 133* and *Pr. 553* become only "9999," and % is not displayed in the setting range of *Pr. 577*. (Values set in *Pr. 553* and *Pr. 577* are converted as differentials.)

*3 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).

(1) PID control basic configuration

•*Pr. 128* = "20, 21" (measured value input)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

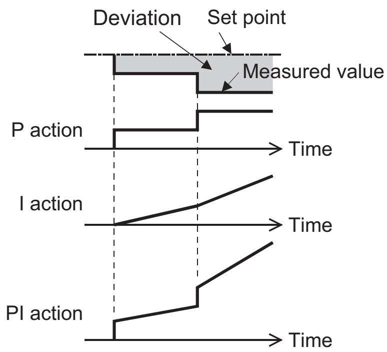
(2) PID action overview

1)PI action

A combination of proportional control action (P) and integral control action (I) for providing a manipulated variable in response to deviation and changes with time.

[Operation example for stepped changes of measured value]

(Note) PI action is the sum of P and I actions.

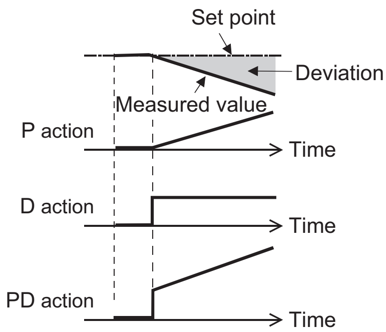


2)PD action

A combination of proportional control action (P) and differential control action (D) for providing a manipulated variable in response to deviation speed to improve the transient characteristic.

[Operation example for proportional changes of measured value]

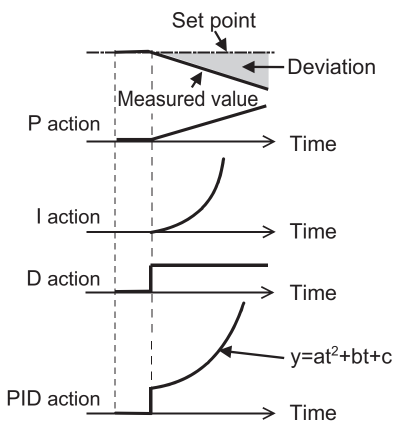
(Note) PD action is the sum of P and D actions.



3)PID action

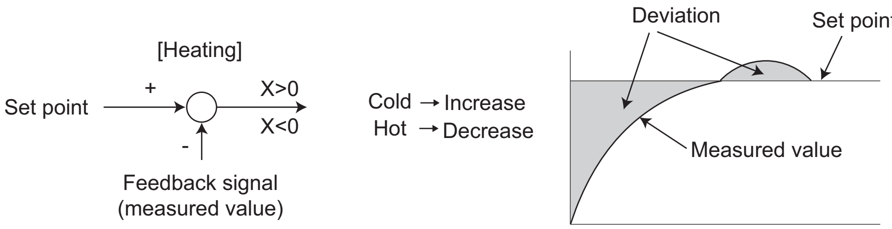
The PI action and PD action are combined to utilize the advantages of both actions for control.

(Note) PID action is the sum of P, I and D actions.



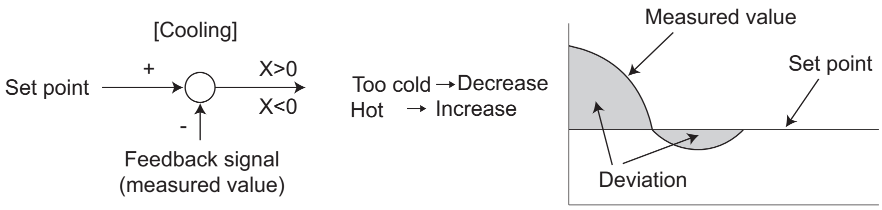
4)Reverse operation

Increases the manipulated variable (output frequency) if deviation X = (set point - measured value) is positive, and decreases the manipulated variable if deviation is negative.



5)Forward action

Increases the manipulated variable (output frequency) if deviation X = (set point - measured value) is negative, and decreases the manipulated variable if deviation is positive.

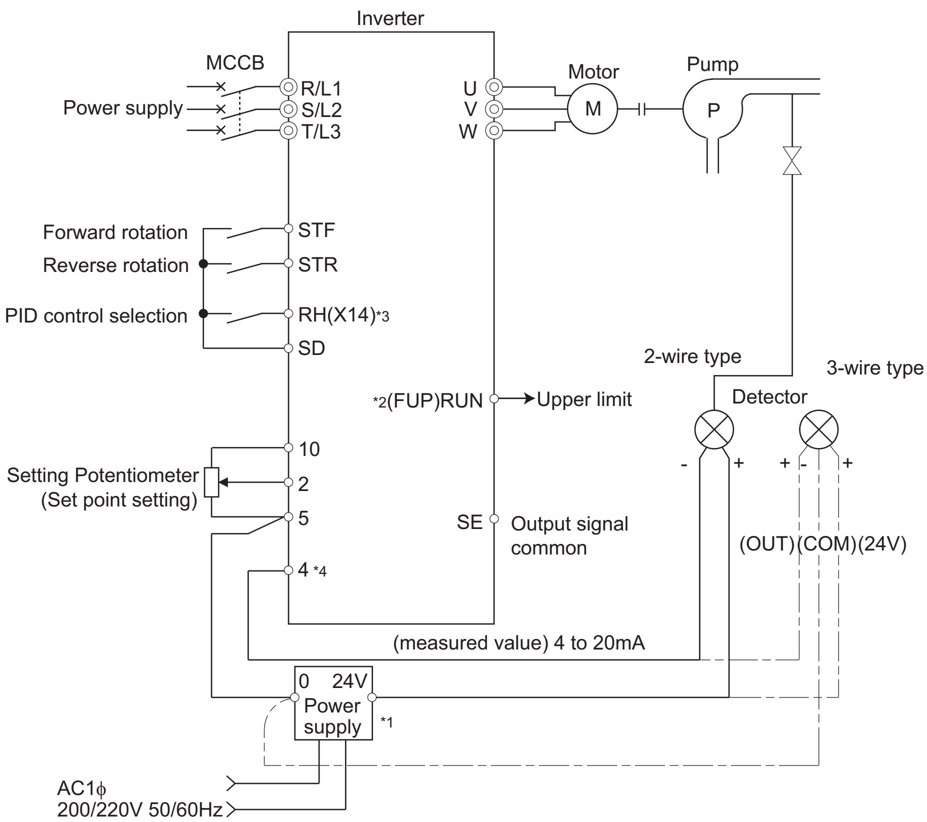


Relationships between deviation and manipulated variable (output frequency)

	Deviation	
	Positive	Negative
Reverse action	↗	↘
Forward action	↘	↗

(3) Connection diagram

- •Sink logic
- •*Pr. 128* = 20
- •*Pr. 182* = 14
- •*Pr. 190* = 15



*1 The power supply must be selected in accordance with the power specifications of the detector used.

*2 The used output signal terminal changes depending on the *Pr. 190 and Pr. 192 (output terminal selection)* settings.

*3 The used input signal terminal changes depending on the *Pr. 178 to Pr. 182 (input terminal selection)* setting.

*4 The AU signal need not be input.

(4) I/O signals and parameter setting

- Set "20, 21" in *Pr. 128* to perform PID operation.
- Set "14" in any of *Pr. 178 to Pr. 182 (input terminal function selection)* to assign PID control selection signal (X14) to turn the X14 signal ON.
  When the X14 signal is not assigned, only the *Pr. 128* setting makes PID control valid.
- Enter the set point using the inverter terminal 2 or *Pr. 133* and enter the measured value to terminal 4.

REMARKS

- When *Pr. 128* = "0" or X14 signal is OFF, normal inverter operation is performed without PID action.
- Turning ON/OFF of bit of the terminal, to which X14 signal is assigned through network as RS-485 communication, enables PID control.

	Signal	Terminal Used	Function	Description	Parameter Setting
Input	X14	Depending on *Pr. 178 to Pr. 182*	PID control selection	Turn ON X14 signal to perform PID control. *1	Set 14 in any of *Pr. 178* to *Pr. 182*.
	X64		PID forward/ reverse action switchover	By turning ON X64, forward action can be selected for PID reverse action (*Pr. 128* = 20), and reverse action for forward action (*Pr. 128* =21).	Set 64 in any of *Pr. 178 to Pr. 182*.
	X72		PID integral value reset	ON: Integral and differential values are reset OFF: Normal processing	Set 72 in any of *Pr. 178 to Pr. 182*.
	2	2 *5	Set point input	You can input the set point for PID control.*4	*Pr. 128* = 20, 21, *Pr. 133* = 9999
				0 to 5V............. 0 to 100%	*Pr. 73* = 1 *2, 11
				0 to 10V........... 0 to 100%	*Pr. 73* = 0, 10
	PU	—	Set point input	Set the set point *(Pr. 133)* from the operation panel.	*Pr. 128* = 20, 21 *Pr. 133* = 0 to 100%
	4	4 *5	Measured value input	Input the signal from the detector (measured value signal).	*Pr. 128* = 20, 21
				4 to 20mA......... 0 to 100%	*Pr. 267* = 0 *2
				1 to 5V............. 0 to 100%	*Pr. 267* = 1
				2 to 10V........... 0 to 100%	*Pr. 267* = 2
Output	FUP	Depending on *Pr. 190, Pr. 192*	Upper limit output	Output to indicate that the measured value signal exceeded the maximum value *(Pr. 131)*.	*Pr. 128* = 20, 21 *Pr. 131* ≠ 9999 Set 15 or 115 in *Pr. 190 or Pr. 192*. *3
	FDN		Lower limit output	Output when the measured value signal falls below the minimum value *(Pr. 132)*.	*Pr. 128* = 20, 21 *Pr. 132* ≠ 9999 Set 14 or 114 in *Pr. 190 or Pr. 192*.
	RL		Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).	Set 16 or 116 in *Pr. 190 or Pr. 192*.
	PID		During PID control activated	Turns ON during PID control.	Set 47 or 147 in *Pr. 190 or Pr. 192*.
	SLEEP		PID output interruption	Turns ON when the PID output interruption function is performed.	*Pr. 575* ≠9999 Set 70 or 170 in *Pr. 190 or Pr. 192*. *3
	Y48		PID deviation limit	Output when the absolute value of deviation exceeds the limit value.	*Pr. 553* ≠ 9999 Set 48 or 148 in any of *Pr. 190 or Pr. 192*. *3
	SE	SE	Output terminal common	Common terminal for open collector output terminal.	

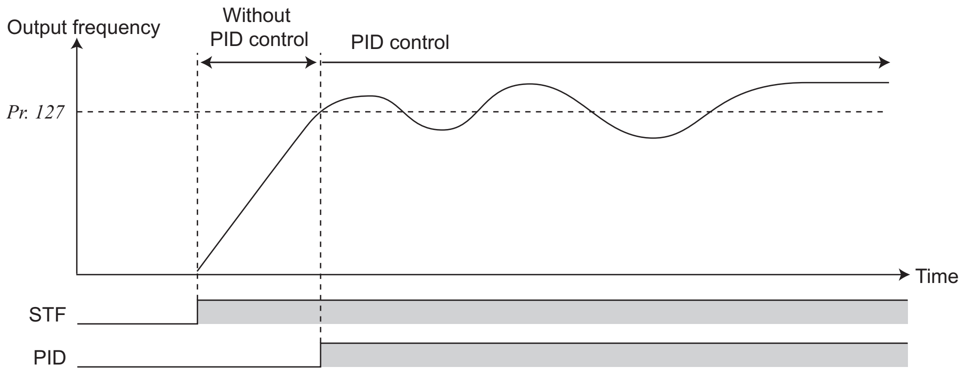
*1 When the X14 signal is not assigned, only the *Pr. 128* setting makes PID control valid.
*2 The shaded area indicates the parameter initial value.
*3 When 100 or larger value is set in any of *Pr. 190, Pr. 192 (output terminal function selection)*, the terminal output has negative logic. *(Refer to page 140 for details)*
*4 When *Pr. 561 PTC thermistor protection level* ≠"9999", terminal 2 is not available for set point input. Use *Pr. 133* for set point input.
*5 When the voltage/current input specifications were changed using *Pr. 73* and *Pr. 267*, be sure to make calibration. *(Refer to page 258 for calibration examples for PID control.)*

NOTE

- **Changing the terminal function using any of *Pr. 178 to Pr. 182, Pr. 190 and Pr. 192* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **When the *Pr. 267* setting was changed, check the voltage/current input switch setting. Different setting may cause a fault, failure or malfunction. (*Refer to page 183* for setting)**
- **Make sure to perform calibration after changing the voltage/current input signal assigned to the terminal 4 with *Pr. 267* setting and the voltage/current input switchover.**

(5) PID automatic switchover control *(Pr. 127)*

- The system can be started up without PID control only at a start.
- When the frequency is set to *Pr. 127 PID control automatic switchover frequency* within the range 0 to 400Hz, the inverter starts up without PID control from a start until output frequency is reached to the set frequency of *Pr. 127*, and then it shifts to PID control. Once the system has entered PID control operation, it continues PID control even if the output frequency falls to or below *Pr. 127*.



(6) Selecting operation to be performed at the output of Upper limit signal, Lower limit signal, and PID deviation limit signal (FUP signal, FDN signal, Y48 signal, *Pr.554*)

You can select the operation to be performed at the detection of upper, lower and deviation limit for the measured value input. With *Pr. 554 PID signal operation selection*, signal output or signal output + alarm stop (E.PID) can be selected for each of upper limit output signal (FUP signal), lower limit output signal (FDN signal), and PID deviation limit signal (Y48 signal).

Pr. 554 Setting	FUP Signal, FDN Signal *	Y48 Signal *	SLEEP Function
0 (Initial value)	Only signal output	Only signal output	Motor coasts to a stop at the start of SLEEP operation
1	Signal output + stop by fault (E.PID)		
2	Only signal output	Signal output + stop by fault (E.PID)	
3	Signal output + stop by fault (E.PID)		
10	Only signal output	Only signal output	Motor decelerates to a stop at the start of SLEEP operation
11	Signal output + stop by fault (E.PID)		
12	Only signal output	Signal output + stop by fault (E.PID)	
13	Signal output + stop by fault (E.PID)		

* When the settings for *Pr. 131 PID upper limit*, *Pr. 132 PID lower limit*, and *Pr. 553 PID deviation limit*, which corresponds with FUP, FDN, and Y48 signals, are "9999" (no function), the signal is not output, or the alarm stop is not performed.

4

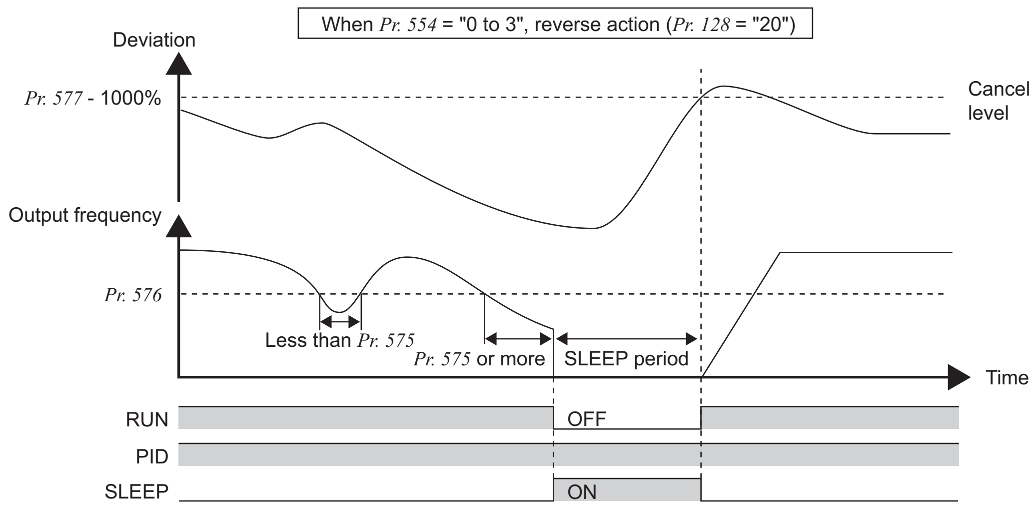
PARAMETERS

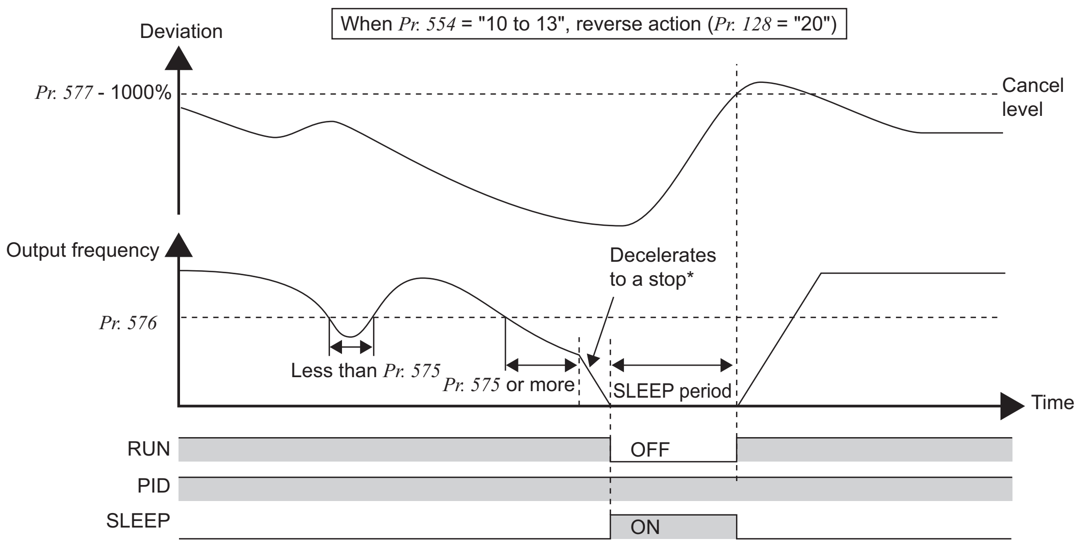
(7) PID output suspension function (SLEEP function) (SLEEP signal, *Pr. 575 to Pr. 577*)

- The inverter stops operation if the output frequency after PID operation remains at less than the *Pr. 576 Output interruption detection level* setting for longer than the time set in *Pr. 575 Output interruption detection time*. This function can reduce energy consumption in the low-efficiency, low-speed range.

Pr.554 Setting	SLEEP Function	FUP Signal, FDN Signal	Y48 Signal
0 (Initial value)	Motor coasts to a stop at the start of SLEEP operation	Only signal output	Only signal output
1		Signal output + stop by fault (E.PID)	
2		Only signal output	Signal output + stop by fault (E.PID)
3		Signal output + stop by fault (E.PID)	
10	Motor decelerates to a stop at the start of SLEEP operation	Only signal output	Only signal output
11		Signal output + stop by fault (E.PID)	
12		Only signal output	Signal output + stop by fault (E.PID)
13		Signal output + stop by fault (E.PID)	

- When the deviation (= set value - measured value) reaches the PID output shutoff cancel level (*Pr. 577* setting -1000%) while the PID output interruption function is ON, the PID output interruption function is canceled and PID control operation is resumed automatically.
- While the PID output interruption function is ON, the PID output interruption signal (SLEEP) is output. At this time, the inverter running signal (RUN) is OFF, and the PID control operating signal (PID) is ON.
- For the terminal used for the SLEEP signal output, assign the function by setting "70" (positive logic) or "170" (negative logic) in *Pr. 190 or Pr. 192 (output terminal function selection)*.





* When the output rises to the output interruption cancel level during deceleration to a stop, output interruption gets cancelled, and the motor accelerates again to continue PID control. *Pr. 576 Output interruption detection level* is invalid during deceleration.

(8) PID monitor function

- The PID control set point, measured value and deviation value can be displayed on the operation panel and output from the terminal FM.
- In the deviation monitor, a negative percent can be displayed as an integer, like 0% as 1000 and so on. (The deviation monitor cannot be output from the terminal FM.)
- For each monitor, set the following value in *Pr. 52 DU/PU main display data selection* and *Pr. 54 FM terminal function selection*.

Setting	Monitor Description	Minimum Increments *	Terminal FM Full Scale *	Remarks
52	**PID set point**	0.1%	100%/*C42(Pr.934)* or *C44(Pr.935)*	—
53	**PID measured value**	0.1%		
54	**PID deviation**	0.1%	—	Value cannot be set to *Pr. 54*. Displays 1000 when the PID deviation is 0%.

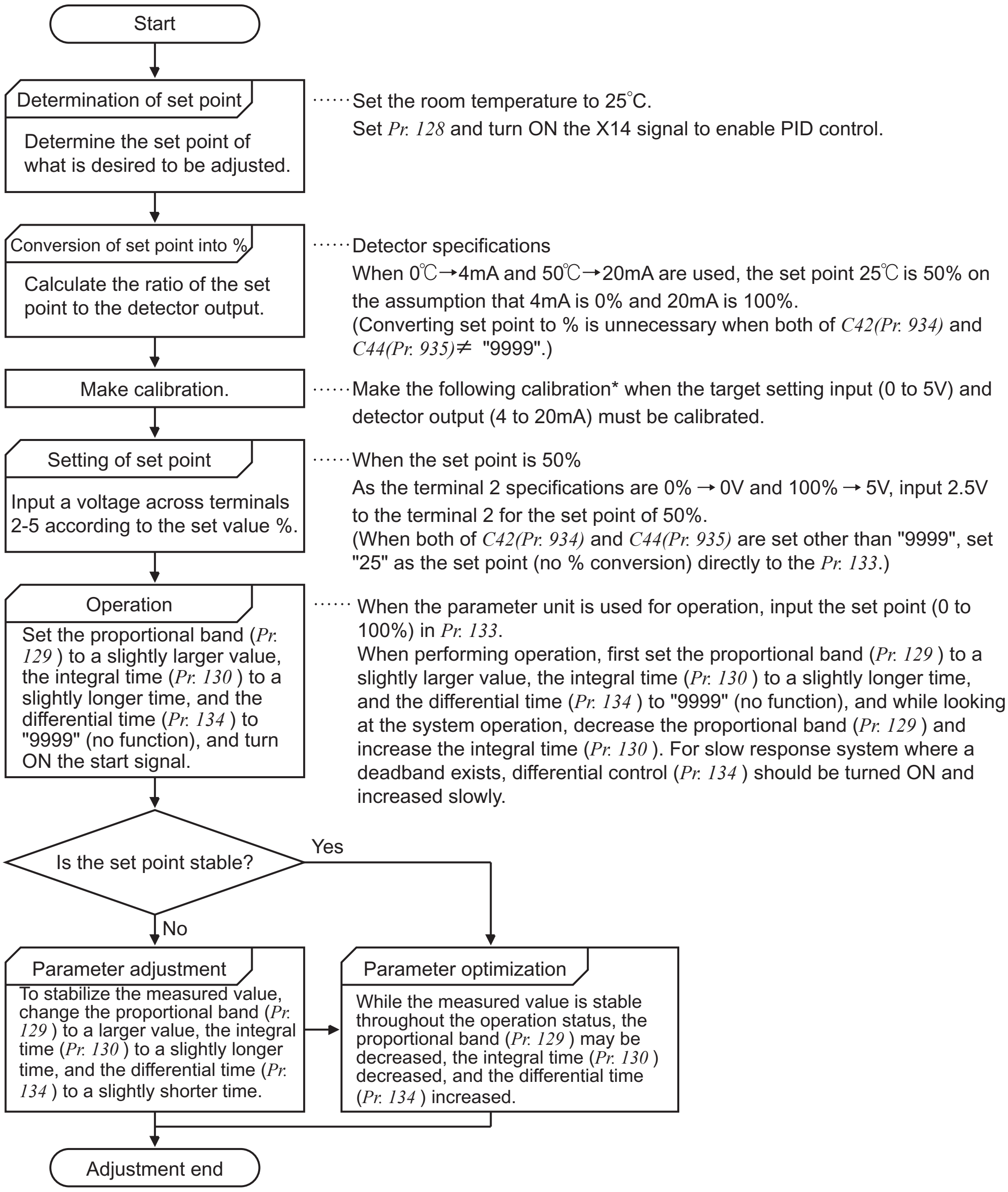
* When neither of *C42(Pr. 934)* nor *C44(Pr. 935)* setting is "9999", minimum increment changes from % to no unit, and the full scale value for the terminal FM changes from 100% to the larger value between *C42(Pr. 934) PID display bias coefficient* and *C44(Pr. 935) PID display gain coefficient*. (The smaller value between *C42(Pr. 934)* and *C44(Pr. 935)* becomes the minimum value.)

(9) Adjustment procedure

Parameter setting	Adjust the PID control parameters, *Pr. 127 to Pr. 134*, *Pr 553, Pr. 554* and *Pr. 575 to Pr. 577*.
Terminal setting	Set the I/O terminals for PID control (*Pr. 178* to *Pr. 182 (input terminal function selection), Pr. 190 or Pr. 192 (output terminal function selection)*)
Turn ON the X14 signal.	When X14 signal is not assigned, setting a value other than "0" in *Pr. 128* activates PID operation.
Operation	

(10) Calibration example

(A detector of 4mA at 0°C and 20mA at 50°C is used to adjust the room temperature to 25°C under PID control.
The set point is given to across inverter terminals 2-5 (0 to 5V).)



* When calibration is required
Using calibration *Pr. 902* and *Pr. 903* (terminal 2) or *Pr. 904* and *Pr. 905* (terminal 4), calibrate the detector output and target setting input.
However, use *Pr. 934* and *Pr. 935* instead of *Pr. 904* and *Pr. 905* when both of *C42 (Pr. 934)* and *C44 (Pr. 935)* ≠ "9999".
Make calibration in the PU mode during an inverter stop.
(For the details of *Pr. 902* to *Pr. 905*, *refer to page 188*. For the details of *Pr. 934* and *Pr. 935*, *refer to page 259*.)

<Set point input calibration>

1) Setting with terminal 2 input

1. Apply the input voltage of 0% set point setting (e.g. 0V) across terminals 2-5.
2. Enter in *C2 (Pr. 902)* the frequency which should be output by the inverter at the deviation of 0% (e.g. 0Hz).
3. In *C3 (Pr. 902)*, set the voltage value at 0%.
4. Apply the voltage of 100% set point (e.g. 5V) across terminals 2-5.
5. Enter in *Pr. 125* the frequency which should be output by the inverter at the deviation of 100% (e.g. 60Hz).
6. In *C4 (Pr. 903)*, set the voltage value at 100%.

2) Setting with *Pr. 133*

When both or one of *C42 (Pr. 934) and C44 (Pr. 935)* is "9999".
For the set point, set a % converted value in the range of 0 to 100%.
When both of *C42 (Pr. 934) and C44 (Pr. 935)* ≠ "9999".
For the set point, set PID coefficient, which corresponds with 0 to 100%.

<Measured value calibration>

1)When both or one of *C42 (Pr. 934)* and *C44 (Pr. 935)* is "9999"

1. Apply the input current of 0% measured value (e.g. 4mA) across terminals 4-5.
2. Make calibration using *C6 (Pr. 904)*.
3. Apply the input current of 100% measured value (e.g. 20mA) across terminals 4-5.
4. Make calibration using *C7 (Pr. 905)*.

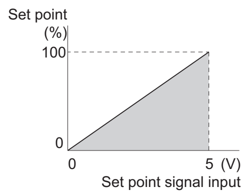
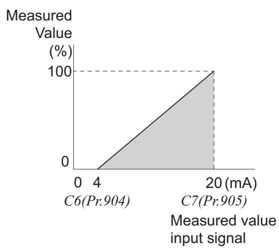
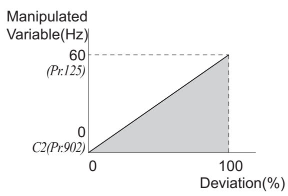
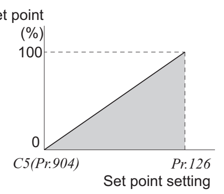
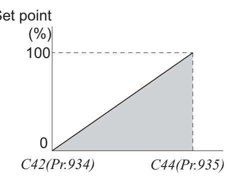
2) When both of *C42 (Pr. 934)* and *C44 (Pr. 935)* ≠ "9999"

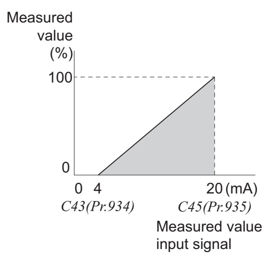
1. Apply the input current of 0% measured value (e.g. 4mA) across terminals 4 and 5.
2. Set PID display value at 0% measured value (example: 15(°C)) to *C42 (Pr. 934)* , and calibrate *C43 (Pr. 934)*.
3. Apply the input current of 100% measured value (e.g. 20mA) across terminals 4 and 5.
4. Set PID display value at 100% measured value (example: 35(°C)) to *C44 (Pr. 935)*, and calibrate *C45 (Pr. 935)*.

REMARKS

- The frequency set in *C5 (Pr. 904)* and *Pr. 126* should be the same as set in *C2 (Pr. 902)* and *Pr. 125* .

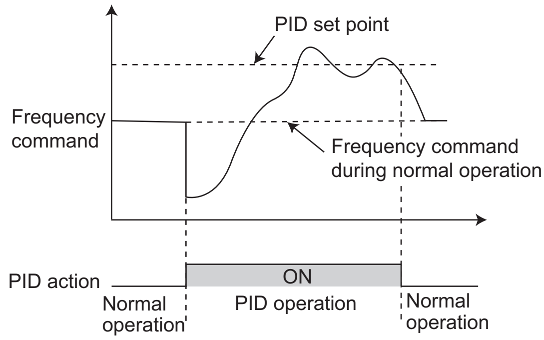
The results of the above calibration are as shown below:

<table>
<tr><th>Pr. 133 Setting</th><th>Pr. 934, Pr. 935 Setting</th><th>Set Point Setting</th><th>Measured Value (Terminal 4)</th><th>Manipulated Variable</th></tr>
<tr><td>9999</td><td>—</td><td>(Terminal 2)

</td><td rowspan="2">
</td><td rowspan="3">
</td></tr>
<tr><td rowspan="2">Other than 9999</td><td>Both or one is 9999</td><td>(Pr.133)

</td></tr>
<tr><td>Other than 9999</td><td>(Pr.133)


Set PID coefficient corresponding with 0 to 100%.</td><td>
</td></tr>
</table>

NOTE

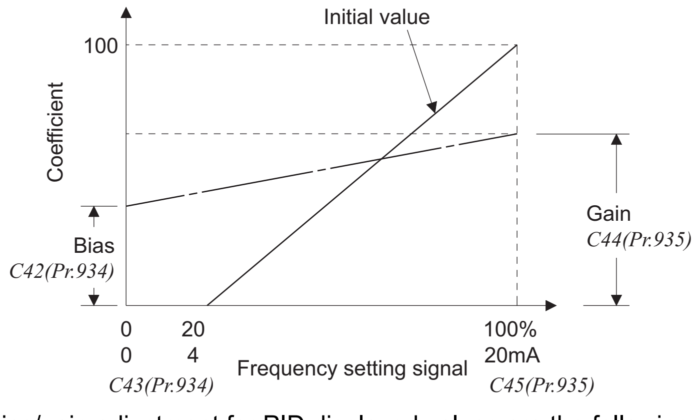
- **If the multi-speed (RH, RM, RL, REX signal) or Jog operation (JOG signal) is entered with the X14 signal ON, PID control is stopped and multi-speed or Jog operation is started.**
- **If the setting is as follows, PID control becomes invalid.**
  ***Pr. 79 Operation mode selection* ="6" (Switchover mode)**
  The inverter is at a stop with *Pr. 261 Power failure stop selection* selected.
- **Changing the terminal function using any of *Pr. 178 to Pr. 182, Pr. 190 and Pr. 192* may affect the other functions. Set parameters after confirming the function of each terminal.**
- **When PID control is selected, the minimum frequency is the frequency set in *Pr. 902* and the maximum frequency is the frequency set in *Pr. 903*.**
  (*Pr. 1 Maximum frequency* and *Pr. 2 Minimum frequency* settings are also valid.)
- **The remote operation function is invalid during PID operation.**
- **When the control is switched to PID control during normal operation, the frequency command value calculated by PID operation using 0Hz as standard is used without the frequency during the operation.**



Operation when control is switched to PID control during normal operation

(11) Bias and gain calibration for PID displayed values (*C42(Pr. 934) to C45(Pr. 935)*)

- When both of *C42(Pr. 934)* and *C44(Pr. 935)* ≠ "9999", bias/gain calibration is available for analog value of set point, measured value, deviation value to perform PID control.
- "Bias" / "gain" function can adjust the relation between PID displayed coefficient and measured value input signal. Examples of measured value input signals are 0 to 5VDC, 0 to 10VDC, or 4 to 20mADC, and they are externally input.
- Set PID display bias coefficient for terminal 4 input with *C42(Pr.934)*.
  (Initial value is the coefficient for 4mA.)
- Set PID display gain coefficient for 20mA of the frequency command current (4 to 20mA) with *C44(Pr. 935)*.
- When both of *C42(Pr. 934)* and *C44(Pr. 935)* ≠ "9999" and *Pr. 133* is set as the set point, the setting of *C42(Pr. 934)* is treated as 0%, and *C44(Pr. 935)* as 100%.



- Three methods of bias/gain adjustment for PID displayed values are the following.
  (a)Method to adjust any point by application of voltage (current) across the terminals 4 and 5.
  (b)Method to adjust any point without application of voltage (current) across terminals 4 and 5.
  (c)Method to adjust only the frequency without adjusting the voltage (current).
  (For the detail of (a) to (c), *refer to page 188*.
  Make adjustment by assuming *C7 (Pr. 905)* as *C45 (Pr. 935)*, and *Pr. 126* as *C44 (Pr. 935)*.)

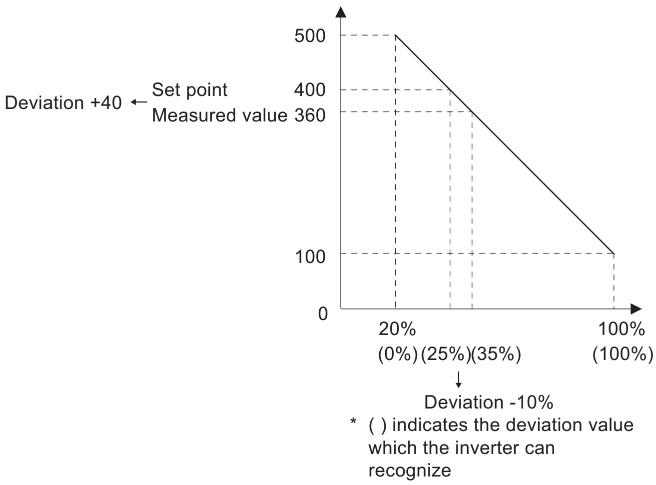
NOTE

- **When the voltage/current input specifications are changed with voltage/current input switch and using *Pr. 73* and *Pr. 267*, be sure to make calibration.**

- Take caution when the following condition is satisfied because the inverter recognizes the deviation value as a negative (positive) value even though a positive (negative) deviation is given:
  Pr. 934 PID display bias coefficient > *Pr. 935 PID display gain coefficient*
  To perform a reverse operation, set the forward operation in *Pr. 128 PID action selection*. To perform a forward operation, set the reverse operation in *Pr. 128*. In this case, the PID output shutoff release level is (1000 - *Pr. 577*).

Pr. 934 < *Pr. 935* **(normal setting)**		*Pr. 934* ≥ *Pr. 935*	
Reverse operation	Reverse operation setting to *Pr. 128*	Reverse operation	Forward operation setting to *Pr. 128*
Forward operation	Forward operation setting to *Pr. 128*	Forward operation	Reverse operation setting to *Pr. 128*
PID output shutoff release level	*Pr. 577* - 1000	PID output shutoff release level	1000 - *Pr. 577*

(Example) Set the following: *Pr. 934* = "500" and 20% (4mA is applied), *Pr. 935* = "100" and 100% (20mA is applied).
When the set point=400 and the measured value=360, the deviation is +40 (>0), but the inverter recognizes the deviation with -10% (<0). Because of this, operation amount does not increase in the reverse operation setting.
The operation amount increases when the forward operation is set.
To perform PID output shutoff release at deviation of +40 or higher, set *Pr. 577* = "960."



(12) Analog input display unit changing *(Pr. 241)*

- You can change the analog input display unit (%/V, mA) for analog input bias/gain calibration.
- Depending on the terminal input specification set to *Pr. 73*, *Pr. 267*, and voltage/current input switch the display units of *C43(Pr. 934), C45(Pr. 935)* change as shown below.
- If the *Pr.241* setting is changed, the increments of the *C3(Pr.902)*, *C4(Pr.903)*, *C6(Pr.904)*, and *C7(Pr.905)* are also changed. (*Refer to page 189*)

Analog Command (Terminal 4) (according to *Pr. 73*, *Pr. 267*, and Voltage/Current Input Switch)	*Pr. 241* = 0 (Initial Value)	*Pr. 241* = 1
0 to 5V input	0 to 5V → displayed in 0 to 100%(0.1%).	0 to 100% → displayed in 0 to 5V(0.01V).
0 to 10V input	0 to 10V → displayed in 0 to 100%(0.1%).	0 to 100% → displayed in 0 to 10V(0.01V).
4 to 20mA input	0 to 20mA → displayed in 0 to 100%(0.1%).	0 to 100% → displayed in 0 to 20mA(0.01mA).

Parameters referred to

Pr. 59 Remote function selection ☞ *Refer to page 110*
Pr. 73 Analog input selection ☞ *Refer to page 183*
Pr. 79 Operation mode selection ☞ *Refer to page 200*
Pr. 178 to Pr. 182 (input terminal function selection) ☞ *Refer to page 134*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*
Pr. 261 Power failure stop selection ☞ *Refer to page 168*
Pr. 561 PTC thermistor protection level ☞ *Refer to page 119*
C2 (Pr. 902) to C7 (Pr. 905) Frequency setting voltage (current) bias/gain ☞ *Refer to page 188*

4
PARAMETERS

4.21.2 Regeneration avoidance function (Pr. 665, Pr. 882, Pr. 883, Pr. 885, Pr. 886)

This function detects a regeneration status and increases the frequency to avoid the regenerative status.

- Possible to avoid regeneration by automatically increasing the frequency to continue operation if the fan happens to rotate faster than the set speed due to the effect of another fan in the same duct.

Parameter Number	Name	Initial Value		Setting Range	Description
882	**Regeneration avoidance operation selection**	0		0	Regeneration avoidance function invalid
				1	Regeneration avoidance function is always valid
				2	Regeneration avoidance function is valid only during a constant speed operation
883	**Regeneration avoidance operation level**	200V class	400 VDC	300 to 800V	Bus voltage level at which regeneration avoidance operates. When the bus voltage level is set to low, overvoltage error will be less apt to occur. However, the actual deceleration time increases. The set value must be higher than the "power supply voltage × $\sqrt{2}$" *.
		400V class	780 VDC		
885	**Regeneration avoidance compensation frequency limit value**	6Hz*		0 to 30Hz	Limit value of frequency which rises at activation of regeneration avoidance function.
				9999	Frequency limit invalid
886	**Regeneration avoidance voltage gain**	100%		0 to 200%	Responsiveness at activation of regeneration avoidance. A larger setting will improve responsiveness to the bus voltage change. However, the output frequency could become unstable. When vibration is not suppressed by decreasing the *Pr. 886* setting, set a smaller value in *Pr. 665*.
665	**Regeneration avoidance frequency gain**	100%		0 to 200%	

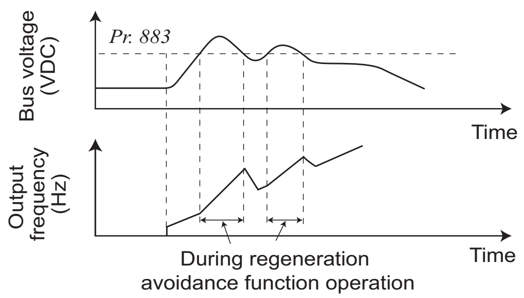
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

* Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

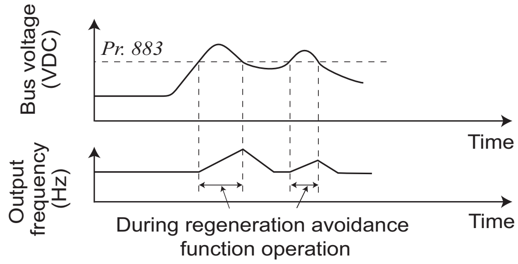
(1) What is regeneration avoidance function? *(Pr. 882, Pr. 883)*

- When the regeneration load is large, the DC bus voltage rises and an overvoltage fault (E. OV□) may occur.
  When this bus voltage rise is detected and the bus voltage level reaches or exceeds *Pr. 883*, increasing the frequency avoids the regeneration status.
- The regeneration avoidance function is always ON when "1" is set in *Pr. 882*, and activated only during a constant speed when "2" is set in *Pr. 882*.

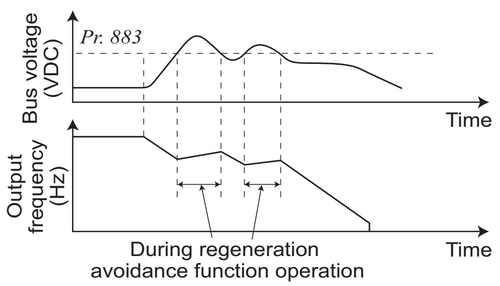
Regeneration avoidance operation example for acceleration



Regeneration avoidance operation example for constant speed



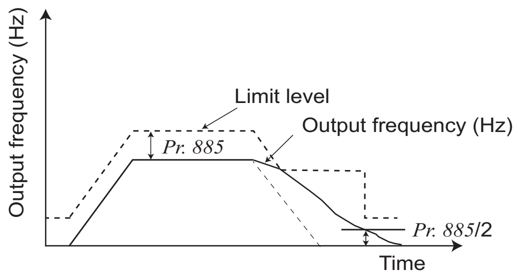
Regeneration avoidance operation example for deceleration



REMARKS

- The acceleration/deceleration ramp while the regeneration avoidance function is operating changes depending on the regeneration load.
- The DC bus voltage of the inverter is about $\sqrt{2}$ times of normal input voltage. (However, it varies with the input power supply waveform.)
  When the input voltage is 220VAC, bus voltage is approximately 311VDC.
  When the input voltage is 440VAC, bus voltage is approximately 622VDC.
- The *Pr. 883* setting should be kept higher than the DC bus voltage level. Otherwise, the regeneration avoidance function is always ON even in the non-regeneration status and the frequency increases.
- While overvoltage stall (oL) is activated only during deceleration and stops the output frequency, the regeneration avoidance function is always ON (*Pr. 882* = 1) or activated only during a constant speed (*Pr. 882* = 2) and increases the frequency according to the regeneration amount.

(2) Limit regeneration avoidance operation frequency *(Pr. 885)*



You can limit the output frequency compensated (increased) by the regeneration avoidance function.

- The frequency is limited to the output frequency (frequency prior to regeneration avoidance operation) + *Pr. 885 Regeneration avoidance compensation frequency limit value* during acceleration or constant speed.
  If the regeneration avoidance frequency exceeds the limit value during deceleration, the limit value is held until the output frequency falls to 1/2 of *Pr. 885*.
- When the frequency increased by regeneration avoidance function has reached *Pr. 1 Maximum frequency*, it is limited to the maximum frequency.
- When *Pr. 885* is set to "9999", regeneration avoidance function operation frequency setting is invalid.

(3) Regeneration avoidance function adjustment *(Pr. 665, Pr. 886)*

- If the frequency becomes instable during regeneration avoidance operation, decrease the setting of *Pr. 886 Regeneration avoidance voltage gain*. Reversely, if sudden regeneration causes an overvoltage alarm, increase the setting.
  When vibration is not suppressed by decreasing the *Pr. 886* setting, set a smaller value in *Pr. 665 Regeneration avoidance frequency gain*.

NOTE

- **The regeneration avoidance function is disabled in the low-speed range (6.5Hz or lower frequency command) under IPM motor control.**
- **When regeneration avoidance operation is performed, oL (overvoltage stall) is displayed and the OL signal is output. Set the operation pattern at an OL signal output using *Pr. 156 Stall prevention operation selection*. Set the output timing of the OL signal using *Pr. 157 OL signal output timer*.**
- **When regeneration avoidance operation is performed, stall prevention is also activated at the same time.**
- **The regeneration avoidance function cannot shorten the actual deceleration time taken to stop the motor. The actual deceleration time depends on the regeneration energy consumption capability. To shorten the deceleration time, consider using the regeneration unit (FR-BU2, FR-CV, FR-HC2) and brake resistor (MRS type, MYS type, FR-ABR etc.) to consume regeneration energy at constant speed.**
- **When using the regeneration unit (FR-BU2, FR-CV, FR-HC2) and brake resistor (MRS type, MYS type, FR-ABR etc.), set *Pr. 882* to "0 (initial value)" (regeneration avoidance function invalid). When using the regeneration unit, etc. to consume regeneration energy at deceleration, set *Pr. 882* to "2" (regeneration avoidance function valid only at a constant speed).**

Parameters referred to

Pr. 1 Maximum frequency ☞ *Refer to page 101*
Pr. 8 Deceleration time ☞ *Refer to page 113*
Pr. 22 Stall prevention operation level ☞ *Refer to page 96*

4.22 Useful functions

Purpose	Parameter that should be Set		Refer to Page
To increase cooling fan life	Cooling fan operation selection	Pr. 244	*264*
To determine the maintenance time of parts	Inverter part life display	Pr. 255 to Pr. 259	*265*
	Maintenance output function	Pr. 503, Pr. 504	*268*
	Current average value monitor signal	Pr. 555 to Pr. 557	*269*
Freely available parameter	Free parameter	Pr. 888, Pr. 889	*271*
To initiate a fault alarm	Fault initiation	Pr. 997	*272*
To save time for parameter setting	Automatic parameter setting	Pr. 999	*273*

4.22.1 Cooling fan operation selection (Pr. 244)

You can control the operation of the cooling fan (1.5K or higher) built in the inverter.

Parameter Number	Name	Initial Value	Setting Range	Description
244	Cooling fan operation selection	1	0	Operates in power-ON status. Cooling fan ON/OFF control invalid (the cooling fan is always ON at power-ON)
			1	Cooling fan ON/OFF control valid The fan is always ON while the inverter is running. During a stop, the inverter status is monitored and the fan switches ON/OFF according to the temperature.

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

- In either of the following cases, fan operation is regarded as faulty as [FN] is shown on the operation panel, and the fan fault (FAN) and alarm (LF) signals are output.
  - *Pr. 244* = "0"
    When the fan comes to a stop with power ON.
  - *Pr. 244* = "1"
    When the inverter is running and the fan stops during fan ON command.

- For the terminal used for FAN signal output, set "25 (positive logic) or 125 (negative logic)" to *Pr. 190 or Pr. 192 (output terminal function selection)*, and for the LF signal, set "98 (positive logic) or 198 (negative logic)".

NOTE

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

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 140*

4.22.2 Display of the lives of the inverter parts (Pr. 255 to Pr. 259)

Degrees of deterioration of main circuit capacitor, control circuit capacitor, cooling fan and inrush current limit circuit can be diagnosed by a monitor.
When any part has approached to the end of its life, an alarm can be output by self diagnosis to prevent a fault.
(Use the life check of this function as a guideline since the life except the main circuit capacitor is calculated theoretically.)
For the life check of the main circuit capacitor, the alarm signal (Y90) will not be output if a measuring method of (4) is not performed.

Parameter Number	Name	Initial Value	Setting Range	Description
255	**Life alarm status display**	0	(0 to 15)	Displays whether the control circuit capacitor, main circuit capacitor, cooling fan, and each parts of the inrush current limit circuit have reached the life alarm output level or not. (Reading only)
256	**Inrush current limit circuit life display**	100%	(0 to 100%)	Displays the deterioration degree of the inrush current limit circuit. (Reading only)
257	**Control circuit capacitor life display**	100%	(0 to 100%)	Displays the deterioration degree of the control circuit capacitor. (Reading only)
258	**Main circuit capacitor life display**	100%	(0 to 100%)	Displays the deterioration degree of the main circuit capacitor. (Reading only) The value measured by *Pr. 259* is displayed.
259	**Main circuit capacitor life measuring**	0	0, 1 (2, 3, 8, 9)	Setting "1" and turning the power supply OFF starts the measurement of the main circuit capacitor life. When the *Pr. 259* value is "3" after powering ON again, the measuring is completed. Writes deterioration degree in *Pr. 258*.

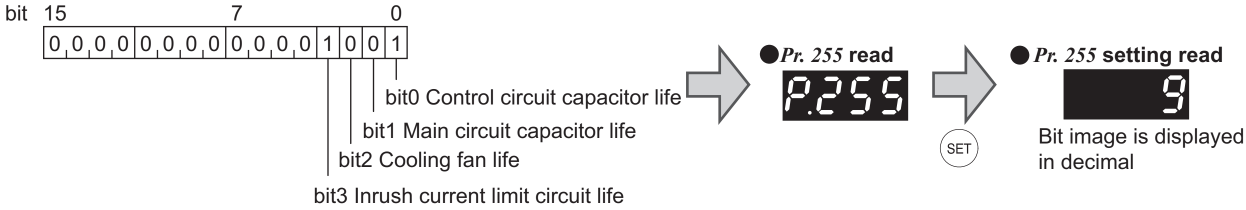
The above parameters can be set when *Pr. 160 Extended function display selection* = "0". (*Refer to page 197*)

REMARKS

Since repeated inrush currents at power ON will shorten the life of the converter circuit, frequent starts and stops of the magnetic contactor must be avoided.

(1) Life alarm display and signal output (Y90 signal, *Pr. 255*)

•Whether any of the control circuit capacitor, main circuit capacitor, cooling fan and inrush current limit circuit has reached the life alarm output level or not can be checked by *Pr. 255 Life alarm status display* and life alarm signal (Y90).



Pr. 255 (decimal)	Bit (binary)	Inrush Current Suppression Circuit Life	Cooling Fan Life	Main Circuit Capacitor Life	Control Circuit Capacitor Life
15	1111	○	○	○	○
14	1110	○	○	○	×
13	1101	○	○	×	○
12	1100	○	○	×	×
11	1011	○	×	○	○
10	1010	○	×	○	×
9	1001	○	×	×	○
8	1000	○	×	×	×
7	0111	×	○	○	○
6	0110	×	○	○	×
5	0101	×	○	×	○
4	0100	×	○	×	×
3	0011	×	×	○	○
2	0010	×	×	○	×
1	0001	×	×	×	○
0	0000	×	×	×	×

○: With warnings, ×: Without warnings

•The life alarm signal (Y90) turns ON when any of the control circuit capacitor, main circuit capacitor, cooling fan and inrush current limit circuit reaches the life alarm output level.

•For the terminal used for the Y90 signal, set "90" (positive logic) or "190" (negative logic) to *Pr. 190 or Pr. 192 (output terminal function selection)*.

NOTE

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

(2) Inrush current limit circuit life display *(Pr. 256)*

•The life of the inrush current limit circuit (relay, contactor and inrush resistor) is displayed in *Pr. 256* .

•Activation of inrush current limit resistor circuit is counted. It is counted every 10,000 times (1%) and counts down from 100% (0 time).
As soon as 10% (900,000 times) is reached, *Pr. 255* bit 3 is turned ON and also an alarm is output to the Y90 signal.
The inrush current limit resistor circuit activates under the following conditions:

•At power-ON

•At undervoltage occurrence (*Refer to page 304*)

•At inverter reset

(3) Control circuit capacitor life display *(Pr. 257)*

•The deterioration degree of the control circuit capacitor is displayed in *Pr. 257* as a life.

•In the operating status, the control circuit capacitor life is calculated from the energization time and temperature, and is counted down from 100%.
As soon as the control circuit capacitor life falls below 10%, *Pr. 255* bit 0 is turned ON and also an alarm is output to the Y90 signal.

(4) Main circuit capacitor life display *(Pr. 258, Pr. 259)*

- The deterioration degree of the control circuit capacitor is displayed in *Pr. 258* as a life.
- On the assumption that the main circuit capacitor capacitance at factory shipment is 100%, the capacitor life is displayed in *Pr. 258* every time measurement is made.
  When the measured value falls to or below 85%, *Pr. 255* bit 1 is turned ON and also an alarm is output to the Y90 signal.
- Measure the capacitor capacity according to the following procedure and check the deterioration level of the capacitor capacity.
  1) Check that the motor is connected and at a stop.
  2) Set "1" (measuring start) in *Pr. 259.*
  3) Switch power OFF. The inverter applies DC voltage to the motor to measure the capacitor capacity when the inverter turns OFF.
  4) After confirming that the LED of the operation panel is OFF, power ON again.
  5) Check that "3" (measuring completion) is set in *Pr. 259*, read *Pr. 258*, and check the deterioration degree of the main circuit capacitor.

Pr. 259	Description	Remarks
0	No measurement	Initial value
1	Measurement start	Measurement starts when the power supply is switched OFF.
2	During measurement	Only displayed and cannot be set
3	Measurement complete	
8	Forced end	
9	Measurement error	

REMARKS

- When the main circuit capacitor life is measured under the following conditions, "forced end" (*Pr. 259* = "8") or "measuring error" (*Pr. 259* ="9") occurs or it remains in "measuring start" (*Pr. 259* = "1"). Therefore, do not measure in such case.
  In addition, even when "measurement completion" (*Pr. 259* = "3") is confirmed under the following conditions, normal measurement can not be done.
  (a)FR-HC2 or FR-CV is connected.
  (b)DC power supply is connected to the terminal P/+ and N/-.
  (c)The power supply switched ON during measurement.
  (d)The motor is not connected to the inverter.
  (e)The motor is running (coasting)
  (f)The motor capacity is two rank smaller as compared to the inverter capacity.
  (g)The inverter is tripped or a fault occurred when power is OFF.
  (h)The inverter output is shut off with the MRS signal.
  (i)The start command is given while measuring.
  (j)The parameter unit (FR-PU04/FR-PU07) is connected.
  (k)Use terminal PC as power supply.
  (l)I/O terminal of the control terminal block is ON (continuity).
- Turning the power ON during measuring before LED of the operation panel turns OFF, it may remain in "measuring" (*Pr. 259* = "2") status. In such case, carry out operation from step 2.

POINT

For accurate life measurement of the main circuit capacitor, wait 3 hours or longer after turning OFF. The temperature left in the main circuit capacitor affects measurement.

WARNING

When measuring the main circuit capacitor capacity (*Pr. 259 Main circuit capacitor life measuring* = "1"), the DC voltage is applied to the motor for 1s at powering OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.

(5) Cooling fan life display

- The cooling fan speed of 50% or less is detected and "FN" is displayed on the operation panel and parameter unit (FR-PU04/FR-PU07). As an alarm display, *Pr. 255* bit2 is turned ON and also an alarm is output to the Y90 signal.

REMARKS

- When the inverter is mounted with two or more cooling fans, "FN" is displayed with one or more fans with speed of 50% or less.

NOTE

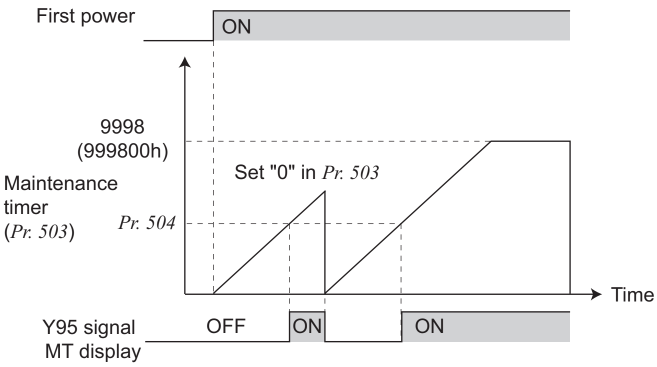
- **For replacement of each part, contact the nearest Mitsubishi FA center.**

4.22.3 Maintenance timer alarm (Pr. 503, Pr. 504)

When the cumulative energization time of the inverter reaches the parameter set time, the maintenance timer output signal (Y95) is output. (MT) is displayed on the operation panel.
This can be used as a guideline for the maintenance time of peripheral devices.

Parameter Number	Name	Initial Value	Setting Range	Description
503	**Maintenance timer**	0	0 (1 to 9998)	Displays the cumulative energization time of the inverter in 100h increments. (Reading only) Writing the setting of "0" clears the cumulative energization time while *Pr. 503* = "1 to 9998".
504	**Maintenance timer alarm output set time**	9999	0 to 9998	Time taken until when the maintenance timer signal (Y95) is output.
			9999	No function

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*



- The cumulative energization time of the inverter is stored into the EEPROM every hour and is displayed in *Pr. 503 Maintenance timer* in 100h increments. *Pr. 503* is clamped at 9998 (999800h).
- When the *Pr. 503* value reaches the time set to *Pr. 504 Maintenance timer alarm output set time* (100h increments), the maintenance timer signal (Y95) is output.
- For the terminal used for the Y95 signal output, assign the function by setting "95" (positive logic) or "195" (negative logic) to *Pr. 190 or Pr. 192 (output terminal function selection)*.

NOTE

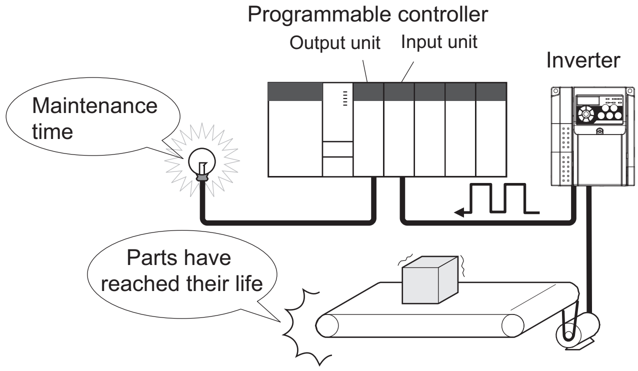
- **The cumulative energization time is counted every hour. The energization time of less than 1h is not counted.**
- **Changing the terminal assignment using *Pr. 190 and Pr. 192 (output terminal function selection)* may affect the other functions. Set parameters after confirming the function of each terminal.**

Parameters referred to

Pr. 190, Pr. 192 (output terminal function selection) *Refer to page 140*

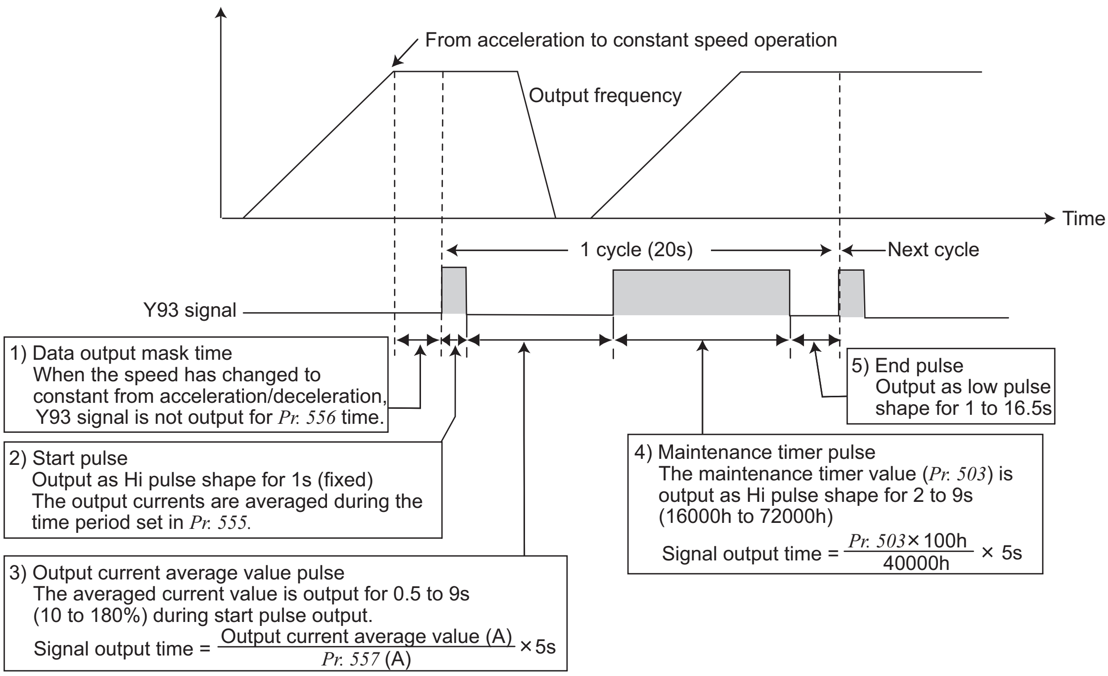
4.22.4 Current average value monitor signal (Pr. 555 to Pr. 557)

The average value of the output current during constant speed operation and the maintenance timer value are output as a pulse to the current average value monitor signal (Y93).
The pulse width output to the I/O module of the programmable controller or the like can be used as a guideline to know abrasion of machines, elongation of belt and the maintenance time for aged deterioration of devices.
The current average value monitor signal (Y93) is output as pulse for 20s as 1 cycle and repeatedly output during constant speed operation.



Parameter Number	Name	Initial Value	Setting Range	Description
555	**Current average time**	1s	0.1 to 1s	Time taken to average the current during start pulse output (1s).
556	**Data output mask time**	0s	0 to 20s	Time for not obtaining (mask) transient state data.
557	**Current average value monitor signal output reference current**	Rated inverter current *	0 to 500A	Reference (100%) for outputting the signal of the current average value.

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
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*.
* Performing IPM parameter initialization changes the settings. *(Refer to page 85)*

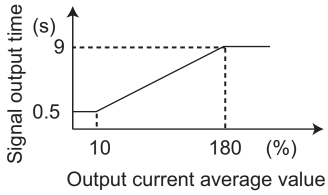


- The pulse output of the current average value monitor signal (Y93) is shown above.
- For the terminal used for the Y93 signal output, assign the function by setting "93" (positive logic) or "193" (negative logic) to *Pr. 190 RUN terminal function selection*. The function can not be assigned to *Pr. 192 A,B,C terminal function selection*.

1) Setting of *Pr. 556 Data output mask time*
   The output current is unstable (transient state) right after the operation is changed from the acceleration/deceleration state to the constant speed operation. Set the time for not obtaining (mask) transient state data in *Pr. 556*.
2) Setting of *Pr. 555 Current average time*
   The average output current is calculated during Hi output of start pulse (1s). Set the time taken to average the current during start bit output in *Pr. 555*.

3) Setting of *Pr.557 Current average value monitor signal output reference current*
Set the reference (100%) for outputting the signal of the current average value. Obtain the time to output the signal from the following calculation.

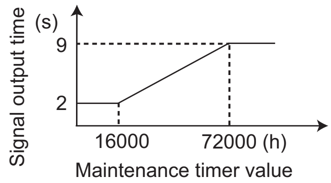
$$\frac{\textbf{Output current average value}}{\textit{Pr. 557}\ \textbf{setting}} \times \textbf{5s (Output current average value 100\%/5s)}$$



Note that the output time range is 0.5 to 9s and the output time is either of the following values when the output current average value is the corresponding percentage of the *Pr. 557* setting.
Less than 10% ... 0.5s, more than 180% ... 9s
Example) when *Pr. 557* = 10A and the average value of output current is 15A
As 15A/10A x 5s=7.5, the current average value monitor signal is output as low pulse shape for 7.5s.

4) Setting of *Pr. 503 Maintenance timer*
After the output current average value is output as low pulse shape, the maintenance timer value is output as high pulse shape. The output time of the maintenance timer value is obtained from the following calculation.

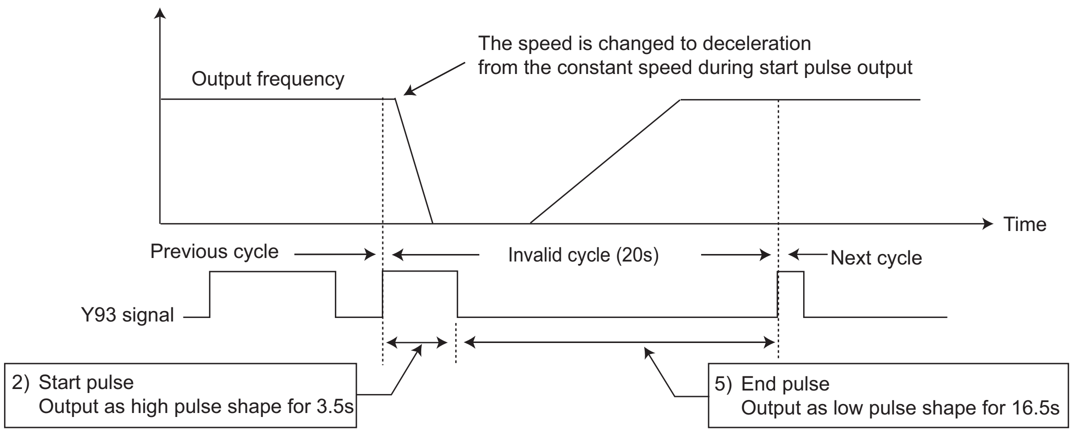
$$\frac{\textit{Pr. 503} \times \textbf{100}}{\textbf{40000h}} \times \textbf{5s} \quad \textbf{(Maintenance timer value 100\%/5s)}$$



Note that the output time range is 2 to 9s, and it is 2s when the *Pr. 503* setting is less than 16000h and 9s when exceeds 72000h.

REMARKS

- Mask of data output and sampling of output current are not performed during acceleration/deceleration.
- When the speed is changed to acceleration/deceleration from constant speed during start pulse output, the data is judged as invalid. The start pulse is output as high pulse shape for 3.5s, and the end signal is output as low pulse shape for 16.5s.
  The signal is output for at least 1 cycle even when acceleration/deceleration state continues after the start pulse output is completed.



- When the output current value (inverter output current monitor) is 0A on completion of the 1 cycle signal output, the signal is not output until the speed becomes constant next time.
- The current average value monitor signal (Y93) is output as low pulse shape for 20s (without data output) under the following conditions.
  (a) When the motor is in the acceleration/deceleration state on completion of the 1 cycle signal output
  (b) When 1-cycle signal output was ended during restart operation with the setting of automatic restart after instantaneous power failure (*Pr. 57* ≠ "9999")
  (c) When restart operation was being performed at the point of data output mask end with the setting of automatic restart after instantaneous power failure (*Pr. 57* ≠ "9999")

NOTE

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

Parameters referred to

Pr. 57 Restart coasting time ☞ *Refer to page 161*
Pr. 190, Pr. 192 (output terminal function selection) ☞ *Refer to page 140*
Pr. 503 Maintenance timer ☞ *Refer to page 268*

4.22.5 Free parameter (Pr. 888, Pr. 889)

You can input any number within the setting range of 0 to 9999.
For example, the number can be used:

- As a unit number when multiple units are used.
- As a pattern number for each operation application when multiple units are used.
- As the year and month of introduction or inspection.

Parameter Number	Name	Initial Value	Setting Range	Description
888	**Free parameter 1**	9999	0 to 9999	Any values can be set. Data is held even if the inverter power is turned OFF.
889	**Free parameter 2**	9999	0 to 9999	

The above parameters can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
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*.

REMARKS

Pr. 888 and Pr. 889 do not influence the inverter operation.

4.22.6 Initiating a fault (Pr.997)

A fault is initiated by setting the parameter.
This function is useful to check how the system operates at a fault.

Parameter number	Name	Initial value	Setting range	Description
997 Ver.UP	**Fault initiation**	9999	16 to 18, 32 to 34, 48, 49, 64, 81, 82, 96, 97, 112, 128, 129, 144, 145, 176 to 178, 192, 196, 197, 199, 201, 208, 230, 245	The setting range is same with the one for fault data codes of the inverter (which can be read through communication). Written data is not stored in EEPROM.
			9999	The read value is always "9999." This setting does not initiate a fault.

The above parameters can be set when User group read selection="0". *(Refer to page 197)*

Ver.UP .... Specifications differ according to the date assembled. *Refer to page 346* to check the SERIAL number.

(1) *Fault initiation (Pr. 997)*

- To initiate a fault, set the assigned number of the fault you want to initiate in *Pr. 997 Fault initiation*.
- The value set in *Pr. 997 Fault initiation* is not stored in EEPROM.
- When a fault occurs, the inverter trips, and the fault is output (ALM).
- While the initiated fault is occurring, the fault is displayed as the latest fault in the faults history. After a reset, the faults history goes back to the previous status. (The fault generated by the fault initiation function is not saved in the faults history.)
- Perform inverter reset to cancel the fault.

●Setting for *Pr. 997 Fault initiation* and corresponding faults

Setting (Data code)	Fault
16(H10)	E.OC1
17(H11)	E.OC2
18(H12)	E.OC3
32(H20)	E.OV1
33(H21)	E.OV2
34(H22)	E.OV3
48(H30)	E.THT
49(H31)	E.THM
64(H40)	E.FIN

Setting (Data code)	Fault
81(H51)	E.UVT
82(H52)	E.ILF
96(H60)	E.OLT
97(H61)	E.SOT
112(H70)	E.BE
128(H80)	E.GF
129(H81)	E.LF
144(H90)	E.OHT
145(H91)	E.PTC
176(HB0)	E.PE

Setting (Data code)	Fault
177(HB1)	E.PUE
178(HB2)	E.RET
192(HC0)	E.CPU
196(HC4)	E.CDO
197(HC5)	E.IOH
199(HC7)	E.AIE
201(HC9)	E.SAF
208(HD0)	E.OS
230(HE6)	E.PID
245(HF5)	E.5

REMARKS

- If a fault is already occurring in the inverter, a fault cannot be initiated by *Pr. 997*.
- The retry function is invalid for the fault initiated by the fault initiation function.
- If another fault occurs after a fault has been initiated, the fault indication does not change.
  The fault is not saved in the faults history either.

4.22.7 Setting multiple parameters as a batch (Pr.999)

- Parameter settings are changed as a batch. Those include communication parameter settings for the Mitsubishi human machine interface (GOT) connection and rated frequency settings of 50Hz/60Hz.
- Multiple parameters are changed automatically. Users do not have to consider each parameter number. (Parameter setting mode)

Parameter Number	Name	Initial value	Setting range	Description
999	**Automatic parameter setting**	9999*	10	GOT initial setting (PU connector)
			20	50Hz rated frequency
			21	60Hz rated frequency
			9999	No action

* The read value is always "9999".

(1) *Automatic parameter setting (Pr.999)*

•Select which parameters to be automatically set, and set that to *Pr. 999*. Multiple parameter settings are changed automatically. *Refer to page 276* for the list of parameters that are changed automatically.

Pr.999 setting	Description		Operation in the parameter setting mode
10	Automatically sets the communication parameters for the GOT connection with a PU connector		(AUTO) → (GOT) → Write "1"
20	50Hz rated frequency	Sets the related parameters of the rated frequency according to the power supply frequency	(AUTO) → (F50) → Write "1"
21	60Hz rated frequency		—

REMARKS

- If the automatic setting is performed, the selected settings including the changed parameter settings will be changed.
- Setting *Pr. 999* = "20 or 21" during the machine speed display changes the *Pr. 505 Speed setting reference* setting to 60Hz or to 50Hz. After setting *Pr. 999* = "20 or 21", calculate the rotations per minute at the changed *Pr. 505* setting, and set *Pr. 37 Speed display* again.

4

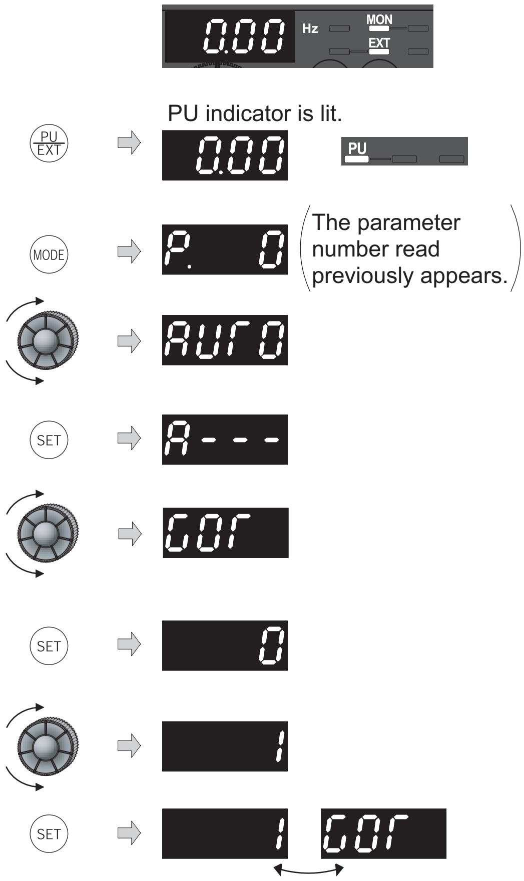
PARAMETERS

(2) Automatic parameter setting using the operation panel (parameter setting mode)

Operation example	The communication setting parameters for the GOT connection with a PU connector are automatically set.

Operation — **Display**

1. Screen at power-ON
   The monitor display appears.
2. Press (PU/EXT) to choose the PU operation mode.
3. Press (MODE) to choose the parameter setting mode.
4. Turn the setting dial until AUTO (AUTO) appears.
5. Press (SET) to enter the automatic parameter setting mode.
6. Turn the setting dial until GOT (GOT) appears.
7. Press (SET) to read the present set value.
   "0" appears.
8. Turn the setting dial to change it to the set value "1".
9. Press (SET) set.



Flicker··· Parameter setting complete!!

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

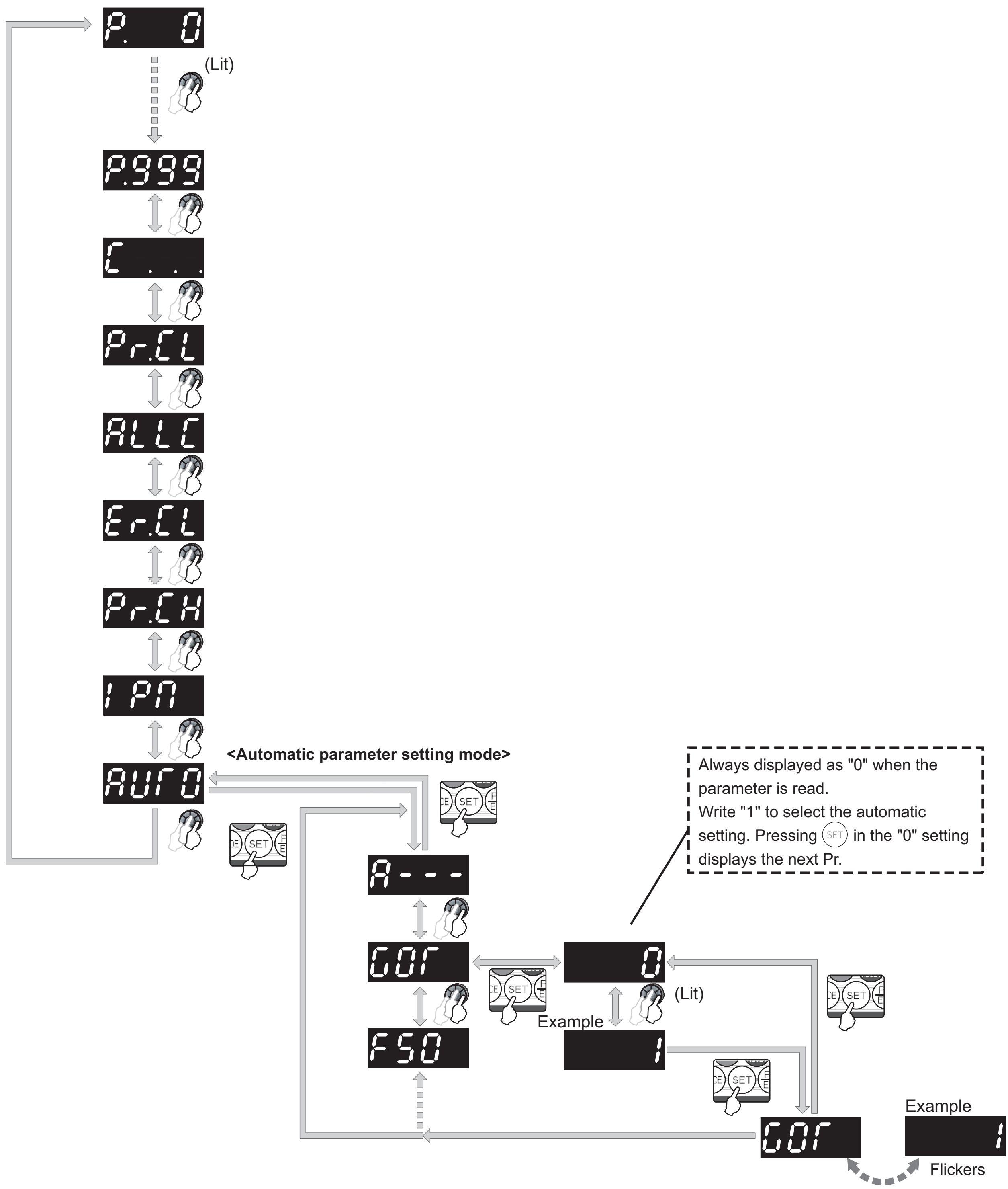
Pr.999 setting	Description	Operation in the parameter setting mode
10	GOT initial setting (PU connector)	AUTO (AUTO) → GOT (GOT) → Write "1"
20	50Hz rated frequency	AUTO (AUTO) → F50 (F50) → Write "1"

? 1 ⇄ Er4 are displayed alternately ... Why?

☞ The inverter is not in the PU operation mode.

1. Press (PU/EXT).
   PU is lit and the monitor (4-digit LED) displays "0." (When *Pr. 79* = "0 (initial setting)")
2. Carry out operation from step 3 again.

(3) Parameter setting mode



(4) List of automatically-set parameters

The following tables show which parameters are changed in each of the automatic parameter settings.

NOTE

- **If the automatic setting is performed with *Pr.999* or the parameter setting mode, the listed settings including the changed parameter settings (changed from the initial setting) will be automatically changed. Before performing the automatic setting, confirm that changing the listed parameters will not cause any problem.**

•GOT initial setting (PU connector) (*Pr.999* = "10")

Parameter	Name	Initial value	Automatically set to	Refer to page
79	Operation mode selection	0	0	*200*
118	PU communication speed	192	192	*221*
119	PU communication stop bit length	1	10	*221*
120	PU communication parity check	2	1	*221*
121	Number of PU communication retries	1	9999	*221*
122	PU communication check time interval	0	9999	*221*
123	PU communication waiting time setting	9999	0ms	*221*
124	PU communication CR/LF selection	1	1	*221*
340	Communication startup mode selection	0	1	*213*
549	Protocol selection	0	0	*238*

REMARKS

Always perform an inverter reset after the initial setting.

•Rated frequency (*Pr. 999* = "20(50Hz), 21(60Hz)")

Parameter	Name	Initial value	*Pr.999* = "21"	*Pr.999* = "20" Automatic parameter setting	Refer to page
3	Base frequency	60Hz	60Hz	50Hz	*103*
4	Multi-speed setting (high speed)	60Hz	60Hz	50Hz	*106*
20	Acceleration/deceleration reference frequency	60Hz	60Hz	50Hz	*113*
37	Speed display	0	0	0	*150*
55	Frequency monitoring reference	60Hz	60Hz	50Hz	*157*
66	Stall prevention operation reduction starting frequency	60Hz	60Hz	50Hz	*96*
125 (903)	Terminal 2 frequency setting gain frequency	60Hz	60Hz	50Hz	*188*
126 (905)	Terminal 4 frequency setting gain frequency	60Hz	60Hz	50Hz	*188*
505	Speed setting reference	60Hz	60Hz	50Hz	*150*
C25 (923)	Frequency setting voltage gain (built-in potentiometer)	60Hz	60Hz	50Hz	*284*

4.23 Setting the parameter unit and operation panel

Purpose	Parameter that should be Set		Refer to Page
Selection of rotation direction by RUN of the operation panel	RUN key rotation direction selection	Pr. 40	277
Switch the display language of the parameter unit	PU display language selection	Pr. 145	277
Use the setting dial of the operation panel like a potentiometer for frequency setting Key lock of operation panel	Operation panel operation selection	Pr. 161	278
Change the magnitude of change of frequency setting by the setting dial of the operation panel	Magnitude of frequency change setting	Pr. 295	281
Control of the parameter unit buzzer	PU buzzer control	Pr. 990	282
Adjust LCD contrast of the parameter unit	PU contrast adjustment	Pr. 991	282

4.23.1 RUN key rotation direction selection (Pr. 40)

Used to choose the direction of rotation by operating RUN of the operation panel.

Parameter Number	Name	Initial Value	Setting Range	Description
40	RUN key rotation direction selection	0	0	Forward rotation
			1	Reverse rotation

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

4.23.2 PU display language selection (Pr. 145)

You can switch the display language of the parameter unit (FR-PU04/FR-PU07) to another.

Parameter Number	Name	Initial Value	Setting Range	Description
145	PU display language selection	0	0	Japanese
			1	English
			2	German
			3	French
			4	Spanish
			5	Italian
			6	Swedish
			7	Finnish

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

4.23.3 Setting dial potentiometer mode/key lock selection (Pr. 161)

The setting dial of the operation panel can be used for setting like a potentiometer.
The key operation of the operation panel can be disabled.

Parameter Number	Name	Initial Value	Setting Range	Description	
161	**Frequency setting/key lock operation selection**	0	0	Setting dial frequency setting mode	Key lock invalid
			1	Setting dial potentiometer mode	
			10	Setting dial frequency setting mode	Key lock valid
			11	Setting dial potentiometer mode	

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

(1) Setting the frequency with the setting dial

Operation example: Operate at 30Hz.

Operation — Display

1. Screen at power-ON

   The monitor display appears.

2. Operation mode change

   Press (PU/EXT) to choose the PU operation mode.

PU indicator is lit.

3. Frequency setting

   Turn (dial) to show the frequency you want to set. The frequency flickers for about 5s.

4. While the value is flickering, press (SET) to set the frequency.

   (If (SET) is not pressed, the indication of the value goes back to "0.00" (0.00Hz) after about 5s of flickering. In that case, go back to “operation step 3”, and set the frequency again.)
   After about 3s of flickering, the indication of the value goes back to "0.00" (monitor display).

Flicker ··· Frequency setting complete!!
After 3s, the monitor display appears.

5. Start → acceleration → constant speed

   Press (RUN) to start operation.
   The frequency value on the display increases in *Pr. 7 Acceleration time*, and "30.00" (30.00Hz) appears.

6. To change the set frequency, perform the operation in above step 3 and 4. (Starting from the previously set frequency.)

7. Deceleration → stop

   Press (STOP/RESET) to stop. The frequency value on the indication decreases in *Pr. 8 Deceleration time*, and the motor stops rotating with "0.00" (0.00Hz) displayed.

REMARKS

· If (SET) is not pressed within 5s after (dial) is turned, the operation may not performed at the set frequency.

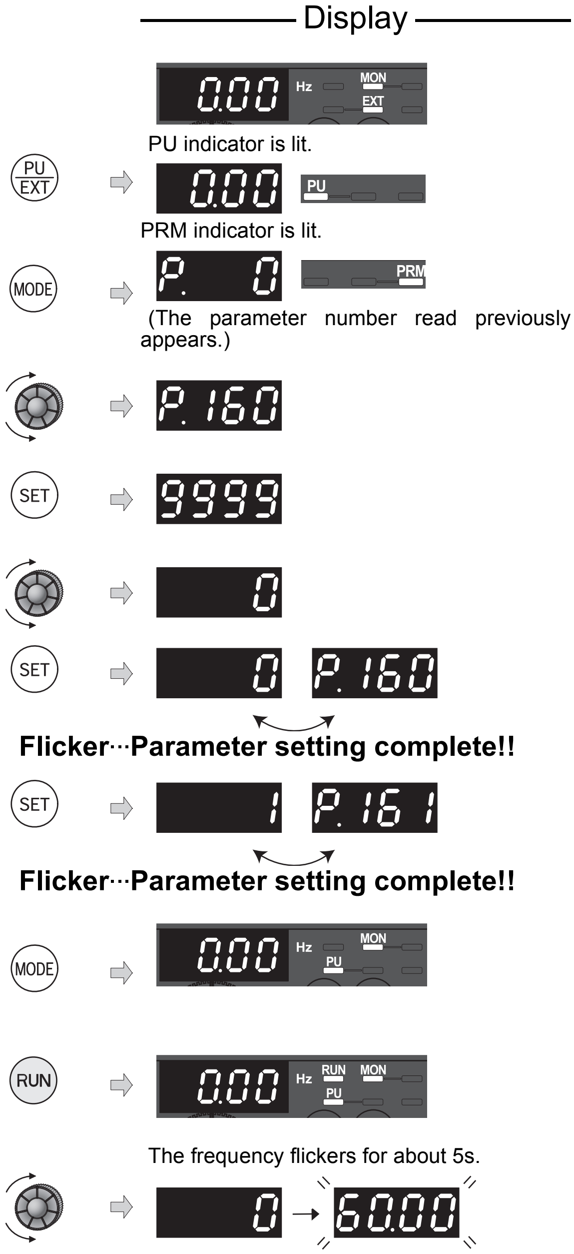
(2) Using the setting dial like a potentiometer to set the frequency

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

Operation

1. Screen at power-ON
   The monitor display appears.
2. Press (PU/EXT) to choose the PU operation mode.
3. Press (MODE) to choose the parameter setting mode.
4. Turn the setting dial until P.160 *(Pr. 160)* appears.
5. Press (SET) to read the present set value.
   "9999"(initial value) appears.
6. Turn the setting dial to change it to the set value "0".
7. Press (SET) to set.
8. Change *Pr. 161* to the setting value of "1" in the similar manner. (Refer to step 4 to 7.)
9. Mode/monitor check
   Press (MODE) twice to choose the monitor/frequency monitor.
10. Press (RUN) to start the inverter.
11. Turn the setting dial until "60.00" appears.
    The flickering frequency is the set frequency.
    You need not press (SET).

Display



REMARKS

- If the display changes from flickering "60.00" to "0.00", the setting of *Pr. 161 Frequency setting/key lock operation selection* may not be "1".
- Independently of whether the inverter is running or at a stop, the frequency can be set by merely turning the dial.
- When the frequency is changed, it will be stored in EEPROM as the set frequency after 10s.

NOTE

- **When using the setting dial under general-purpose motor control, the frequency goes up to the set value of *Pr.1 Maximum frequency* (initial value:120Hz). When using the setting dial under IPM motor control, the frequency goes up to the set value of the maximum motor speed (frequency).**
  Adjust the setting of *Pr.1 Maximum frequency* according to the application.

4 PARAMETERS

(3) Disable the setting dial and key operation of the operation panel (Press [MODE] long (2s))

- Operation using the setting dial and key of the operation panel can be invalid to prevent parameter change, and unexpected start or frequency setting.
- Set "10 or 11" in *Pr. 161*, then press (MODE) for 2s to make the setting dial and key operation invalid.
- When the setting dial and key operation are invalid, HOLd appears on the operation panel. If dial or key operation is attempted while dial and key operation are invalid, HOLd appears. (When dial or key is not touched for 2s, monitor display appears.)
- To make the setting dial and key operation valid again, press (MODE) for 2s.

REMARKS

- Even if the setting dial and key operation are disabled, the monitor display and (STOP/RESET) are valid.

NOTE

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

4.23.4 Magnitude of frequency change setting (Pr. 295)

When setting the set frequency with the setting dial, frequency changes in 0.01Hz increments in the initial status. Setting this parameter increases the magnitude of frequency which changes according to the rotated amount of the setting dial, improving operability.

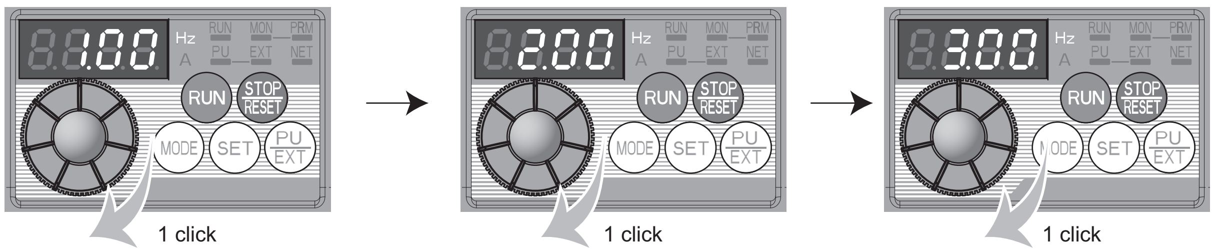
Parameter Number	Name	Initial Value	Setting Range	Description
295	**Magnitude of frequency change setting**	0	0	Function invalid
			0.01	The minimum varying width when the set frequency is changed by the setting dial can be set.
			0.1	
			1	
			10	

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*

(1) Basic operation

When a value other than "0" is set in *Pr. 295*, the minimum varying width when the set frequency is changed by the setting dial can be set.
For example, when "1.00Hz" is set in *Pr. 295*, one click (one dial gauge) of the setting dial changes the frequency in increments of 1.00Hz→2.00Hz→3.00Hz.

When *Pr. 295* = "1"



*One rotation of the setting dial equals to 24 clicks (24 dial gauges).

REMARKS

- When machine speed display is selected with *Pr. 37*, the minimum increments of the magnitude of change is determined by *Pr.295* as well. Note that the setting value may differ as speed setting changes the set machine speed and converts it to the speed display again.
- When the set frequency (speed) is 100 or more, frequency is displayed in 0.1 increments. Therefore, the minimum varying width is 0.1 even when *Pr. 295* < 0.1.
- When the machine speed setting is 1000 or more, frequency is displayed in 1 increments. Therefore, the minimum varying width is 1 even when *Pr. 295* < 1.

NOTE

- **For *Pr. 295* , unit is not displayed .**
- **This parameter is valid only in the set frequency mode. When other frequency-related parameters are set, it is not activated.**
- **When 10 is set, frequency setting changes in 10Hz increments. Be cautions for the excess speed. (in potentiometer mode)**

4.23.5 Buzzer control (Pr. 990)

You can make the buzzer "beep" when you press the key of the parameter unit (FR-PU04/FR-PU07).

Parameter Number	Name	Initial Value	Setting Range	Description
990	**PU buzzer control**	1	0	Without buzzer
			1	With buzzer

The above parameter can be set when *Pr. 160 Extended function display selection* = "0". *(Refer to page 197)*
The above parameter 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*.

REMARKS

Inverter alert faults with beep sounds when this parameter is set to activate the buzzer.

4.23.6 PU contrast adjustment (Pr. 991)

Contrast adjustment of the LCD of the parameter unit (FR-PU04/FR-PU07) can be performed.
Decreasing the setting value makes contrast light.

Parameter Number	Name	Initial Value	Setting Range	Description
991	**PU contrast adjustment**	58	0 to 63	0: Light ↓ 63: Dark

The above parameter is displayed as simple mode parameter only when the parameter unit FR-PU04/FR-PU07 is connected.
The above parameter 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*.

4.24 FR-E500 series operation panel (PA02) setting

The operation panel (PA02) for the FR-E500 series can be hooked up with the PU cable for use.
(The inverter can not be directly connected.)

Purpose	Parameter that should be Set		Refer to Page
Select the frequency setting method of the operation panel (built-in potentiometer, ▲/▼ key)	**Frequency setting command selection**	**Pr. 146**	*283*
Set the magnitude (slope) of the output frequency by the built-in potentiometer as desired.	**Built-in frequency setting potentiometer bias/gain**	**C22(Pr. 922), C23(Pr. 922), C24(Pr. 923), C25(Pr. 923)**	*284*

4.24.1 Built-in potentiometer switching (Pr. 146)

Switches the frequency setting method between the PA02 built-in frequency setting potentiometer and digital frequency setting by the ▲/▼ key.

Parameter Number	Name	Initial Value	Setting Range	Description
146	**Built-in potentiometer switching**	1	0 ∗1	PA02 built-in frequency setting potentiometer valid Frequency setting by the built-in frequency setting potentiometer
			1	PA02 built-in frequency setting potentiometer invalid Digital frequency setting by the ▲/▼ key. Changing frequency continuously by pressing the ▲/▼ key. Hold down the ▲/▼ key to perform operation.

∗1 Set when performing operation using the built-in frequency setting potentiometer using the operation panel (PA02) for the FR-E500 series.
Operation from the inverter operation panel or communication is not available.

The above parameter can be set when *Pr.160 Extended function display selection* = "0". *(Refer to page 197)*

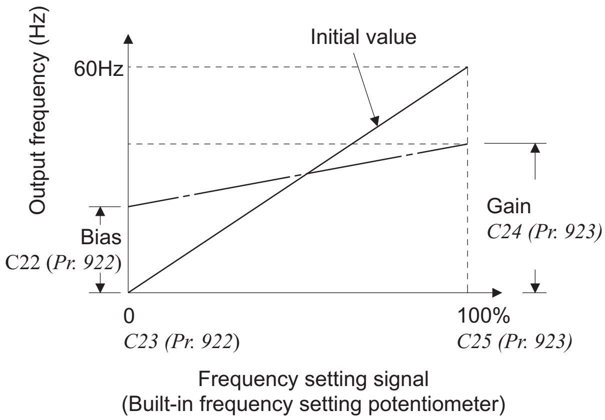
4.24.2 Bias and gain of the built-in frequency setting potentiometer (C22 (Pr. 922) to C25 (Pr. 923))

When the operation panel (PA02) for the FR-E500 series is hooked up with the PU cable, the magnitude (slope) of the output frequency to the frequency setting potentiometer of the operation panel can be set as desired.

Parameter No.	Name	Initial Value	Setting Range	Description
C22(922) *1	**Frequency setting voltage bias frequency (built-in potentiometer)**	0Hz	0 to 400Hz	Frequency on the bias side of PA02 built-in frequency setting potentiometer.
C23(922) *1	**Frequency setting voltage bias (built-in potentiometer)**	0%	0 to 300%	Converted % of the bias side setting level of PA02 built-in frequency setting potentiometer.
C24(923) *1*2	**Frequency setting voltage gain frequency (built-in potentiometer)**	60Hz	0 to 400Hz	Frequency on the gain side of PA02 built-in frequency setting potentiometer.
C25(923) *1	**Frequency setting voltage gain (built-in potentiometer)**	100%	0 to 300%	Converted % of the bias side setting level of PA02 built-in frequency setting potentiometer.

*1 The parameter numbers in parentheses are for the operation panel (PA02) of the FR-E500 series or parameter unit (FR-PU04/FR-PU07).
*2 Performing IPM parameter initialization changes the settings. *(Refer to page 85)*
The above parameters can be set when *Pr. 160 Extended function display selection* ="0". *(Refer to page 197)*

Adjust the bias of the potentiometer of the operation panel using *Pr. 922 (C22, C23)* and gain with *Pr. 923 (C24, C25)*.



<Setting>

[Setting from the FR-E500 series operation panel (PA02)]
Bias/gain adjustment methods using the built-in potentiometer are shown below.

- Method to adjust any point by turning the potentiometer.
- Method to adjust any point without turning the potentiometer.
- Method to adjust the bias/gain frequency only.

Power ON

↓

Make sure that the inverter is in PU mode.

↓

Read *Pr. 923* to display the present set gain speed.

↓

Set the gain frequency in *Pr. 923* to display the analog voltage value of the built-in frequency setting potentiometer in %.

↓

Method to adjust any point by turning the potentiometer.

Method to adjust only the gain frequency and not to adjust the voltage

Method to adjust any point without turning the potentiometer.

↓

Press the SET key to shift to the next parameter

↓

Set the *Pr.79 Operation mode selection* value according to the operation mode being used.

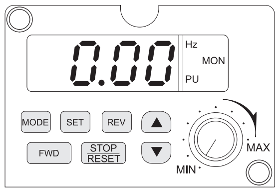
Pr. 923 "Built-in frequency setting potentiometer gain"

(Pr. 922 can be adjusted in a similar manner.)

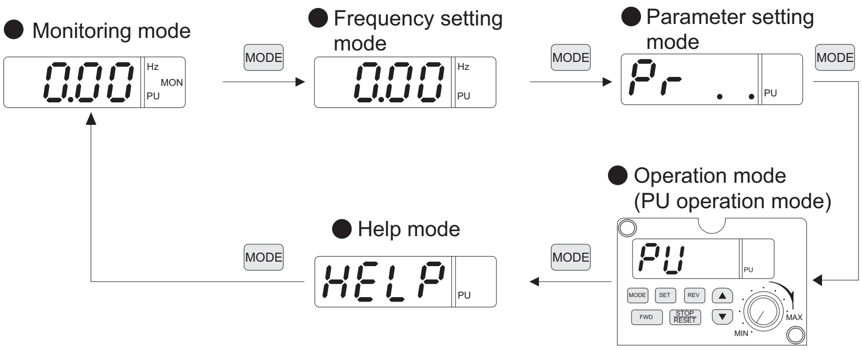
Set the magnitude (slope) of the output frequency by the built-in potentiometer as desired using the built-in frequency setting potentiometer.

Operation

1. Power-ON (monitoring mode)



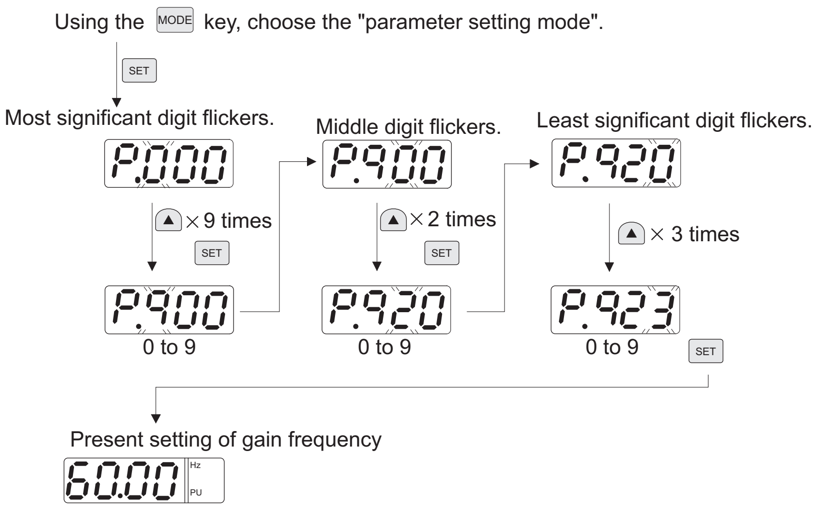
2. Make sure that the inverter is in PU mode with MODE key.



Confirm that the PU operation mode (PU) has been chosen.
In the Jog operation mode (JOG) or External operation mode (OP.nd), press the ▲/▼ key to display PU .

If PU cannot be displayed by pressing the ▲/▼ key in the External operation mode (OP.nd) (if *Pr. 79 operation mode selection* ≠"0"), set "1" in *Pr. 79 operation mode selection*.

3. Read *Pr. 923* to display the present set gain frequency.
(*Pr. 922* can be adjusted in a similar manner.)



Operation

4. Set the gain frequency in *Pr.923* to display the analog voltage value of the built-in frequency setting potentiometer in %. (80Hz maximum)

● Current setting of gain frequency

60.00 Hz PU

→

● Changing the gain frequency

80.00 Hz PU

Press ▲ ▼ to change the set frequency.

Press for 1.5s SET

● Analog voltage value (%) of the built-in frequency setting potentiometer

0.0 PU

A near-0 value is shown at the MIN position of the potentiometer, and near-100 at MAX.
Set to the potentiometer position where operation is to be performed at the set frequency
(80Hz in the example).

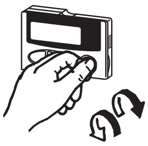
5. Method to adjust any point by turning the built-in frequency setting potentiometer.
(application of 5V)

● Analog voltage value (%) of the built-in frequency setting potentiometer

0.0 PU

→

● Turn the potentiometer to the gain frequency output (MAX) position.



→

● The gain voltage corresponding to the potentiometer position appears.

100

Press for 1.5s SET

100

Flicker

100

When the potentiometer is at the MAX position, the value is nearly 100.

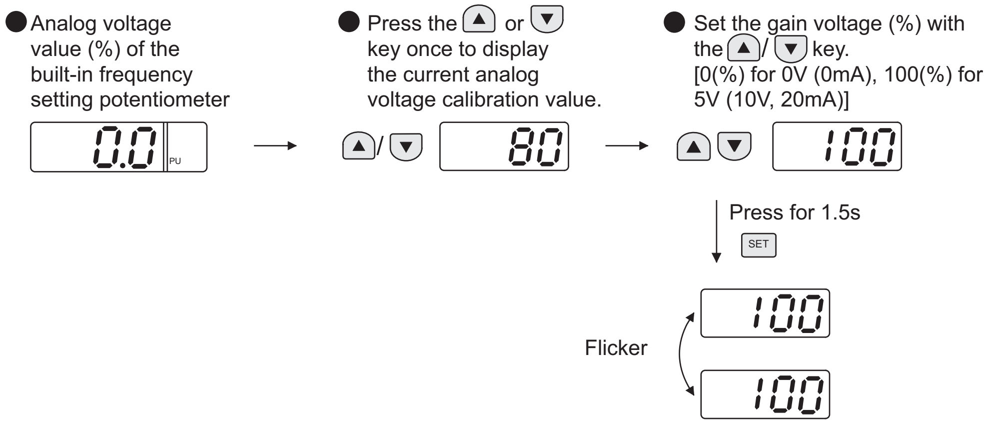
6. Pressing SET shifts to the next parameter.

7. Set the *Pr. 79 Operation mode selection* value according to the operation mode being used.

● Method to adjust any point without turning the potentiometer (changing from 4V(80%) to 5V(100%))

Operation

1. Perform steps 1. to 4. on page *285, 286*.
2. Set the gain voltage (%).

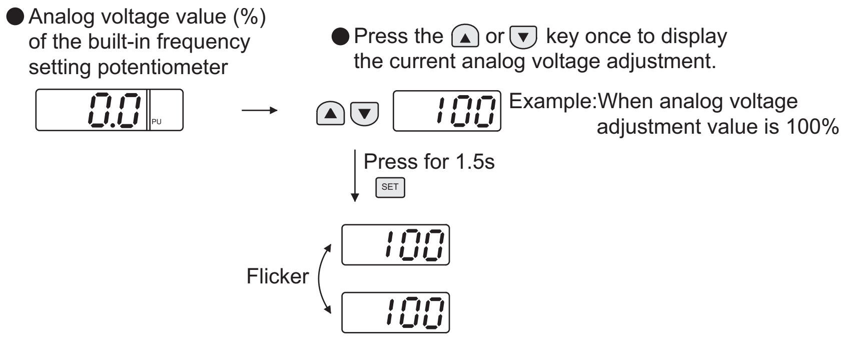


3. Pressing SET shifts to the next parameter.
4. Set the *Pr.79 Operation mode selection* value according to the operation mode being used.

● Method to adjust only the gain frequency and not to adjust the voltage

Operation

1. Perform steps 1. to 4. on page *285, 286*.
2. Adjust the analog voltage adjustment value.



3. Pressing SET shifts to the next parameter.
4. Set the *Pr. 79 Operation mode selection* value according to the operation mode being used.

⚠ CAUTION

⚠ **Take care when setting any value other than "0" as the bias speed at 0V. Even if a speed command is not given, simply turning ON the start signal will start the motor at the preset frequency.**

[Setting with the inverter operation panel without fitting the FR-E500 series operation panel (PA02)]

(a) Method to adjust any point
(to change to 80% from 100%)

Operation	Display
1. Confirm the operation status indicator and operation mode indicator ● The inverter should be at a stop. ● The inverter should be in the PU operation mode (depends on (PU/EXT)).	0.00 Hz MON PU
2. Press (MODE) to choose the parameter setting mode.	(MODE) ⇨ P. 0 (The parameter number read previously appears.)
3. Turn (dial) until C. . . appears.	(dial) ⇨ C. . .
4. Press (SET) to display C - - - .	(SET) ⇨ C - - - (C0 to C25 settings are enabled.)
5. Turn (dial) until C 25 appears. Turn the dial to *C25 (Pr. 923) Frequency setting voltage gain (built-in potentiometer)*	(dial) ⇨ C 25
6. Press (SET) to show the analog-to digital conversion value (%).	(SET) ⇨ 0.0 Analog voltage value (%) of built-in frequency setting potentiometer
7. Turn (dial) to set gain voltage (%). "minimum value of the potentiometer is 0%, maximum value is 100%"	(dial) ⇨ 80 The gain frequency is reached when analog voltage value (%) of built-in frequency setting potentiometer is 80%.

REMARKS

The current setting at the instant of turning (dial) is displayed. 100

8. Press (SET) to set.	(SET) ⇨ 80 ⇄ C 25

Flicker...Parameter setting complete!!
(Adjustment completed)

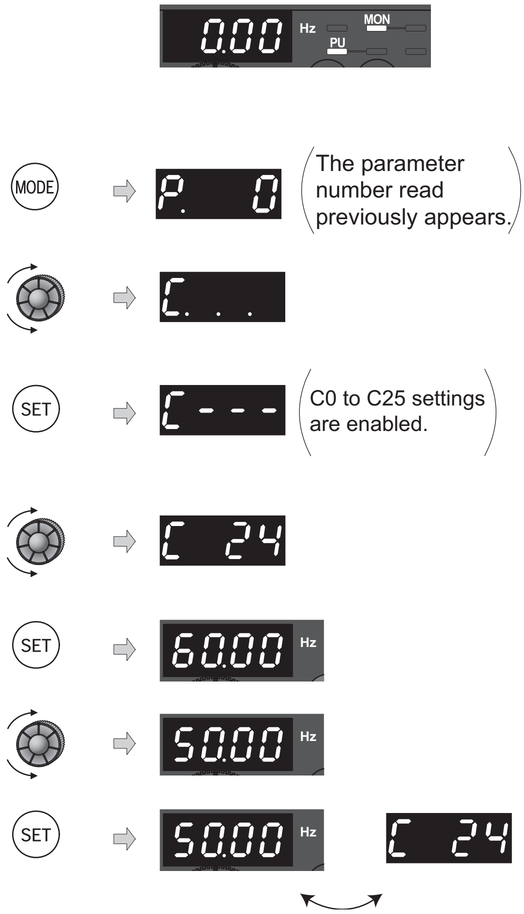
- Turn (dial) to read another parameter.
- Press (SET) to return to the C - - - indication (step 4).
- Press (SET) twice to show the next parameter (Pr.CL).

REMARKS

By pressing (dial) after step 6, you can confirm the present frequency setting bias/gain setting.
It cannot be confirmed after execution of step 7.

(b) Method to set frequency only without adjusting gain analog value
(When changing the gain frequency from 60Hz to 50Hz)

Operation	Display
1. Confirm the operation status indicator and operation mode indicator ● The inverter should be at a stop. ● The inverter should be in the PU operation mode (depends on PU/EXT).	
2. Press MODE to choose the parameter setting mode.	
3. Turn the dial until C. . . appears.	
4. Press SET to display C - - - .	
5. Turn the dial until C 24 appears. Turn the dial to *C24 (Pr.923) Frequency setting voltage gain frequency (built-in potentiometer)*	
6. Press SET to show the present set value.	
7. Turn the dial to change the set value to "50.00".	
8. Press SET to set.	



Flicker...Parameter setting complete!!
(Adjustment completed)

- Turn the dial to read another parameter.
- Press SET to return to the C - - - indication (step 4).
- Press SET twice to show the next parameter (Pr.CL).

REMARKS

- To use the built-in frequency setting potentiometer (*Pr.146* = "0") to operate at a frequency higher than 60Hz, change *C24* and *C25 (Pr.923)* settings. Simply changing the *Pr.1* and *Pr.18* settings does not enable the operation at a frequency higher than 60Hz.
- Setting of *Pr. 146, C22 (Pr. 922), C23 (Pr. 922), C24 (Pr. 923), C25 (Pr. 923)* can be performed from the inverter operation panel. However, it can be performed only when the operation panel PA02 for the FR-E500 is connected.
- When setting frequency, parameter, etc. using the operation panel PA02, it is necessary to hold down the SET key for 1.5s.
- Past four faults are stored in the faults history when the operation panel PA02 is connected.
- All faults (E.ILF, E.IOH. E.AIE, E.CDO, E.PTC, E.SOT, E.PID, E.SAF) added to the FR-F700PJ series are displayed as E.14.

4 PARAMETERS

4.25 Parameter clear/ All parameter clear

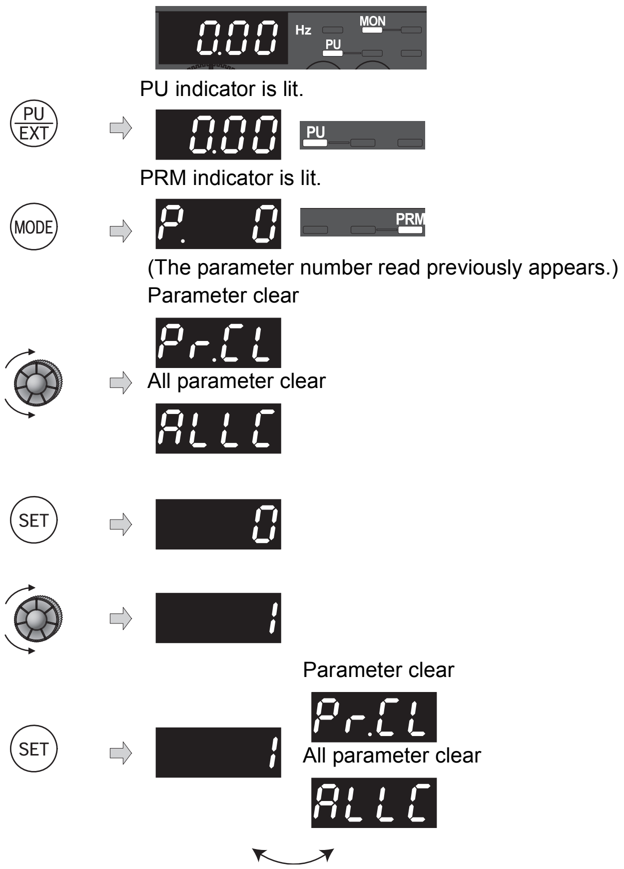
POINT

- Set "1" in *Pr.CL Parameter clear, ALLC all parameter clear* to initialize all parameters. (Parameters are not cleared when "1" is set in *Pr. 77 Parameter write selection*.)
- Refer to the extended parameter list on *page 64* for parameters cleared with this operation.

Operation

1. Screen at power-ON
   The monitor display appears.
2. Press (PU/EXT) to choose the PU operation mode.
3. Press (MODE) to choose the parameter setting mode.
4. Turn (dial) until Pr.CL (ALLC) appears.
5. Press (SET) to read the present set value.
   "0"(initial value) appears.
6. Turn (dial) to change it to the set value "1".
7. Press (SET) to set.

Display



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.

Setting	Description
0	Not executed.
1	Set parameters back to the initial values. (Parameter clear sets back all parameters except *calibration parameters, terminal function selection parameters* to the initial values.) *Refer to the parameter list on page 64* for availability of parameter clear and all parameter clear.

REMARKS

? 1 ⇄ Er4 are displayed alternately ... Why?

☞ The inverter is not in the PU operation mode.

☞ PU connector is used.

1. Press (PU/EXT). [PU] is lit and the monitor (4-digit LED) displays "1". (When *Pr. 79* = "0" (initial value))
2. Carry out operation from step 6 again.

- Stop the inverter. Parameter clear is unavailable when the inverter is running, and will cause the write disable error.

4.26 Initial value change list

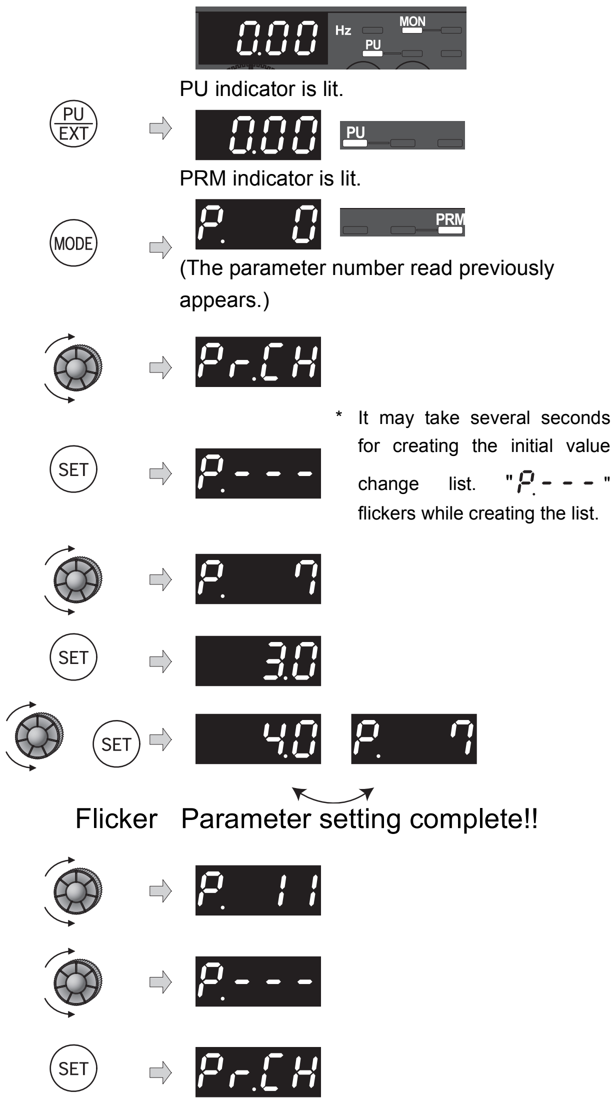
Displays and sets the parameters changed from the initial value.

Operation

1. Screen at power-ON
   The monitor display appears.
2. Press (PU/EXT) to choose the PU operation mode.
3. Press (MODE) to choose the parameter setting mode.
4. Turn (dial) until Pr.CH appears.
5. Pressing (SET) changes to the initial value change list screen.
6. Turning (dial) displays the parameter number changed.
   - Press (SET) to read the present set value.

     Turn (dial) and press (SET) to change the setting
     (refer to step 6 and 7 on page 61)
   - Turn (dial) to read another parameter.
   - The display returns to P.- - - after all parameters are displayed.
7. Pressing (SET) in P.- - - status returns to the parameter setting mode.
   - Turning (dial) sets other parameters.
   - Pressing (SET) displays the change list again.

Display



NOTE

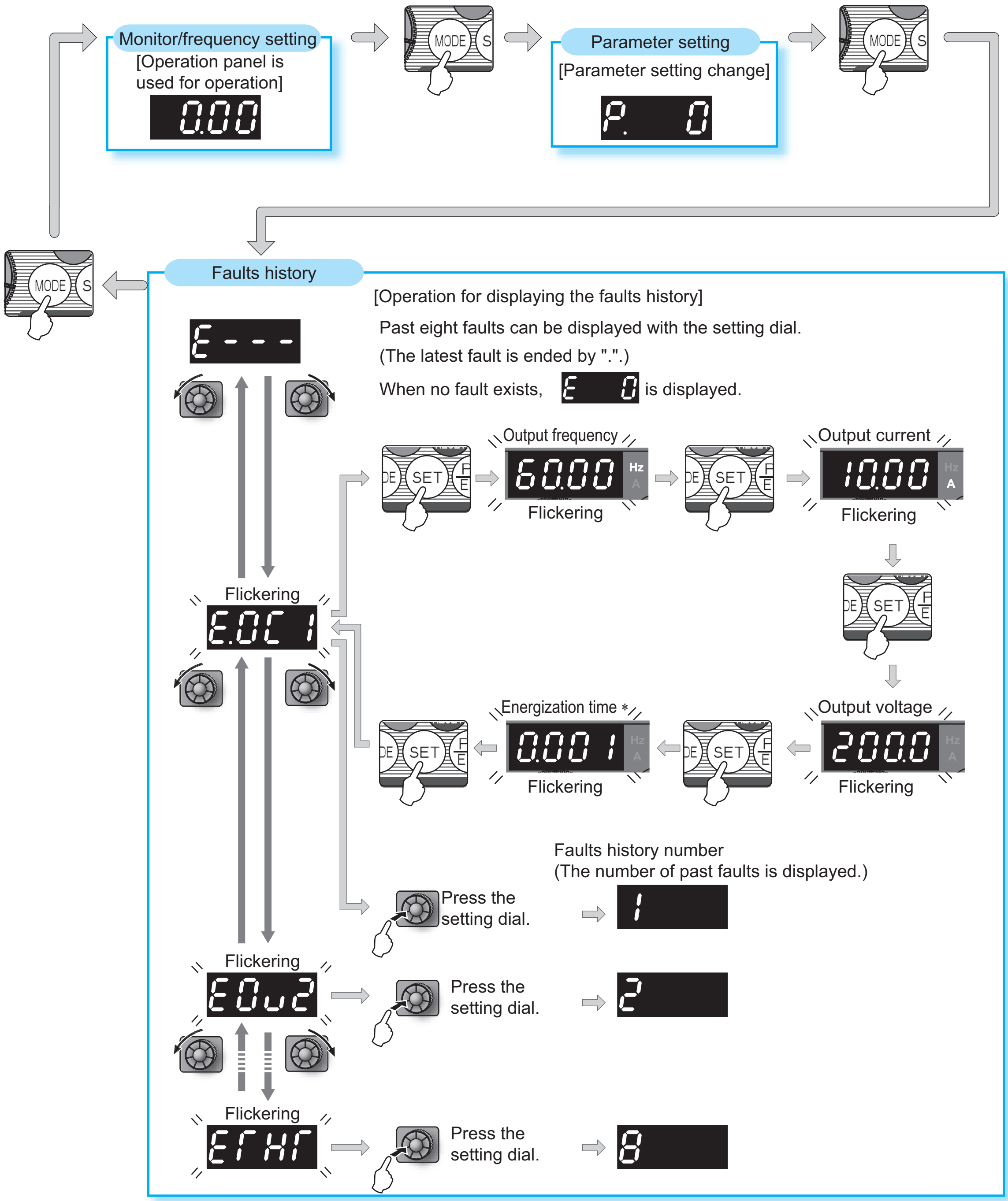
- **Calibration parameters *(C0 (Pr. 900) to C7 (Pr. 905), C22 (Pr. 922) to C25 (Pr. 923))* are not displayed even when these are changed from the initial settings.**
- **Only simple mode parameter is displayed when simple mode is set (*Pr. 160* = "9999" (initial value))**
- ***Pr. 160* is displayed independently of whether the setting value is changed or not.**
- **When parameter setting is changed after creating the initial value change list, the setting will be applied to the initial value change list next time.**

Parameters referred to

Pr. 160 Extended function display selection *Refer to page 197*
C0 (Pr. 900) FM terminal calibration *Refer to page 158*
C2(Pr. 902) to C7(Pr. 905) (Frequency setting bias/gain parameter) *Refer to page 188*
C22(Pr. 922) to C25(Pr. 923) (Bias and gain of built-in frequency setting potentiometer) *Refer to page 284*

4.27 Check and clear of the faults history

(1) Check for the faults history

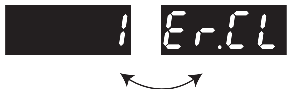


* The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel is used, the time is displayed up to 65.53 (65530h) in the indication of 1h = 0.001, and thereafter, it is added up from 0.

(2) Clearing procedure

POINT

- Set "1" in *Er.CL Fault history clear* to clear the faults history.

Operation	Display
1. Screen at power-ON The monitor display appears.	
2. Press (MODE) to choose the parameter setting mode.	PRM indicator is lit.  (The parameter number read previously appears.)
3. Turn the dial until Er.CL (faults history clear) appears.	
4. Press (SET) to read the present set value. "0" (initial value) appears.	
5. Turn the dial to change it to the set value "1".	
6. Press (SET) to set.	 **Flicker...Faults history clear complete!!**

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

Parameters referred to

Pr. 77 Parameter write selection *Refer to page 196*

MEMO

5 TROUBLESHOOTING

This chapter provides the "TROUBLESHOOTING" of this product.
Always read the instructions before using the equipment.

5.1 Reset method of protective function 296
5.2 List of fault or alarm indications 297
5.3 Causes and corrective actions.. 298
5.4 Correspondences between digital and actual characters 308
5.5 Check first when you have a trouble 309

When a fault occurs in the inverter, the inverter trips and the PU display automatically changes to one of the following fault or alarm indications.
If the fault does not correspond to any of the following faults or if you have any other problem, please contact your sales representative.

- Retention of fault output signal... When the magnetic contactor (MC) provided on the input side of the inverter is opened when a fault occurs, the inverter's control power will be lost and the fault output will not be held.
- Fault or alarm indication .... When a fault or alarm occurs, the operation panel display automatically switches to the fault or alarm indication.
- Resetting method .... When a fault occurs, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart. *(Refer to page 296)*
- When any fault occurs, take the appropriate corrective action, then reset the inverter, and resume operation.
  Not doing so may lead to the inverter fault and damage.

Inverter fault or alarm indications are roughly categorized as below.

(1) Error message
A message regarding operational fault and setting fault by the operation panel and parameter unit (FR-PU04 /FR-PU07) is displayed. The inverter does not trip.

(2) Warnings
The inverter does not trip even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.

(3) Alarm
The inverter does not trip. You can also output an alarm signal by making parameter setting.

(4) Fault
When a fault occurs, the inverter trips and a fault signal is output.

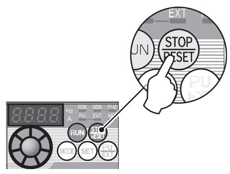
REMARKS

- Past eight faults can be displayed using the setting dial. (*Refer to page 59* for the operation.)

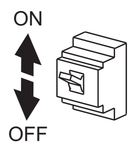
5.1 Reset method of protective function

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

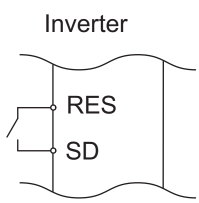
Operation 1: ...... Using the operation panel, press  to reset the inverter.
(This may only be performed when a fault occurs (*Refer to page 301* for fault.))



Operation 2: .... Switch power OFF once. After the indicator of the operation panel turns OFF, switch it ON again.



Operation 3: ...... Turn ON the reset signal (RES) for more than 0.1s. (If the RES signal is kept ON, "Err." appears (flickers) to indicate that the inverter is in a reset status.)



NOTE

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

5.2 List of fault or alarm indications

	Operation Panel Indication		Name	Fault data code	Refer to Page
Error message	E---	E---	Faults history	—	292
Error message	HOLd	HOLD	Operation panel lock	—	298
Error message	LOCd	LOCD	Password locked	—	298
Error message	Er1 to Er4	Er1 to 4	Parameter write error	—	298
Error message	Err.	Err.	Inverter reset	—	299
Warning	OL	OL	Stall prevention (overcurrent)	—	299
Warning	oL	oL	Stall prevention (overvoltage)	—	299
Warning	rb	RB	Regenerative brake pre-alarm	—	300
Warning	TH	TH	Electronic thermal relay function pre-alarm	—	300
Warning	PS	PS	PU stop	—	300
Warning	MT	MT	Maintenance signal output	—	300
Warning	Uv	UV	Undervoltage	—	300
Warning	SA	SA	SA	—	301
Alarm	Fn	FN	Fan alarm	—	301
Fault	E.OC1	E.OC1	Overcurrent trip during acceleration	16 (H10)	301
Fault	E.OC2	E.OC2	Overcurrent trip during constant speed	17 (H11)	302
Fault	E.OC3	E.OC3	Overcurrent trip during deceleration or stop	18 (H12)	302
Fault	E.Ov1	E.OV1	Regenerative overvoltage trip during acceleration	32 (H20)	302
Fault	E.Ov2	E.OV2	Regenerative overvoltage trip during constant speed	33 (H21)	303
Fault	E.Ov3	E.OV3	Regenerative overvoltage trip during deceleration or stop	34 (H22)	303
Fault	E.THT	E.THT	Inverter overload trip (electronic thermal O/L relay function)	48 (H30)	303
Fault	E.THM	E.THM	Motor overload trip (electronic thermal O/L relay function)	49 (H31)	303

	Operation Panel Indication		Name	Fault data code	Refer to Page
Fault	E.FIn	E.FIN	Heatsink overheat	64 (H40)	304
Fault	E.UvT	E.UVT IPM	Undervoltage	81 (H51)	304
Fault	E.ILF	E.ILF *	Input phase loss	82 (H52)	304
Fault	E.OLT	E.OLT	Stall prevention stop	96 (H60)	304
Fault	E.SOT	E.SOT* IPM	Loss of synchronism detection	97 (H61)	304
Fault	E. bE	E. BE	Brake transistor alarm detection	112 (H70)	305
Fault	E. GF	E.GF	Output side earth (ground) fault overcurrent at start	128 (H80)	305
Fault	E. LF	E.LF	Output phase loss	129 (H81)	305
Fault	E.OHT	E.OHT	External thermal relay operation	144 (H90)	305
Fault	E.PTC	E.PTC*	PTC thermistor operation	145 (H91)	305
Fault	E. PE	E.PE	Parameter storage device fault	176 (HB0)	306
Fault	E.PUE	E.PUE	PU disconnection	177 (HB1)	306
Fault	E.rET	E.RET	Retry count excess	178 (HB2)	306
Fault	E. 5 /E.CPU	E.5 / E.CPU	CPU fault	245 (HF5) 192 (HC0)	306
Fault	E.CdO	E.CDO *	Output current detection value exceeded	196 (HC4)	306
Fault	E.IOH	E.IOH *	Inrush current limit circuit fault	197 (HC5)	306
Fault	E.AIE	E.AIE *	Analog input fault	199 (HC7)	307
Fault	E. OS	E.OS IPM	Overspeed occurrence	208 (HD0)	307
Fault	E.PId	E.PID *	PID signal fault	230 (HE6)	307
Fault	E.SAF	E.SAF *	E.SAF	201 (HC9)	307

* If a fault occurs when using with FR-PU04, "Fault 14" is displayed on the FR-PU04.

TROUBLESHOOTING

5

5.3 Causes and corrective actions

(1) Error message

A message regarding operational troubles is displayed. Output is not shut off.

Operation panel indication	**HOLD**	HOLd
Name	Operation panel lock	
Description	Operation lock mode is set. Operation other than STOP/RESET is invalid. *(Refer to page 280)*	
Check point	—	
Corrective action	Press MODE for 2s to release the lock.	

Operation panel indication	**LOCD**	LOCd
Name	Password locked	
Description	Password function is active. Display and setting of parameter is restricted.	
Check point	—	
Corrective action	Enter the password in *Pr. 297 Password lock/unlock* to unlock the password function before operating. *(Refer to page 198)*	

Operation panel indication	**Er1**	Er 1
Name	Write disable error	
Description	• You attempted to make parameter setting when *Pr. 77 Parameter write selection* has been set to disable parameter write. • Frequency jump setting range overlapped. • The PU and inverter cannot make normal communication.	
Check point	• Check the setting of *Pr. 77 Parameter write selection*. *(Refer to page 196)* • Check the settings of *Pr. 31 to Pr. 36 (frequency jump)*. *(Refer to page 102)* • Check the connection of the PU and inverter.	

Operation panel indication	**Er2**	Er 2
Name	Write error during operation	
Description	When parameter write was performed during operation with a value other than "2" (writing is enabled independently of operation status in any operation mode) is set in *Pr. 77* and the STF (STR) is ON.	
Check point	• Check the *Pr. 77* setting. *(Refer to page 196)* • Check that the inverter is not operating.	
Corrective action	• Set "2" in *Pr. 77*. • After stopping operation, make parameter setting.	

Operation panel indication	**Er3**	Er 3
Name	Calibration error	
Description	Analog input bias and gain calibration values are too close.	
Check point	Check the settings of *C3, C4, C6 and C7 (calibration functions)*. *(Refer to page 188)*	

Operation panel indication	**Er4**	Er 4
Name	Mode designation error	
Description	• Appears if a parameter setting is attempted in the External or NET operation mode with *Pr. 77* ≠ "2". • Appears if a parameter setting is attempted when the command source is not at the operation panel.	
Check point	• Check that operation mode is PU operation mode. • Check the *Pr. 77* setting. *(Refer to page 196)* • Check if a parameter unit (FR-PU04/FR-PU07) is connected. • Check the *Pr. 551* setting.	
Corrective action	• After setting the operation mode to the "PU operation mode", make parameter setting. *(Refer to page 200)* • After setting *Pr. 77* = "2", make parameter setting. • Disconnect the parameter unit (FR-PU04/FR-PU07), and set *Pr. 551* = "9999 (initial value)." • Set *Pr. 551* = "4". (*Refer to page 214)*	

Operation panel indication	Err.	Err.		
Name	Inverter reset			
Description	• Executing reset using RES signal, or reset command from communication or PU • Displays at powering OFF.			
Corrective action	• Turn OFF the reset command			

(2) Warning

When a warning occurs, the output is not shut off.

Operation panel indication	OL	OL	FR-PU04 FR-PU07	OL
Name	Stall prevention (overcurrent)			
Description	During acceleration	When the output current of the inverter exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function stops the increase in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the frequency again.		
	During constant-speed operation	When the output current of the inverter exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function reduces frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the frequency up to the set value.		
	During deceleration	When the output current of the inverter exceeds the stall prevention operation level (*Pr. 22 Stall prevention operation level*, etc.), this function stops the decrease in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has decreased below stall prevention operation level, this function decreases the frequency again.		
Check point	• Check that the *Pr. 0 Torque boost* setting is not too large. (V/F control) • Check that the *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time* settings are not too small. • Check that the load is not too heavy. • Are there any failure in peripheral devices? • Check that the *Pr. 13 Starting frequency* is not too large. (V/F control, General-purpose magnetic flux vector control) • Check that the *Pr. 22 Stall prevention operation level* is appropriate • Check if the operation was performed without connecting a motor under IPM motor control.			
Corrective action	• Increase or decrease the *Pr. 0 Torque boost* setting by 1% and check the motor status. *(Refer to page 92)* • Set a larger value in *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time*. *(Refer to page 113)* • Reduce the load weight. Try General-purpose magnetic flux vector control. • Check the peripheral devices • Adjust the *Pr.13* setting. Change the *Pr. 14 Load pattern selection* setting. (V/F control) • Set stall prevention operation current in *Pr. 22 Stall prevention operation level*. (The initial value is 120%.) The acceleration/deceleration time may change. Increase the stall prevention operation level with *Pr. 22 Stall prevention operation level*, or disable stall prevention with *Pr. 156 Stall prevention operation selection*. (Operation at OL occurrence can be selected using *Pr. 156*.) • Check the connection of the IPM motor.			

Operation panel indication	oL	oL	FR-PU04 FR-PU07	oL
Name	Stall prevention (overvoltage)			
Description	During deceleration	• If the regenerative energy of the motor becomes excessive to exceed the regenerative energy consumption capability, this function stops the decrease in frequency to prevent overvoltage trip. As soon as the regenerative energy has reduced, deceleration resumes. • If the regenerative energy of the motor becomes excessive when regeneration avoidance function is selected (*Pr. 882* =1), this function increases the speed to prevent overvoltage trip. *(Refer to page 262)*		
Check point	• Check for sudden speed reduction. • Check that regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886)* is used. *(Refer to page 262)*			
Corrective action	Increase the deceleration time using *Pr. 8 Deceleration time*.			

Operation panel indication	**PS**		**FR-PU04** **FR-PU07**	**PS**
Name	PU stop			
Description	Stop with STOP/RESET of the PU is set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*. (For *Pr. 75 refer to page 193* .)			
Check point	Check for a stop made by pressing STOP/RESET of the operation panel.			
Corrective action	Turn the start signal OFF and release with PU/EXT.			

Operation panel indication	**RB**		**FR-PU04** **FR-PU07**	**RB**
Name	Regenerative brake pre-alarm			
Description	Appears if the regenerative brake duty reaches or exceeds 85% of the *Pr. 70 Special regenerative brake duty* value. When the setting of *Pr. 70 Special regenerative brake duty* is the initial value (*Pr. 70* = "0"), this warning does not occur. If the regenerative brake duty reaches 100%, a regenerative overvoltage (E. OV_) occurs. The RBP signal can be simultaneously output with the [RB] display. For the terminal used for the RBP signal output, assign the function by setting "7 (positive logic) or 107 (negative logic)" in *Pr. 190 or Pr. 192 (output terminal function selection)*. *(Refer to page 140)*			
Check point	• Check that the brake resistor duty is not high. • Check that the *Pr. 30 Regenerative function selection* and *Pr. 70 Special regenerative brake duty* settings are correct.			
Corrective action	• Increase the deceleration time. • Check that the *Pr. 30 Regenerative function selection* and *Pr. 70 Special regenerative brake duty* settings.			

Operation panel indication	**TH**		**FR-PU04** **FR-PU07**	**TH**
Name	Electronic thermal relay function pre-alarm			
Description	Appears if the cumulative value of the *Pr. 9 Electronic thermal O/L relay* reaches or exceeds 85% of the preset level. If it reaches 100% of the *Pr. 9 Electronic thermal O/L relay* setting, a motor overload trip (E. THM) occurs. The THP signal can be simultaneously output with the [TH] display. For the terminal used for 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)*. *(Refer to page 140)*			
Check point	• Check for large load or sudden acceleration. • Is the *Pr. 9 Electronic thermal O/L relay* setting is appropriate? *(Refer to page 119)*			
Corrective action	• Reduce the load and frequency of operation. • Set an appropriate value in *Pr. 9 Electronic thermal O/L relay*. *(Refer to page 119)*			

Operation panel indication	**MT**		**FR-PU04**	——
			FR-PU07	**MT**
Name	Maintenance signal output			
Description	Indicates that the cumulative energization time of the inverter has reached a given time. When the setting of *Pr. 504 Maintenance timer alarm output set time* is the initial value (*Pr. 504* = "9999"), this warning does not occur.			
Check point	The *Pr. 503 Maintenance timer* setting is larger than the *Pr. 504 Maintenance timer alarm output set time* setting. *(Refer to page 268)*			
Corrective action	Setting "0" in *Pr. 503 Maintenance timer* erases the signal.			

Operation panel indication	**UV**		**FR-PU04** **FR-PU07**	——
Name	Undervoltage			
Description	If the power supply voltage of the inverter decreases, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage decreases below about 115VAC (about 230VAC for 400V class), this function stops the inverter output and displays Uv . An alarm is reset when the voltage returns to normal.			
Check point	• Check that the power supply voltage is normal. • Check if a high-capacity motor is driven.			
Corrective action	Check the power supply system equipment such as power supply.			

Operation panel indication	**SA**	SA	**FR-PU04** **FR-PU07**	——
Name	SA			
Description	Appears when the shorting wire across the terminals S1 and SC or the terminals S2 and SC is disconnected.			
Check point	Check if the shorting wire across the terminals S1 and SC or the terminals S2 and SC is disconnected.			
Corrective action	Short across the terminals S1 and SC and the terminals S2 and SC with shortening wires.			

(3) Alarm

When an alarm occurs, the output is not shut off. You can also output an alarm signal by making parameter setting. (Set "98" in *Pr. 190 or Pr. 192 (output terminal function selection)*. *Refer to page 140*)

Operation panel indication	**FN**	Fn	**FR-PU04** **FR-PU07**	**FN**
Name	Fan alarm			
Description	For the inverter that contains a cooling fan, Fn appears on the operation panel when the cooling fan stops due to an alarm or different operation from the setting of *Pr. 244 Cooling fan operation selection*.			
Check point	Check the cooling fan for an alarm.			
Corrective action	Check for fan alarm. Please contact your sales representative.			

(4) Fault

When a fault occurs, the inverter trips and a fault signal is output.

Operation panel indication	**E.OC1**	E.OC1	**FR-PU04** **FR-PU07**	**OC During Acc**
Name	Overcurrent trip during acceleration			
Description	When the inverter output current reaches or exceeds approximately 170% of the rated current during acceleration, the protective circuit is activated and the inverter trips.			
Check point	• Check for sudden acceleration. • Check that the downward acceleration time is not long for the lift. • Check for output short-circuit/ground fault. • Check that the *Pr. 3 Base frequency* setting is not 60Hz when the motor rated frequency is 50Hz. (V/F control, General-purpose magnetic flux vector control) • Check if the stall prevention operation level is set too high. • Check if the fast-response current limit operation is disabled. (V/F control, General-purpose magnetic flux vector control) • Check that regeneration is not performed frequently. (Check that the output voltage becomes larger than the V/F reference value at regeneration and overcurrent occurs due to increase in motor current.) (V/F control, General-purpose magnetic flux vector control) • Check that the inverter capacity matches with the motor capacity. (IPM motor control) • Check if a start command is given to the inverter while the motor is coasting. (IPM motor control)			
Corrective action	• Increase the acceleration time. (Shorten the downward acceleration time for the lift.) • When "E.OC1" is always lit at starting, disconnect the motor once and start the inverter. If "E.OC1" is still lit, contact your sales representative. • Check the wiring to make sure that output short circuit/ground fault does not occur. • Set 50Hz in *Pr. 3 Base frequency*. (V/F control, General-purpose magnetic flux vector control) *(Refer to page 103)* • Lower the setting of stall prevention operation level. *(Refer to page 103.)* • Activate the fast-response current limit operation. (V/F control, General-purpose magnetic flux vector control) • Set base voltage (rated voltage of the motor, etc.) in *Pr. 19 Base frequency voltage*. *(Refer to page 103)* • Choose inverter and motor capacities that match. (IPM motor control) • Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. (IPM motor control) *(Refer to page 161.)*			

Operation panel indication	E.OC2	E.OC 2	FR-PU04 FR-PU07	Stedy Spd OC
Name	Overcurrent trip during constant speed			
Description	When the inverter output current reaches or exceeds approximately 170% of the rated current during constant speed operation, the protective circuit is activated and the inverter trips.			
Check point	• Check for sudden load change. • Check for output short-circuit/ground fault. • Check if the stall prevention operation level is set too high. • Check if the fast-response current limit operation is disabled. (V/F control, General-purpose magnetic flux vector control) • Check that the inverter capacity matches with the motor capacity. (IPM motor control) • Check if a start command is given to the inverter while the motor is coasting. (IPM motor control)			
Corrective action	• Keep load stable. • Check the wiring to make sure that output short circuit/ground fault does not occur. • Lower the setting of stall prevention operation level. *(Refer to page 103.)* • Activate the fast-response current limit operation. (V/F control, General-purpose magnetic flux vector control) • Choose inverter and motor capacities that match. (IPM motor control) • Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. (IPM motor control) *(Refer to page 161.)*			

Operation panel indication	E.OC3	E.OC 3	FR-PU04 FR-PU07	OC During Dec
Name	Overcurrent trip during deceleration or stop			
Description	When the inverter output current reaches or exceeds approximately 170% of the rated inverter current during deceleration (other than acceleration or constant speed), the protective circuit is activated and the inverter trips.			
Check point	• Check for sudden speed reduction. • Check for output short-circuit/ground fault. • Check for too fast operation of the motor's mechanical brake. • Check if the stall prevention operation level is set too high. • Check if the fast-response current limit operation is disabled. (V/F control, General-purpose magnetic flux vector control) • Check that the inverter capacity matches with the motor capacity. (IPM motor control) • Check if a start command is given to the inverter while the motor is coasting. (IPM motor control)			
Corrective action	• Increase the deceleration time. • Check the wiring to make sure that output short circuit/ground fault does not occur. • Check the mechanical brake operation. • Lower the setting of stall prevention operation level. *(Refer to page 103.)* • Activate the fast-response current limit operation. (V/F control, General-purpose magnetic flux vector control) • Choose inverter and motor capacities that match. (IPM motor control) • Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. (IPM motor control) *(Refer to page 161.)*			

Operation panel indication	E.OV1	E.Ou 1	FR-PU04 FR-PU07	OV During Acc
Name	Regenerative overvoltage trip during acceleration			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated and the inverter trips. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	• Check for too slow acceleration. (e.g. during downward acceleration in vertical lift load) • Check that the setting of *Pr. 22 Stall prevention operation level* is not too small. • Check if the stall prevention operation is frequently activated in an application with a large load inertia.			
Corrective action	• Decrease the acceleration time. • Use regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886)*. *(Refer to page 262)* • Set the *Pr.22 Stall prevention operation level* correctly. • Set *Pr.154 Voltage reduction selection during stall prevention operation* = "11".			

Operation panel indication	E.OV2		FR-PU04 FR-PU07	Stedy Spd OV
Name	Regenerative overvoltage trip during constant speed			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	• Check for sudden load change. • Check that the setting of *Pr. 22 Stall prevention operation level* is not too small. • Check if the stall prevention operation is frequently activated in an application with a large load inertia.			
Corrective action	• Keep load stable. • Use regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886)*. *(Refer to page 262)* • Use the brake resistor, brake unit or power regeneration common converter (FR-CV) as required. • Set the *Pr.22 Stall prevention operation level* correctly. • Set *Pr.154 Voltage reduction selection during stall prevention operation* = "11".			

Operation panel indication	E.OV3		FR-PU04 FR-PU07	OV During Dec
Name	Regenerative overvoltage trip during deceleration or stop			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	• Check for sudden speed reduction. • Check if the stall prevention operation is frequently activated in an application with a large load inertia.			
Corrective action	• Increase the deceleration time. (Set the deceleration time which matches the moment of inertia of the load) • Make the brake cycle longer. • Use regeneration avoidance function *(Pr. 882, Pr. 883, Pr. 885, Pr. 886)*. *(Refer to page 262)* • Use the brake resistor, brake unit or power regeneration common converter (FR-CV) as required. • Set *Pr.154 Voltage reduction selection during stall prevention operation* = "11".			

Operation panel indication	E.THT		FR-PU04 FR-PU07	Inv. Overload
Name	Inverter overload trip (electronic thermal O/L relay function) *1			
Description	If the temperature of the output transistor element exceeds the protection level under the condition that a current not less than the rated inverter current flows and overcurrent trip does not occur (170% or less), the electronic thermal relay activates to stop the inverter output. (Overload capacity 120% 60s, 150% 0.5s)			
Check point	• Check that acceleration/deceleration time is not too short. • Check that *Pr. 0 Torque boost* setting is not too large (small). (V/F control) • Check that *Pr. 14 Load pattern selection* setting is appropriate for the load pattern of the using machine. (V/F control) • Check the motor for use under overload. • Check for too high surrounding air temperature.			
Corrective action	• Increase acceleration/deceleration time. • Adjust the *Pr. 0 Torque boost* setting. (V/F control) • Set the *Pr. 14 Load pattern selection* setting according to the load pattern of the using machine. (V/F control) • Reduce the load weight. • Set the surrounding air temperature to within the specifications.			

Operation panel indication	E.THM		FR-PU04 FR-PU07	Motor Ovrload
Name	Motor overload trip (electronic thermal O/L relay function) *1			
Description	The electronic thermal relay function in the inverter detects motor overheat due to overload or reduced cooling capability during constant-speed operation, and pre-alarm (TH display) is output when the integrated value reaches 85% of the *Pr. 9 Electronic thermal O/L relay* setting, and the protection circuit is activated to stop the inverter output when the integrated value reaches the specified value. When running a special motor such as a multi-pole motor or multiple motors, provide a thermal relay on the inverter output side since such motor(s) cannot be protected by the electronic thermal relay function.			
Check point	• Check the motor for use under overload. • Check that the setting of *Pr. 71 Applied motor* for motor selection is correct. (V/F control, General-purpose magnetic flux vector control) *(Refer to page 123)* • Check that stall prevention operation setting is correct.			
Corrective action	• Reduce the load weight. • For a constant-torque motor, set the constant-torque motor in *Pr. 71 Applied motor*. (V/F control, General-purpose magnetic flux vector control) • Check that stall prevention operation setting is correct. *(Refer to page 96)*			

*1 Resetting the inverter initializes the internal accumulated heat value of the electronic thermal relay function.

Operation panel indication	E.FIN	E.FIn	FR-PU04 FR-PU07	H/Sink O/Temp
Name	Heatsink overheat			
Description	If the heatsink overheats, the temperature sensor is actuated and the inverter trips. The FIN signal can be output when the temperature becomes approximately 85% of the heatsink overheat protection operation temperature. For the terminal used for the FIN signal output, assign the function by setting "26 (positive logic) or 126 (negative logic)" in any of *Pr. 190 or Pr. 192 (output terminal function selection)*. *(Refer to page 140)*			
Check point	• Check for too high surrounding air temperature. • Check for heatsink clogging. • Check that the cooling fan is not stopped (Check that Fn is not displayed on the operation panel).			
Corrective action	• Set the surrounding air temperature to within the specifications. • Clean the heatsink. • Replace the cooling fan.			

Operation panel indication	E.UVT IPM	E.UVT	FR-PU04 FR-PU07	Under Voltage
Name	Undervoltage			
Description	This function activates when the restart operation is repeatedly unsuccessful because the power supply voltage of the inverter has dropped.			
Check point	Check if the power supply voltage is appropriate.			
Corrective action	Investigate the devices on the power supply line such as the power supply itself.			

Operation panel indication	E.ILF	E.ILF	FR-PU04	Fault 14
			FR-PU07	Input phase loss
Name	Input phase loss			
Description	Inverter trips when function valid setting (=1) is selected in *Pr. 872 Input phase loss protection selection* and one phase of the three phase power input is lost. *(Refer to page 172)* It may may be activated if phase-to-phase voltage of the three-phase power input becomes largely unbalanced. When the setting of *Pr. 872 Input phase loss protection selection* is the initial value (*Pr. 872* ="0"), this warning does not occur.			
Check point	• Check for a break in the cable for the three-phase power supply input. • Check that phase-to-phase voltage of the three-phase power input is not largely unbalanced.			
Corrective action	• Wire the cables properly. • Repair a break portion in the cable. • Check the *Pr. 872 Input phase loss protection selection* setting. • Set *Pr. 872* = "0" (without input phase loss protection) when three-phase input voltage is largely unbalanced.			

Operation panel indication	E.OLT	E.OLT	FR-PU04 FR-PU07	Stll Prev STP
Name	Stall prevention stop			
Description	If the output frequency has fallen to 1Hz (1.5Hz under IPM motor control) by stall prevention operation and remains for 3s, a fault (E.OLT) appears and the inverter trips. OL appears while stall prevention is being activated. E.OLT may not occur if stall prevention (OL) is activated during output phase loss.			
Check point	• Check the motor for use under overload. *(Refer to page 97)* • Check that a motor is connected during IPM motor control. (IPM motor control) • Check if a start command is given to the inverter while the motor is coasting. (IPM motor control)			
Corrective action	• Reduce the load weight. (Check the *Pr. 22 Stall prevention operation level* setting.) • Check the connection of the IPM motor. (IPM motor control) • Set the IPM motor test operation. *(Refer to page 88)* • Input a start command after the motor stops. Alternatively, set the automatic restart after instantaneous power failure/flying start function. (IPM motor control) *(Refer to page 161.)*			

Operation panel indication	E.SOT IPM	E.SOT	FR-PU04	Fault 14
			FR-PU07	Motor step out
Name	Loss of synchronism detection			
Description	Stops the output when the operation is not synchronized. (This function is only available under IPM motor control.)			
Check point	• Check that the IPM motor is not driven overloaded. • Check if a start command is given to the inverter while the IPM motor is coasting. • Check if a motor other than the IPM motor (MM-EF series) is driven.			
Corrective action	• Set the acceleration time longer. • Reduce the load. • If the inverter restarts during coasting, set *Pr.57 Restart coasting time* ≠ "9999," and select the automatic restart after instantaneous power failure. • Drive the IPM motor (MM-EF series).			

Operation panel indication	E.BE	E. bE	FR-PU04 FR-PU07	Br. Cct. Fault
Name	Brake transistor alarm detection			
Description	When a brake transistor alarm has occurred due to the large regenerative energy from the motor etc., the brake transistor alarm is detected and the inverter trips. In this case, the inverter must be powered OFF immediately.			
Check point	• Reduce the load inertia. • Check that the frequency of using the brake is appropriate. • Check that the brake resistor selected is correct.			
Corrective action	Replace the inverter.			

Operation panel indication	E.GF	E. GF	FR-PU04 FR-PU07	Ground Fault
Name	Output side earth (ground) fault overcurrent at start			
Description	The inverter trips if an earth (ground) fault overcurrent flows at start due to an earth (ground) fault that occurred on the inverter's output side (load side). Whether this protective function is used or not is set with *Pr. 249 Earth (ground) fault detection at start*. When the setting of *Pr. 249 Earth (ground) fault detection at start* is the initial value *(Pr. 249 ="0")*, this warning does not occur.			
Check point	Check for a ground fault in the motor and connection cable.			
Corrective action	Remedy the ground fault portion.			

Operation panel indication	E.LF	E. LF	FR-PU04 FR-PU07	E.LF
Name	Output phase loss			
Description	If one of the three phases (U, V, W) on the inverter's output side (load side) is lost during inverter operation (except during DC injection brake operation and when output frequency is under 1Hz), inverter stops the output. Whether the protective function is used or not is set with *Pr.251 Output phase loss protection selection*.			
Check point	• Check the wiring. (Check that the motor is normal.) • Check that the capacity of the motor used is not smaller than that of the inverter. • Check if a start command is given to the inverter while the motor is coasting. (IPM motor control)			
Corrective action	• Wire the cables properly. • Choose inverter and motor capacities that match. • Input a start command after the motor stops. Alternatively, use automatic restart after instantaneous power failure/flying start function. (IPM motor control) *(Refer to page 161, 166)*			

Operation panel indication	E.OHT	E.OHT	FR-PU04 FR-PU07	OH Fault
Name	External thermal relay operation			
Description	If the external thermal relay provided for motor overheat protection or the internally mounted temperature relay in the motor, etc. switches ON (contacts open), the inverter output is stopped. This function is available when "7" (OH signal) is set in any of *Pr. 178 to Pr. 182 (input terminal function selection)*. This protective function is not available in the initial status (OH signal is not assigned).			
Check point	• Check for motor overheating. • Check that the value of 7 (OH signal) is set correctly in any of *Pr. 178 to Pr. 182 (input terminal function selection)*.			
Corrective action	• Reduce the load and frequency of operation. • Even if the relay contacts are reset automatically, the inverter will not restart unless it is reset.			

Operation panel indication	E.PTC	E.PTC	FR-PU04	Fault 14
			FR-PU07	PTC activated
Name	PTC thermistor operation			
Description	Inverter trips when resistance of PTC thermistor connected between terminal 2 and terminal 10 is more than the value set in *Pr. 561 PTC thermistor protection level*. This protective function is not available when *Pr. 561* setting is initial value (*Pr. 561* = "9999").			
Check point	• Check the connection of the PTC thermistor. • Check the *Pr. 561 PTC thermistor protection level* setting. • Check the motor for operation under overload.			
Corrective action	Reduce the load weight.			

Operation panel indication	E.PE	E. PE	FR-PU04 FR-PU07	Corrupt Memry
Name	Parameter storage device fault (control circuit board)			
Description	Appears when a fault occurred in the stored parameters. (EEPROM fault)			
Check point	Check for too many number of parameter write times.			
Corrective action	Please contact your sales representative. When performing parameter write frequently for communication purposes, set "1" in *Pr. 342* to enable RAM write. Note that powering OFF returns the inverter to the status before RAM write.			

Operation panel indication	E.PUE	E.PUE	FR-PU04 FR-PU07	PU Leave Out
Name	PU disconnection			
Description	• This function stops the inverter output if communication between the inverter and PU is suspended, e.g. the parameter unit (FR-PU04/FR-PU07) is disconnected, when "2", "3", "16" or "17" was set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*. • This function stops the inverter output when communication errors occurred consecutively for more than permissible number of retries when a value other than "9999" is set in *Pr. 121 Number of PU communication retries* during the RS-485 communication with the PU connector. (Use *Pr. 502 Stop mode selection at communication error* to change.) • This function also stops the inverter output if communication is broken within the period of time set in *Pr. 122 PU communication check time interval* during the RS-485 communication with the PU connector.			
Check point	• Check that the parameter unit cable is connected properly. • Check the *Pr. 75* setting. • Check that RS-485 communication data is correct. And check that the settings of communication parameter at inverter match settings of the computer. • Check that data is transmitted from the computer within a time set in *Pr. 122 PU communication check time interval*.			
Corrective action	• Connect the parameter unit cable securely. • Check the communication data and communication settings. • Increase the *Pr. 122 PU communication check time interval* setting. Or set "9999" (no communication check).			

Operation panel indication	E.RET	E.rET	FR-PU04 FR-PU07	Retry No Over
Name	Retry count excess			
Description	If operation cannot be resumed properly within the number of retries set, this function trips the inverter. This function is available only when *Pr. 67 Number of retries at fault occurrence* is set. When the initial value (*Pr. 67* = "0") is set, this protective function is not available.			
Check point	Find the cause of fault occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

Operation panel indication	E.5	E. 5	FR-PU04 FR-PU07	Fault 5
	E.CPU	E.CPU		CPU Fault
Name	CPU fault			
Description	Stops the inverter output if the communication fault of the built-in CPU occurs.			
Check point	Check for devices producing excess electrical noises around the inverter.			
Corrective action	• Take measures against noises if there are devices producing excess electrical noises around the inverter. • Please contact your sales representative.			

Operation panel indication	E.CDO	E.CdO	FR-PU04	Fault 14
			FR-PU07	OC detect level
Name	Output current detection value exceeded			
Description	This function is activated when the output current exceeds the *Pr. 150 Output current detection level* setting.			
Check point	Check the settings of *Pr. 150 Output current detection level*, *Pr. 151 Output current detection signal delay time*, *Pr. 166 Output current detection signal retention time*, *Pr. 167 Output current detection operation selection*. (*Refer to page 146*)			

Operation panel indication	E.IOH	E.IOH	FR-PU04	Fault 14
			FR-PU07	Inrush overheat
Name	Inrush current limit circuit fault			
Description	This function is activated when the resistor of the inrush current limit circuit overheats. The inrush current limit circuit fault			
Check point	Check that frequent power ON/OFF is not repeated.			
Corrective action	Configure a circuit where frequent power ON/OFF is not repeated. If the problem still persists after taking the above measure, please contact your sales representative.			

Operation panel indication	**E.AIE**	E.AI E	**FR-PU04**	**Fault 14**
			FR-PU07	**Analog in error**
Name	Analog input fault			
Description	Appears if voltage(current) is input to terminal 4 when the setting in *Pr.267 Terminal 4 input selection* and the setting of voltage/current input switch are different.			
Check point	Check the setting of *Pr. 267 Terminal 4 input selection* and voltage/current input switch. *(Refer to page 183)*			
Corrective action	Either give a frequency command by current input or set *Pr. 267 Terminal 4 input selection*, and voltage/current input switch to voltage input.			

Operation panel indication	**E.OS**	E. OS	**FR-PU04** **FR-PU07**	**E.OS**
Name	Overspeed occurrence			
Description	Stops the inverter outputs when the motor speed exceeds the *Pr.374 Overspeed detection level* under IPM motor control. This protective function is available while the IPM motor control is selected.			
Check point	• Check that the *Pr.374 Overspeed detection level* value is correct.			
Corrective action	• Set the *Pr.374 Overspeed detection level* value correctly.			

Operation panel indication	**E.PID**	E.PI d	**FR-PU04**	**Fault 14**
			FR-PU07	**Fault** **PID Signal Error**
Name	PID signal fault			
Description	If any of PID upper limit (FUP), PID lower limit (FDN), and PID deviation limit (Y48) turns ON during PID control, inverter shuts off the output. This function is active under the following parameter settings: *Pr.554 PID signal operation selection* ≠ "0 or 10", *Pr.131 PID upper limit* ≠ "9999", *Pr.132 PID lower limit* ≠ "9999", and *Pr.553 PID deviation limit* ≠ "9999". This protective function is not active in the initial setting (*Pr.554* = "0", *Pr.131* = "9999", *Pr.132* = "9999", *Pr.553* = "9999").			
Check point	• Check if the measured PID value is greater than the upper limit *(Pr.131)* or smaller than the lower limit *(Pr.132)*. • Check if the absolute PID deviation value is greater than the limit value *(Pr.553)*.			
Corrective action	Make correct settings for *Pr.131 PID upper limit*, *Pr.132 PID lower limit*, *Pr.553 PID deviation limit*. *(Refer to page 250)*			

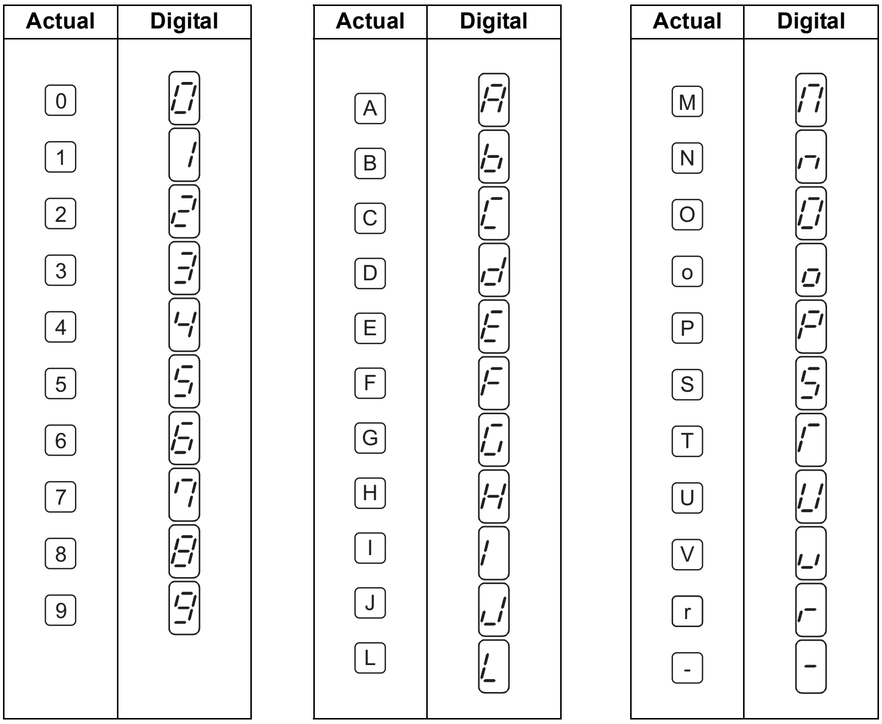
Operation panel indication	**E.SAF**	E.SAF	**FR-PU04**	**Fault 14**
			FR-PU07	**Fault** **E.SAF**
Name	Safety circuit fault			
Description	• Appears when internal circuits are malfunctioning. • Appears when one of the lines between S1 and SC, or between S2 and SC is opened.			
Check point	Check if the shorting wire across the terminals S1 and SC or the terminals S2 and SC is disconnected.			
Corrective action	Short across the terminals S1 and SC and the terminals S2 and SC with shortening wires.			

NOTE

- **If protective functions of E.ILF, E.SOT, E.AIE, E.IOH, E.PTC, E.CDO, E.PID and E.SAF are activated when using the FR-PU04, "Fault 14" is displayed.**
  Also when the faults history is checked on the FR-PU04, the display is "E.14".
- **If faults other than the above appear, contact your sales representative.**

5.4 Correspondences between digital and actual characters

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel:



5.5 Check first when you have a trouble

POINT

- If the cause is still unknown after every check, it is recommended to initialize the parameters (initial value) then set the required parameter values and check again.

5.5.1 Motor does not start

Check points	Possible Cause	Countermeasures	Refer to page
Main Circuit	Appropriate power supply voltage is not applied. (Operation panel display is not provided.)	Power ON moulded case circuit breaker (MCCB), an earth leakage circuit breaker (ELB), or a magnetic contactor (MC). Check for the decreased input voltage, input phase loss, and wiring.	—
	Motor is not connected properly.	Check the wiring between the inverter and the motor.	19
	The jumper across P/+ to P1 is disconnected.	Securely fit a jumper across P/+ to P1. To use a DC reactor (FR-HEL) or Filterpack, remove the jumper across the terminals P/+ and P1, then connect the DC reactor or Filterpack.	40
	Filterpack terminals P and P1 are not connected properly.	Check that the Filterpack terminals P and P1 are connected properly when Filterpack is installed.	21
Input Signal	Start signal is not input.	Check the start command source, and input a start signal. PU operation mode: RUN External operation mode : STF/STR signal	203
	Both the forward and reverse rotation start signals (STF, STR) are input simultaneously.	Turn ON only one of the forward and reverse rotation start signals (STF or STR). If the STF and STR signals are turned ON simultaneously in the initial setting, a stop command is given.	25
	Frequency command is zero. (RUN LED on the operation panel is flickering.)	Check the frequency command source and enter a frequency command.	203
	AU signal is not ON when terminal 4 is used for frequency setting. (RUN LED on the operation panel is flickering.)	Turn ON the AU signal. Turning ON the AU signal activates terminal 4 input.	183
	Output stop signal (MRS) or reset signal (RES) is ON. (RUN LED on the operation panel flickers while MRS signal is ON.)	Turn MRS or RES signal OFF. Inverter starts the operation with a given start command and a frequency command after turning OFF MRS or RES signal. Before turning OFF, ensure the safety.	136, 296
	Jumper connector of sink - source is wrongly selected. (RUN LED on the operation panel is flickering.)	Check that the control logic switchover jumper connector is correctly installed. If it is not installed correctly, input signal is not recognized.	27
	Shorting wires between S1 and SC, S2 and SC are disconnected.	Short between S1 and SC, S2 and SC with shorting wires.	26
	Voltage/current input switch is not correctly set for analog input signal (0 to 5V/0 to 10V, 4 to 20mA). (RUN LED on the operation panel is flickering.)	Set *Pr. 73, Pr. 267*, and a voltage/current input switch correctly, then input an analog signal in accordance with the setting.	25
	STOP/RESET was pressed. (Operation panel indication is PS (PS).)	During the External operation mode, check the method of restarting from a STOP/RESET input stop from PU.	300
	Two-wire or three-wire type connection is wrong.	Check the connection. Connect STOP signal when three-wire type is used.	138

TROUBLESHOOTING

5

Check points	Possible Cause	Countermeasures	Refer to page
Parameter Setting	*Pr. 0 Torque boost* setting is improper when V/F control is used.	Increase *Pr. 0* setting by 0.5% increments while observing the rotation of a motor. If that makes no difference, decrease the setting.	*92*
	Pr. 78 Reverse rotation prevention selection is set.	Check the *Pr. 78* setting. Set *Pr. 78* when you want to limit the motor rotation to only one direction.	*197*
	Pr. 79 Operation mode selection setting is wrong.	Select the operation mode which corresponds with input methods of start command and frequency command.	*203*
	Pr. 146 Built-in potentiometer switching setting is improper.	Set *Pr. 146* ="1" (initial value) when not using FR-E500 operation panel (PA02).	*283*
	Bias and gain *(calibration parameter C2 to C7)* settings are improper.	Check the bias and gain *(calibration parameter C2 to C7)* settings.	*188*
	Pr. 13 Starting frequency setting is greater than the running frequency.	Set running frequency higher than *Pr. 13*. The inverter does not start if the frequency setting signal is less than the value set in *Pr. 13*.	*116*
	Frequency settings of various running frequency (such as multi-speed operation) are zero. Especially, *Pr. 1 Maximum frequency* is zero.	Set the frequency command according to the application. Set *Pr. 1* higher than the actual frequency used.	*101*
	Pr. 15 Jog frequency setting is lower than *Pr. 13 Starting frequency*.	Set *Pr. 15 Jog frequency* higher than *Pr. 13 Starting frequency.*	*108*
	Operation mode and a writing device do not match.	Check *Pr. 79, Pr. 338, Pr. 339, Pr. 551,* and select an operation mode suitable for the purpose.	*200, 214*
	Start signal operation selection is set by the *Pr. 250 Stop selection*	Check *Pr. 250* setting and connection of STF and STR signals.	*138*
	The motor is decelerated to a stop when power failure deceleration stop function is selected.	When power is restored, ensure the safety, and turn OFF the start signal once, then turn ON again to restart. The motor restarts when *Pr. 261*="2".	*168*
	Performing auto tuning.	When offline auto tuning ends, press STOP RESET of the operation panel for the PU operation. For the External operation, turn OFF the start signal (STF or STR). 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.)	*125*
	Automatic restart after instantaneous power failure function or power failure stop function is activated. (Performing overload operation during input phase loss may cause voltage insufficiency, and that may result in detection of power failure.)	• Set *Pr. 872 Input phase loss protection selection* = "1" (input phase failure protection active). • Disable the automatic restart after instantaneous power failure function and power failure stop function. • Reduce the load. • Increase the acceleration time if the automatic restart after instantaneous power failure function or power failure stop function occurred during acceleration.	*161, 168*
	IPM motor test operation is selected under IPM motor control.	Set "30" in *Pr.800 Control method selection*.	*88*
Load	Load is too heavy.	Reduce the load.	—
	Shaft is locked.	Inspect the machine (motor).	—
Others	Operation panel display shows an error (e.g. E.OC1).	When any fault occurs, take an appropriate corrective action, then reset the inverter, and resume the operation.	*297*

5.5.2 Motor or machine is making abnormal acoustic noise

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Disturbance due to EMI when frequency command is given from analog input (terminal 2, 4).	Take countermeasures against EMI.	*45*
Parameter Setting		Increase the *Pr. 74 Input filter time constant* if steady operation cannot be performed due to EMI.	*187*
Parameter Setting	No carrier frequency noises (metallic noises) are generated.	In the initial setting, *Pr. 240 Soft-PWM operation selection* is enabled to change motor noise to an unoffending complex tone. Therefore, no carrier frequency noises (metallic noises) are generated. Set *Pr. 240* = "0" to disable this function.	*181*
	Resonance occurs. (output frequency)	Set *Pr. 31 to Pr. 36 (Frequency jump)*. When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped.	*102*
	Resonance occurs. (carrier frequency)	Change *Pr. 72 PWM frequency selection* setting. Changing the PWM carrier frequency produces an effect on avoiding the resonance frequency of a mechanical system or a motor.	*181*
	Auto tuning is not performed under General-purpose magnetic flux vector control.	Perform offline auto tuning.	*125*
	Gain adjustment during PID control is insufficient.	To stabilize the measured value, change the proportional band (*Pr. 129*) to a larger value, the integral time (*Pr. 130*) to a slightly longer time, and the differential time (*Pr. 134*) to a slightly shorter time. Check the calibration of set point and measured value.	*250*
Others	Mechanical looseness	Adjust machine/equipment so that there is no mechanical looseness.	—
Motor	Operating with output phase loss	Check the motor wiring.	—
	Contact the motor manufacturer.		

5.5.3 Inverter generates abnormal noise

Check points	Possible Cause	Countermeasures	Refer to page
Fan	Fan cover was not correctly installed when a cooling fan was replaced.	Install the fan cover correctly. Install the fan cover securely with the enclosed fan cover fixing screws.	*322*

5.5.4 Motor generates heat abnormally

Check points	Possible Cause	Countermeasures	Refer to page
Motor	Motor fan is not working (Dust is accumulated.)	Clean the motor fan. Improve the environment.	—
	Phase to phase insulation of the motor is insufficient.	Check the insulation of the motor.	—
Main Circuit	The inverter output voltage (U, V, W) are unbalanced.	Check the output voltage of the inverter. Check the insulation of the motor.	*319*
Parameter Setting	The *Pr. 71 Applied motor* setting is wrong. (V/F control, General-purpose magnetic flux vector control)	Check the *Pr. 71 Applied motor* setting. (V/F control, General-purpose magnetic flux vector control)	*123*
—	Motor current is large.	Refer to "5.5.11 Motor current is too large"	*314*

5.5.5 Motor rotates in the opposite direction

Check points	Possible Cause	Countermeasures	Refer to page
Main Circuit	Phase sequence of output terminals U, V and W is incorrect.	Connect phase sequence of the output cables (terminal U, V, W) to the motor correctly	*20*
Input signal	The start signals (forward rotation, reverse rotation) are connected improperly.	Check the wiring. (STF: forward rotation, STR: reverse rotation)	*25*
	Adjustment by the output frequency is improper during the reversible operation with *Pr. 73 Analog input selection* setting.	Check the setting of *Pr. 125, Pr. 126, C2 to C7.*	*185*
Parameter Setting	*Pr. 40 RUN key rotation direction selection* setting is incorrect.	Check the *Pr. 40* setting.	*277*

5.5.6 Speed greatly differs from the setting

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Frequency setting signal is incorrectly input.	Measure the input signal level.	—
	The input signal lines are affected by external EMI.	Take countermeasures against EMI such as using shielded wires for input signal lines.	*45*
Parameter Setting	*Pr. 1, Pr. 2, Pr. 18, calibration parameter C2 to C7* settings are improper.	Check the settings of *Pr. 1 Maximum frequency, Pr. 2 Minimum frequency, Pr. 18 High speed maximum frequency.*	*101*
		Check the *calibration parameter C2 to C7* settings.	*188*
		During IPM motor control, maximum frequency is limited to the maximum motor speed (frequency) of the IPM motor.	*340*
	Pr. 31 to Pr. 36 (frequency jump) settings are improper.	Narrow down the range of frequency jump.	*102*
Load	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
Parameter Setting		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	*96*
Motor		Check the capacities of the inverter and the motor.	—

5.5.7 Acceleration/deceleration is not smooth

Check points	Possible Cause	Countermeasures	Refer to page
Parameter Setting	Acceleration/deceleration time is too short.	Increase acceleration/deceleration time.	113
	Torque boost *(Pr. 0, Pr. 46)* setting is improper under V/F control, so the stall prevention function is activated.	Increase/decrease *Pr. 0 Torque boost* setting value by 0.5% increments to the setting.	92
	The base frequency does not match the motor characteristics under V/F control or General-purpose magnetic flux vector control.	For V/F control, set *Pr. 3 Base frequency and Pr. 47 Second V/F (base frequency)*.	103
		For General-purpose magnetic flux vector control, set *Pr. 84 Rated motor frequency*.	125
	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	96
		Check the capacities of the inverter and the motor.	—
	Regeneration avoidance operation is performed	If the frequency becomes unstable during regeneration avoidance operation, decrease the setting of *Pr. 886 Regeneration avoidance voltage gain*.	262

5.5.8 Speed varies during operation

When the slip compensation is selected, the output frequency varies between 0 and 2Hz as with load fluctuates. This is a normal operation and not a fault.

Check points	Possible Cause	Countermeasures	Refer to page
Load	Load varies during an operation. (V/F control)	Select General-purpose magnetic flux vector control.	93
Input signal	Frequency setting signal is varying.	Check the frequency setting signal.	—
	The frequency setting signal is affected by EMI.	Set filter to the analog input terminal using *Pr. 74 Input filter time constant*.	187
		Take countermeasures against EMI, such as using shielded wires for input signal lines.	45
	Malfunction is occurring due to the undesirable current generated when the transistor output unit is connected.	Use terminal PC (terminal SD when source logic) as a common terminal to prevent a malfunction caused by undesirable current.	28
	Multi-speed command signal is chattering.	Take countermeasures to suppress chattering.	—
Parameter Setting	The *Pr.80 Motor capacity* setting is inappropriate for the inverter and motor capacities under General-purpose magnetic flux vector control and IPM motor control.	Check the *Pr. 80 Motor capacity* setting.	93
	Fluctuation of power supply voltage is too large.	Change the *Pr. 19 Base frequency voltage* setting (about 3%) under V/F control.	103
	Hunting occurs by the generated vibration, for example, when structural rigidity at load side is insufficient.	Disable automatic control functions, such as energy saving operation, fast-response current limit function, regeneration avoidance function, General-purpose magnetic flux vector control, and stall prevention. For PID control, set smaller values to *Pr.129 PID proportional band* and *Pr.130 PID integral time*. Lower the control gain, and adjust to increase the stability.	—
		Change *Pr. 72 PWM frequency selection* setting.	181
Others	Wiring length exceeds 30m when General-purpose magnetic flux vector control is performed.	Perform offline auto tuning.	125
	Wiring length is too long for V/F control, and a voltage drop occurs.	Adjust *Pr. 0 Torque boost* by increasing with 0.5% increments for low-speed operation.	92
		Change to General-purpose magnetic flux vector control.	93

5.5.9 Operation mode is not changed properly

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Start signal (STF or STR) is ON.	Check that the STF and STR signals are OFF. When either is ON, the operation mode cannot be changed.	*200*
Parameter Setting	*Pr. 79* setting is improper.	When *Pr. 79 Operation mode selection* setting is "0" (initial value), the inverter is placed in the External operation mode at input power ON. To switch to the PU operation mode, press PU/EXT on the operation panel (press PU when the parameter unit (FR-PU04/FR-PU07) is used). At other settings (1 to 4, 6, 7), the operation mode is limited accordingly.	*200*
	Operation mode and a writing device do not correspond.	Check *Pr. 79, Pr. 338, Pr. 339, Pr. 551,* and select an operation mode suitable for the purpose.	*200, 214*

5.5.10 Operation panel display is not operating

Check points	Possible Cause	Countermeasures	Refer to page
Main Circuit	Wiring or installation is improper.	Check for the wiring and the installation.	*18*
		Make sure that the connector is fitted securely across terminal P/+ to P1.	
		Check that the Filterpack terminals P and P1 are connected properly when Filterpack is installed.	*21*
Main Circuit Control Circuit	Power is not input.	Input the power.	*18*
Parameter Setting	Command sources at the PU operation mode is not at the operation panel. (None of the operation mode displays (PU EXT NET) is lit.)	Check the setting of *Pr. 551 PU mode operation command source selection.* (If parameter unit (FR-PU04/FR-PU07) is connected while *Pr. 551* = "9999" (initial setting), all the operation mode displays (PU EXT NET) turn OFF.)	*214*

5.5.11 Motor current is too large

Check points	Possible Cause	Countermeasures	Refer to page
Parameter Setting	Torque boost *(Pr. 0, Pr. 46)* setting is improper under V/F control, so the stall prevention function is activated.	Increase/decrease *Pr. 0 Torque boost* setting value by 0.5% increments to the setting.	*92*
	V/F pattern is improper when V/F control or General-purpose magnetic flux vector control is performed. (*Pr. 3, Pr. 14, Pr. 19*)	Set rated frequency of the motor to *Pr. 3 Base frequency*. Use *Pr. 19 Base frequency voltage* to set the base voltage (e.g. rated motor voltage). (V/F control, General-purpose magnetic flux vector control)	*103*
		Change *Pr. 14 Load pattern selection* according to the load characteristic. (V/F control)	*105*
	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	*96*
		Check the capacities of the inverter and the motor.	—
	Auto tuning is not performed under General-purpose magnetic flux vector control.	Perform offline auto tuning.	*125*

5.5.12 Speed does not accelerate

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Start command and frequency command are chattering.	Check if the start command and the frequency command are correct.	—
	The wiring length used for analog frequency command is too long, and it is causing a voltage (current) drop.	Perform analog input bias/gain calibration.	*188*
	Input signal lines are affected by external EMI.	Take countermeasures against EMI, such as using shielded wires for input signal lines.	*45*
Parameter Setting	*Pr. 1, Pr. 2, Pr. 18, calibration parameter C2 to C7* settings are improper.	Check the settings of *Pr. 1 Maximum frequency and Pr. 2 Minimum frequency*. If you want to run the motor at 120Hz or higher, set *Pr. 18 High speed maximum frequency*.	*101*
		Check the *calibration parameter C2 to C7* settings.	*188*
		During IPM motor control, maximum frequency is limited to the maximum motor speed (frequency) of the IPM motor.	*340*
	The maximum voltage (current) input value is not set during the External operation. *(Pr.125, Pr.126, Pr.18)*	Check the *Pr.125 Terminal 2 frequency setting gain frequency* and *Pr.126 Terminal 4 frequency setting gain frequency* settings. To operate at 120Hz or higher, set *Pr.18 High speed maximum frequency*.	*101, 188*
	Torque boost *(Pr. 0, Pr. 46)* setting is improper under V/F control, so the stall prevention function is activated.	Increase/decrease *Pr. 0 Torque boost* setting value by 0.5% increments so that stall prevention does not occur.	*92*
	V/F pattern is improper when V/F control or General-purpose magnetic flux vector control is performed. *(Pr. 3, Pr. 14, Pr. 19)*	Set rated frequency of the motor to *Pr. 3 Base frequency*. (V/F control, General-purpose magnetic flux vector control) Use *Pr. 19 Base frequency voltage* to set the base voltage (e.g. rated motor voltage). (V/F control, General-purpose magnetic flux vector control)	*103*
		Change *Pr. 14 Load pattern selection* according to the load characteristic. (V/F control)	*105*
	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
		Set *Pr. 22 Stall prevention operation level* higher according to the load. (Setting *Pr. 22* too large may result in frequent overcurrent trip (E.OC□).)	*96*
		Check the capacities of the inverter and the motor.	—
	Auto tuning is not performed under General-purpose magnetic flux vector control.	Perform offline auto tuning.	*125*
	During PID control, output frequency is automatically controlled to make measured value = set point.		*250*
Main Circuit	Brake resistor is connected between terminal P/+ and P1 by mistake.	Connect an optional brake transistor (MRS type, MYS type, FR-ABR) between terminal P/+ and PR.	*34*

5.5.13 Unable to write parameter setting

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Operation is being performed (signal STF or STR is ON).	Stop the operation. When *Pr. 77* = "0" (initial value), write is enabled only during a stop.	*196*
Parameter Setting	You are attempting to set the parameter in the External operation mode.	Choose the PU operation mode. Or, set *Pr. 77* = "2" to enable parameter write regardless of the operation mode.	*196*
	Parameter is disabled by the *Pr. 77 Parameter write selection* setting.	Check *Pr. 77 Parameter write selection* setting.	*196*
	Key lock is activated by the *Pr. 161 Frequency setting/key lock operation selection* setting.	Check *Pr. 161 Frequency setting/key lock operation selection* setting.	*278*
	Operation mode and a writing device do not correspond.	Check *Pr. 79, Pr. 338, Pr. 339, Pr. 551,* and select an operation mode suitable for the purpose.	*200, 214*

MEMO

6 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

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

6.1 Inspection items... 318
6.2 Measurement of main circuit voltages, currents and powers 324

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

●Precautions for maintenance and inspection

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

6.1 Inspection items

6.1.1 Daily inspection

Basically, check for the following faults during operation.

(1) Motor operation fault
(2) Improper installation environment
(3) Cooling system fault
(4) Abnormal vibration, abnormal noise
(5) Abnormal overheat, discoloration

6.1.2 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.
Consult us for periodic inspection.

(1) Check for cooling system fault............Clean the air filter, etc.
(2) Tightening check and retightening......The screws and bolts may become loose due to vibration, temperature changes, etc. Check and tighten them.
Tighten them according to the specified tightening torque *(Refer to page 17)*.
(3) Check the conductors and insulating materials for corrosion and damage.
(4) Measure insulation resistance.
(5) Check and change the cooling fan and relay.

6.1.3 Daily and periodic inspection

Area of Inspection	Inspection Item	Description	Interval: Daily	Interval: Periodic *2	Corrective Action at Alarm Occurrence	Customer's Check
General	Surrounding environment	Check the surrounding air temperature, humidity, dirt, corrosive gas, oil mist, etc.	○		Improve environment	
	Overall unit	Check for unusual vibration and noise.	○		Check alarm location and retighten	
		Check for dirt, oil, and other foreign material.	○		Clean	
	Power supply voltage	Check that the main circuit voltages are normal.*1	○		Inspect the power supply	
Main circuit	General	(1) Check with megger (across main circuit terminals and earth (ground) terminal).		○	Contact the manufacturer	
		(2) Check for loose screws and bolts.		○	Retighten	
		(3) Check for overheat traces on the parts.		○	Contact the manufacturer	
		(4) Check for stain		○	Clean	
	Conductors, cables	(1) Check conductors for distortion.		○	Contact the manufacturer	
		(2) Check cable sheaths for breakage and deterioration (crack, discoloration, etc.)		○	Contact the manufacturer	
	Terminal block	Check for damage.		○	Stop the device and contact the manufacturer.	
	Smoothing aluminum electrolytic capacitor	(1) Check for liquid leakage.		○	Contact the manufacturer	
		(2) Check for safety valve projection and bulge.		○	Contact the manufacturer	
		(3) Visual check and judge by the life check of the main circuit capacitor *(Refer to page 320)*		○		
	Relay	Check that the operation is normal and no chatter is heard.		○	Contact the manufacturer	
Control circuit, Protective circuit	Operation check	(1) Check that the output voltages across phases with the inverter operated alone is balanced		○	Contact the manufacturer	
		(2) Check that no fault is found in protective and display circuits in a sequence protective operation test.		○	Contact the manufacturer	
	Parts check: Overall	(1) Check for unusual odor and discoloration.		○	Stop the device and contact the manufacturer.	
		(2) Check for serious rust development		○	Contact the manufacturer	
	Parts check: Aluminum electrolytic capacitor	(1) Check for liquid leakage in a capacitor and deformation trace		○	Contact the manufacturer	
		(2) Visual check and judge by the life check of the main circuit capacitor *(Refer to page 320)*		○		
Cooling system	Cooling fan	(1) Check for unusual vibration and noise.	○		Replace the fan	
		(2) Check for loose screws and bolts		○	Fix with the fan cover fixing screws	
		(3) Check for stain		○	Clean	
	Heatsink	(1) Check for clogging		○	Clean	
		(2) Check for stain		○	Clean	
Display	Indication	(1) Check that display is normal.	○		Contact the manufacturer	
		(2) Check for stain		○	Clean	
	Meter	Check that reading is normal	○		Stop the device and contact the manufacturer.	
Load motor	Operation check	Check for vibration and abnormal increase in operation noise	○		Stop the device and contact the manufacturer.	

*1 It is recommended to install a device to monitor voltage for checking the power supply voltage to the inverter.

*2 One to two years of periodic inspection cycle is recommended. However, it differs according to the installation environment. Consult us for periodic inspection.

6.1.4 Display of the life of the inverter parts

The self-diagnostic alarm is output when the life span of the control circuit capacitor, cooling fan and each parts of the inrush current limit circuit is near its end. It gives an indication of replacement time.

The life alarm output can be used as a guideline for life judgement.

Parts	Judgement Level
Main circuit capacitor	85% of the initial capacity
Control circuit capacitor	Estimated remaining life 10%
Inrush current limit circuit	Estimated remaining life 10% (Power ON: 100,000 times left)
Cooling fan	Less than 50% of the predetermined speed

POINT

Refer to page 265 to perform the life check of the inverter parts.

6.1.5 Checking the inverter and converter modules

<Preparation>

(1) Disconnect the external power supply cables (R/L1, S/L2, T/L3) and motor cables (U, V, W).

(2) Prepare a tester. (Use 100Ω range.)

<Checking method>

Change the polarity of the tester alternately at the inverter terminals R/L1, S/L2, T/L3, U, V, W, + and -, and check for continuity.

NOTE

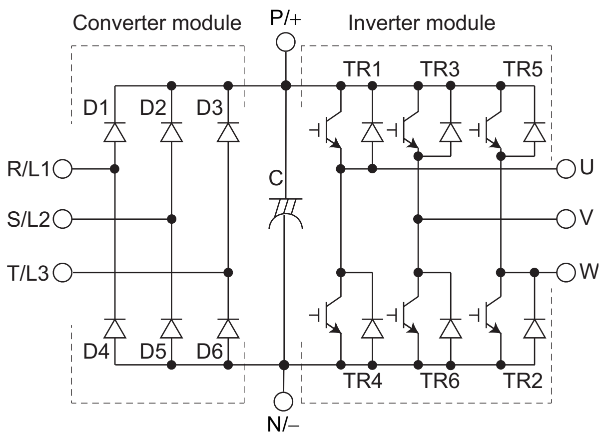
1. Before measurement, check that the smoothing capacitor is discharged.

2. At the time of discontinuity, the measured value is almost ∞. When there is an instantaneous continuity, due to the smoothing capacitor, the tester may not indicate ∞. At the time of continuity, the measured value is several to several tens-of ohms depending on the module type, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

<Module device numbers and terminals to be checked>

		Tester Polarity		Result		Tester Polarity		Result
		⊕	⊖			⊕	⊖	
Converter module	D1	R/L1	P/+	Discontinuity	D4	R/L1	N/−	Continuity
		P/+	R/L1	Continuity		N/−	R/L1	Discontinuity
	D2	S/L2	P/+	Discontinuity	D5	S/L2	N/−	Continuity
		P/+	S/L2	Continuity		N/−	S/L2	Discontinuity
	D3	T/L3	P/+	Discontinuity	D6	T/L3	N/−	Continuity
		P/+	T/L3	Continuity		N/−	T/L3	Discontinuity
Inverter module	TR1	U	P/+	Discontinuity	TR4	U	N/−	Continuity
		P/+	U	Continuity		N/−	U	Discontinuity
	TR3	V	P/+	Discontinuity	TR6	V	N/−	Continuity
		P/+	V	Continuity		N/−	V	Discontinuity
	TR5	W	P/+	Discontinuity	TR2	W	N/−	Continuity
		P/+	W	Continuity		N/−	W	Discontinuity

(Assumes the use of an analog meter.)



6.1.6 Cleaning

Always run the inverter in a clean status.

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

NOTE

Do not use solvent, such as acetone, benzene, toluene and alcohol, as these will cause the inverter surface paint to peel off.

The display, etc. of the operation panel and parameter unit (FR-PU04/FR-PU07) are vulnerable to detergent and alcohol. Therefore, avoid using them for cleaning.

6.1.7 Replacement of parts

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

Part Name	Estimated lifespan ∗1	Description
Cooling fan	10 years	Replace (as required)
Main circuit smoothing capacitor	10 years ∗2	Replace (as required)
On-board smoothing capacitor	10 years ∗2	Replace the board (as required)
Relays	—	as required

∗1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C
(without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
∗2 Output current: 80% of the rated inverter current

NOTE

For parts replacement, contact the nearest Mitsubishi FA Center.

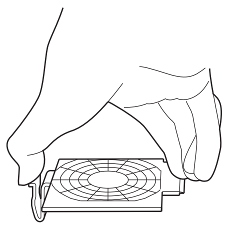
(1) Cooling fan

The replacement interval of the cooling fan used for cooling the parts generating heat such as the main circuit semiconductor is greatly affected by the surrounding air temperature. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be replaced immediately.

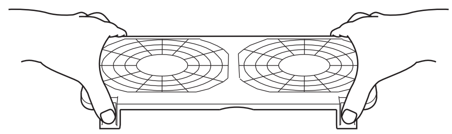
●Removal

1) Push the hooks from above and remove the fan cover.

3.7K or lower

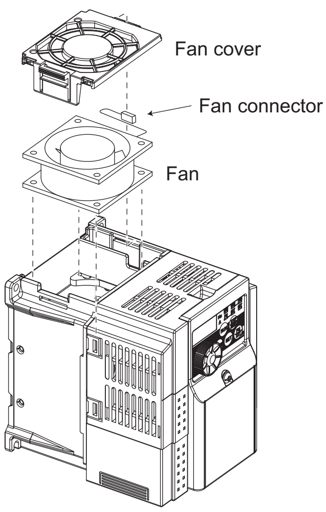


5.5K or higher



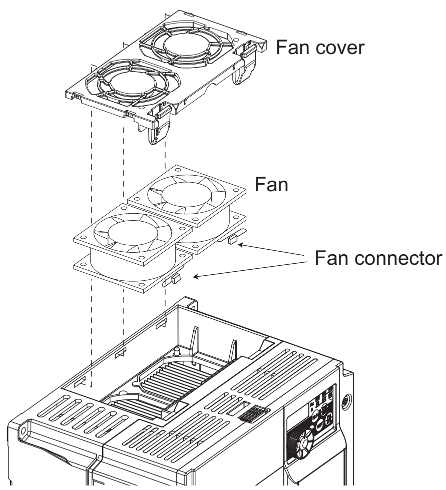
2) Disconnect the fan connectors.
3) Remove the fan.

3.7K or lower



Example for FR-F740PJ-1.5K

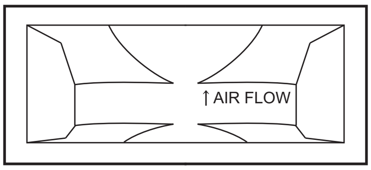
5.5K or higher



Example for FR-F740PJ-7.5K

●**Reinstallation**

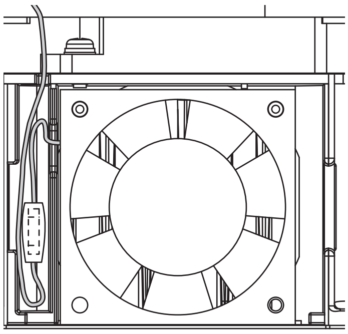
1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.



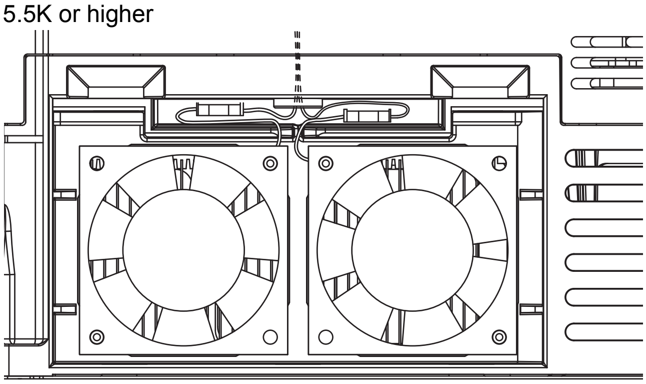
<Fan side face>

2) Reconnect the fan connectors.
3) When wiring, avoid the cables being caught by the fan.

3.7K or lower

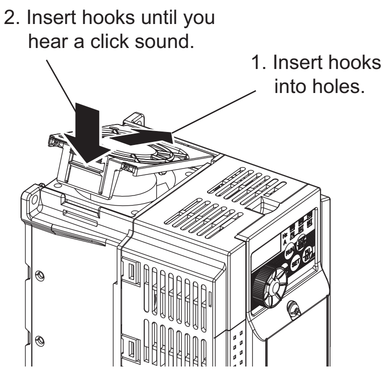


5.5K or higher



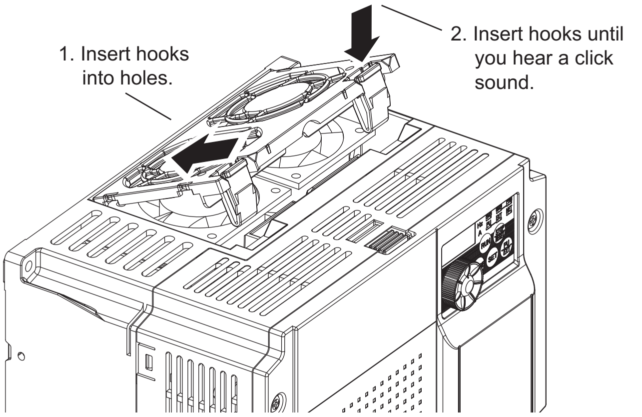
4) Reinstall the fan cover.

3.7K or lower



Example for FR-F740PJ-1.5K

5.5K or higher



Example for FR-F740PJ-7.5K

NOTE

- **Installing the fan in the opposite of air flow direction can cause the inverter life to be shorter.**
- **Prevent the cable from being caught when installing a fan.**
- **Switch the power OFF before replacing fans. Since the inverter circuits are charged with voltage even after power OFF, replace fans only when the inverter cover is on the inverter to prevent an electric shock accident.**

(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc. The replacement intervals greatly vary with the surrounding air temperature and operating conditions. When the inverter is operated in air-conditioned and normal environment conditions, replace the capacitors about every 10 years.
When a certain period of time has elapsed, the capacitors will deteriorate more rapidly. Check the capacitors at least every year (less than six months if the life will be expired soon).
The appearance criteria for inspection are as follows:

1) Case: Check the side and bottom faces for expansion
2) Sealing plate: Check for remarkable warp and extreme crack.
3) Check for external crack, discoloration, liquid leakage, etc. Judge that the capacitor has reached its life when the measured capacitance of the capacitor reduced below 80% of the rating.

POINT

Refer to page 265 to perform the life check of the main circuit capacitor.

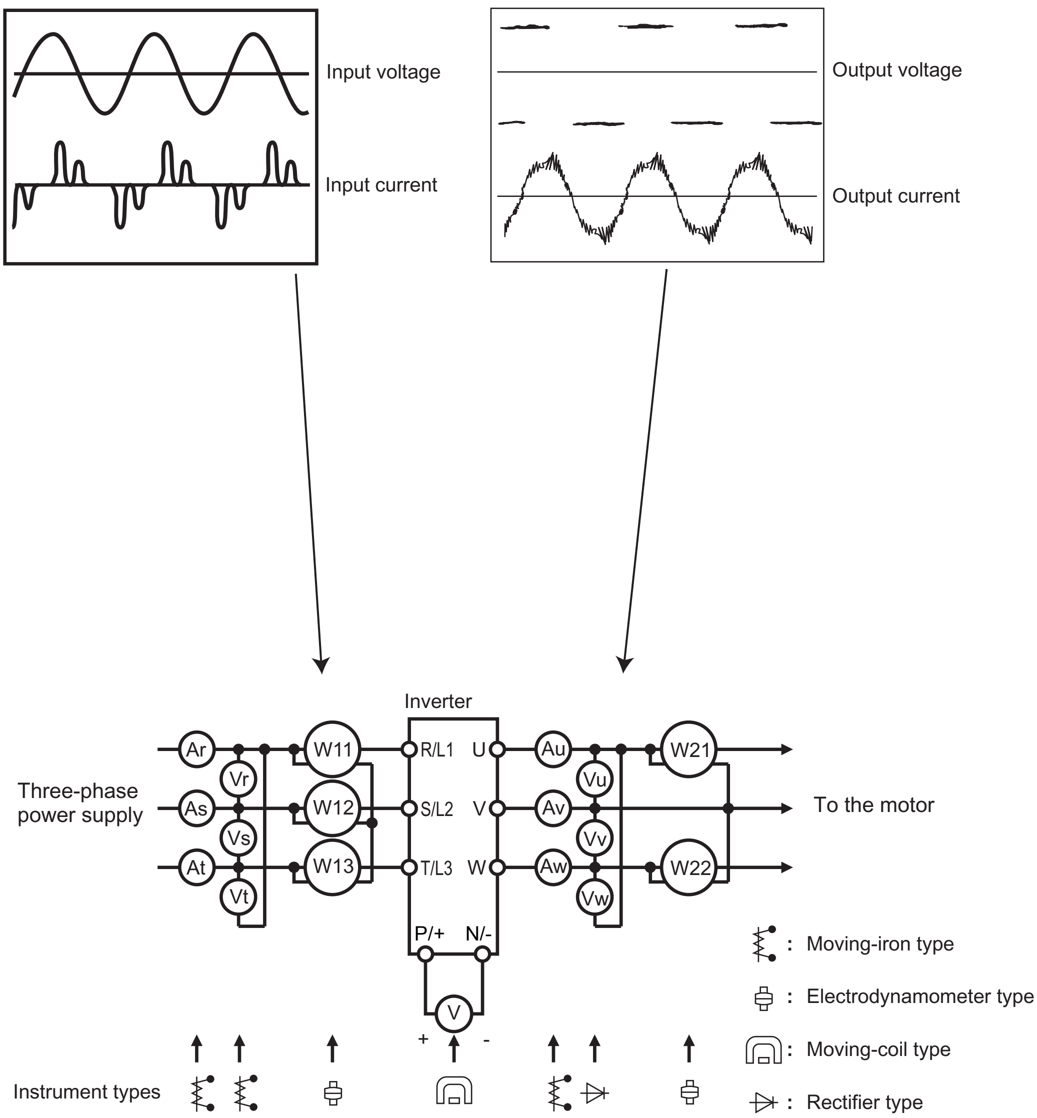
(3) Relays

To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

6.2 Measurement of main circuit voltages, currents and powers

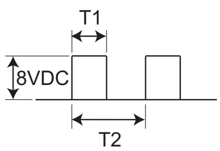
Since the voltages and currents on the inverter power supply and output sides include harmonics, measurement data depends on the instruments used and circuits measured.
When instruments for commercial frequency are used for measurement, measure the following circuits with the instruments given on the next page.

- When installing meters etc. on the inverter output side
  When the inverter-to-motor wiring length is large, especially in the 400V class, small-capacity models, the meters and CTs may generate heat due to line-to-line leakage current. Therefore, choose the equipment which has enough allowance for the current rating.
  To measure and display the output voltage and output current of the inverter, it is recommended to use the terminal FM output function of the inverter.



Examples of Measuring Points and Instruments

Measuring Points and Instruments

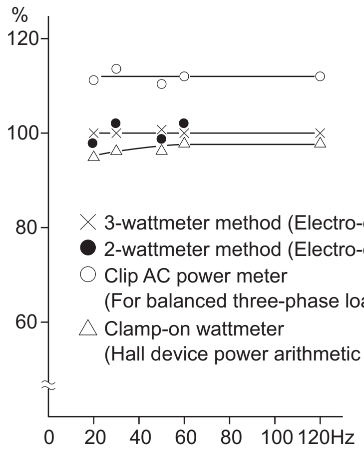
Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value)	
Power supply voltage V1	R/L1 and S/L2 S/L2 and T/L3 T/L3 and R/L1	Moving-iron type AC voltmeter ∗4	Commercial power supply Within permissible AC voltage fluctuation *(Refer to page 330)*	
Power supply side current I1	R/L1, S/L2, T/L3 line current	Moving-iron type AC ammeter ∗4		
Power supply side power P1	R/L1, S/L2, T/L3 and R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1	Digital power meter (designed for inverter) or electrodynamic type single-phase wattmeter	P1=W11+W12+W13 (3-wattmeter method)	
Power supply side power factor Pf1	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf_1 = \frac{P_1}{\sqrt{3}V_1 \times I_1} \times 100$ %			
Output side voltage V2	Across U and V, V and W, and W and U	Rectifier type AC voltage meter ∗1 ∗4 (moving-iron type cannot measure)	Difference between the phases is within 1% of the maximum output voltage.	
Output side current I2	U, V and W line currents	Moving-iron type AC ammeter ∗2 ∗4	Difference between the phases is 10% or lower of the rated inverter current.	
Output side power P2	U, V, W and U and V, V and W	Digital power meter (designed for inverter) or electrodynamic type single-phase wattmeter	P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)	
Output side power factor Pf2	Calculate in similar manner to power supply side power factor. $Pf_2 = \frac{P_2}{\sqrt{3}V_2 \times I_2} \times 100$ %			
Converter output	Across P/+ and N/-	Moving-coil type (such as tester)	Inverter LED display is lit. 1.35 × V1	
Frequency setting signal	Across 2(+) and 5 Across 4(+) and 5	Moving-coil type (tester and such may be used) (internal resistance 50kΩ or more)	0 to 10VDC, 4 to 20mADC	"5" is common
Frequency setting power supply	Across 10(+) and 5		5.2VDC	
Frequency meter signal	Across FM(+) and SD		Approximately 5VDC at maximum frequency (without frequency meter)  Pulse width T1 : Adjust with *C0 (Pr. 900)* Pulse cycle T2 : Set with *Pr. 55* (frequency monitor only)	"SD" is common.
Start signal Select signal	Across SD and STF, STR, RH, RM, or AU(+)		When open 20 to 30VDC ON voltage: 1V or less	
Fault signal	Across A and C Across B and C	Moving-coil type (such as tester)	Continuity check ∗3 <Normal> <Fault> Across A and C: Discontinuity, Continuity Across B and C: Continuity, Discontinuity	

∗1 Use an FFT to measure the output voltage accurately. An FA tester or general measuring instrument cannot measure accurately.
∗2 When the carrier frequency exceeds 5kHz, do not use this instrument since using it may increase eddy-current losses produced in metal parts inside the instrument, leading to burnout. In this case, use an approximate-effective value type.
∗3 When the setting of *Pr. 192 A,B,C terminal function selection* is positive logic
∗4 A digital power meter (designed for inverter) can also be used to measure.

6.2.1 Measurement of powers

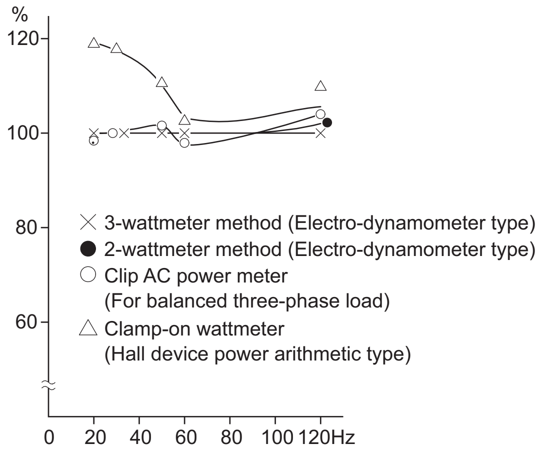
Use digital power meters (for inverter) for the both of inverter input and output side. Alternatively, measure using electrodynamic type single-phase wattmeters for the both of inverter input and output side in two-wattmeter or three-wattmeter method. As the current is liable to be imbalanced especially in the input side, it is recommended to use the three-wattmeter method.
Examples of measured value differences produced by different measuring meters are shown below.
An error will be produced by difference between measuring instruments, e.g. power calculation type and two- or three-wattmeter type three-phase wattmeter. When a CT is used in the current measuring side or when the meter contains a PT on the voltage measurement side, an error will also be produced due to the frequency characteristics of the CT and PT.

[Measurement conditions]
Constant-torque (100%) load, note that 60Hz or more should be constantly output 3.7kW, 4-pole motor, value indicated in 3-wattmeter method is 100%.



Example of Measuring Inverter Input Power

[Measurement conditions]
Constant-torque (100%) load, note that 60Hz or more should be constantly output 3.7kW, 4-pole motor, value indicated in 3-wattmeter method is 100%.



Example of Measuring Inverter Output Power

6.2.2 Measurement of voltages and use of PT

(1) Inverter input side

As the input side voltage has a sine wave and it is extremely small in distortion, accurate measurement can be made with an ordinary AC meter.

(2) Inverter output side

Since the output side voltage has a PWM-controlled rectangular wave, always use a rectifier type voltmeter. A needle type tester cannot be used to measure the output side voltage as it indicates a value much greater than the actual value. A moving-iron type meter indicates an effective value which includes harmonics and therefore the value is larger than that of the fundamental wave. The value monitored on the operation panel is the inverter-controlled voltage itself. Hence, that value is accurate and it is recommended to monitor values using the operation panel.

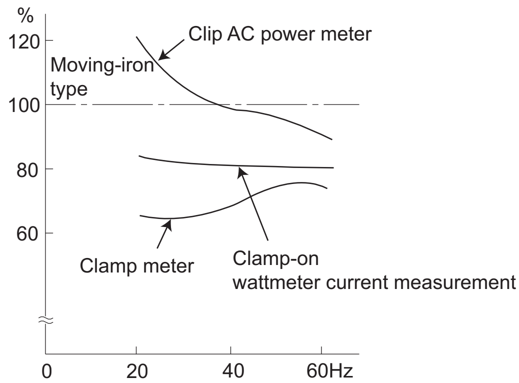
(3) PT

No PT can be used in the output side of the inverter. Use a direct-reading meter. (A PT can be used in the input side of the inverter.)

6.2.3 Measurement of currents

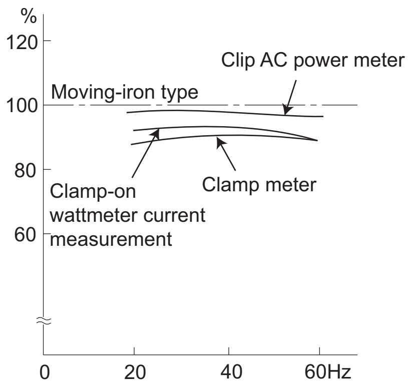
Use moving-iron type meters on both the input and output sides of the inverter. However, If the carrier frequency exceeds 5kHz, do not use that meter since an overcurrent losses produced in the internal metal parts of the meter will increase and the meter may burn out. In this case, use an approximate-effective value type.
Since current on the inverter input side tends to be unbalanced, measurement of three phases is recommended. Correct value cannot be obtained by measuring only one or two phases. On the other hand, the unbalanced ratio of each phase of the output side current should be within 10%.
When a clamp ammeter is used, always use an effective value detection type. A mean value detection type produces a large error and may indicate an extremely smaller value than the actual value. The value monitored on the operation panel is accurate if the output frequency varies, and it is recommended to monitor values (provide analog output) using the operation panel.
Examples of measured value differences produced by different measuring meters are shown below.

[Measurement conditions]
Value indicated by moving-iron type ammeter is 100%.



Example of measuring inverter input current

[Measurement conditions]
Value indicated by moving-iron type ammeter is 100%.



Example of measuring inverter output current

6.2.4 Use of CT and transducer

A CT may be used in both the input and output sides of the inverter, but the one used should have the largest possible VA ability because an error will increase if the frequency gets lower.
When using a transducer, use the effective value calculation type which is immune to harmonics.

6.2.5 Measurement of inverter input power factor

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

$$\text{Total power factor of the inverter} = \frac{\text{Effective power}}{\text{Apparent power}} = \frac{\text{3-phase input power found by 3-wattmeter method}}{\sqrt{3} \times \text{V (power supply voltage)} \times \text{I (input current effective value)}}$$

6.2.6 Measurement of converter output voltage (across terminals P and N)

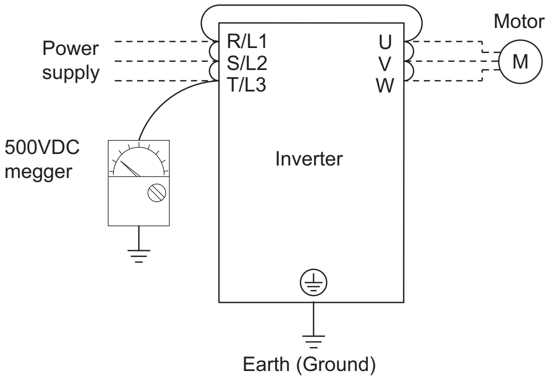
The output voltage of the converter is developed across terminals P and N and can be measured with a moving-coil type meter (tester). Although the voltage varies according to the power supply voltage, approximately 270VDC to 300VDC (540VDC to 600VDC for the 400V class) is output when no load is connected and voltage decreases during driving load operation.
When energy is regenerated from the motor during deceleration, for example, the converter output voltage rises to nearly 400VDC to 450VDC (800VDC to 900VDC for the 400V class) maximum.

6.2.7 Measurement of inverter output frequency

A pulse train proportional to the output frequency is output across the frequency meter signal output terminal FM-SD of the inverter. This pulse train output can be counted by a frequency counter, or a meter (moving-coil type voltmeter) can be used to read the mean value of the pulse train output voltage. When a meter is used to measure the output frequency, approximately 5VDC is indicated at the maximum frequency.
For detailed specifications of the frequency meter signal output terminal FM, refer to *page 158*.

6.2.8 Insulation resistance test using megger

- For the inverter, conduct the insulation resistance test on the main circuit only as shown below and do not perform the test on the control circuit. (Use a 500VDC megger.)



NOTE

- **Before performing the insulation resistance test on the external circuit, disconnect the cables from all terminals of the inverter and Filterpack so that the test voltage is not applied to the inverter.**
- **For the continuity test of the control circuit, use a tester (high resistance range) and do not use the megger or buzzer.**

6.2.9 Pressure test

Do not conduct a pressure test. Deterioration may occur.

7 SPECIFICATIONS

This chapter provides the "SPECIFICATIONS" of this product. Always read the instructions before using the equipment.

7.1 Rating 330
7.2 Common specifications 331
7.3 Outline dimension drawings 333
7.4 Specification of the premium high-efficiency IPM motor [MM-EFS (1500r/min) series] 339
7.5 Specification of dedicated IPM motor [MM-EF(1800r/min) series] 340

7.1 Rating

●Three-phase 200V power supply

Inverter											
Model FR-F720PJ-□K			**0.4**	**0.75**	**1.5**	**2.2**	**3.7**	**5.5**	**7.5**	**11**	**15**
Applicable general-purpose motor capacity (kW)*1			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Output	**Rated capacity (kVA)*2**		1.0	1.6	2.7	3.8	6.3	9.1	12.1	17.1	22.1
	Rated current (A)		2.5	4.2	7.0	10.0	16.5	23.8	31.8	45	58
	Overload current rating*3		120% 60s, 150% 0.5s (inverse-time characteristics)								
	Rated voltage*4		Three-phase 200 to 240V								
Power supply	**Rated input AC voltage/frequency**		Three-phase 200 to 240V 50Hz/60Hz								
	Permissible AC voltage fluctuation		170 to 264V 50Hz/60Hz								
	Permissible frequency fluctuation		±5%								
	Power supply capacity (kVA)*5	**Without Filterpack**	1.2	2.1	4.0	5.0	8.8	12.0	17.0	20.0	27.0
		With Filterpack	0.8	1.2	2.6	3.4	5.5	8.4	11.0	16.0	19.0
Protective structure (JEM 1030)			Enclosed type (IP20)*6								
Cooling system			Self-cooling		Forced air cooling						
Approximate mass(kg)			0.8	1.0	1.4	1.4	1.8	3.6	3.6	6.5	6.5

Filterpack										
Model FR-BFP2-□K		**0.4**	**0.75**	**1.5**	**2.2**	**3.7**	**5.5**	**7.5**	**11**	**15**
Approximate mass(kg)		1.3	1.4	2.0	2.2	2.8	3.8	4.5	6.7	7.0
Power factor improving reactor		Install the DC reactor in the DC side. 93% to 95% of power supply power factor under 100% load (94.4% *7)								
EMC filter	**Common mode choke**	Install a ferrite core on the input side								
	Capacitive filter	About 4mA of capacitor leakage current*8								
Protective structure (JEM 1030)		Open type (IP00)								

●Three-phase 400V power supply

Inverter											
Model FR-F740PJ-□K			**0.4**	**0.75**	**1.5**	**2.2**	**3.7**	**5.5**	**7.5**	**11**	**15**
Applicable general-purpose motor capacity (kW)*1			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Output	**Rated capacity (kVA)*2**		0.9	1.7	2.8	3.8	6.2	9.1	12.4	17.5	22.5
	Rated current (A)		1.2	2.2	3.7	5.0	8.1	12.0	16.3	23.0	29.5
	Overload current rating*3		120%60s, 150% 0.5s (inverse-time characteristics)								
	Rated voltage*4		Three-phase 380 to 480V								
Power supply	**Rated input AC voltage/frequency**		Three-phase 380 to 480V 50Hz/60Hz								
	Permissible AC voltage fluctuation		325 to 528V 50Hz/60Hz								
	Permissible frequency fluctuation		±5%								
	Power supply capacity (kVA)*5	**Without Filterpack**	1.1	2.2	4.2	4.8	8.6	12.0	17.0	20.0	28.0
		With Filterpack	0.7	1.3	2.7	3.3	5.4	8.5	11.0	16.0	19.0
Protective structure (JEM 1030)			Enclosed type (IP20) *6								
Cooling system			Self-cooling		Forced air cooling						
Approximate mass (kg)			1.3	1.3	1.4	1.5	1.5	3.3	3.3	6.0	6.0

Filterpack										
Model FR-BFP2-H□K		**0.4**	**0.75**	**1.5**	**2.2**	**3.7**	**5.5**	**7.5**	**11**	**15**
Approximate mass (kg)		1.6	1.7	1.9	2.3	2.6	4.5	5.0	7.0	8.2
Power factor improving reactor		Install the DC reactor in the DC side. 93% to 95% of power supply power factor under 100% load (94.4% *7)								
EMC filter	**Common mode choke**	Install a ferrite core on the input side								
	Capacitive filter	About 8mA of capacitor leakage current *8								
Protective structure (JEM 1030)		Open type (IP00)								

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor. To use a dedicated IPM motor, refer to page 339, 340.
*2 The rated output capacity assumes the following output voltages: 220V for the three-phase 200V and 440V for the three-phase 400V class.
*3 The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
*4 The maximum output voltage does not exceed the power supply voltage.The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
*5 The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).
*6 Open type (IP00) for Filterpack.
*7 The values in parentheses are calculated with 1 fundamental frequency power factor according to the Year 2010 Standard specification for public constructions (electric installation works), published by the Ministry of Land, Infrastructure, Transport and Tourism in Japan.
*8 The indicated leakage current is equivalent to one-phase of the three-phase three wire 人 connection cable.

7.2 Common specifications

Control specifications	Control method		High carrier frequency PWM control (V/F control)/Optimum excitation control/General-purpose magnetic flux vector control/IPM motor control
	Output frequency range		0.2 to 400Hz
	Frequency setting resolution	Analog input	0.06Hz/60Hz (terminals 2 and 4: 0 to 10V/10-bit) 0.12Hz/60Hz (terminals 2 and 4: 0 to 5V/9-bit) 0.06Hz/60Hz (terminal 4: 0 to 20mA/10-bit)
		Digital input	0.01Hz
	Frequency accuracy	Analog input	Within ±1% of the max. output frequency (25°C ± 10°C)
		Digital input	Within 0.01% of the set output frequency
	Speed control range		V/F control 1:10, General-purpose magnetic flux vector control (during power driving) 1:60, IPM motor control 1:10
	Voltage/frequency characteristics		Base frequency can be set from 0 to 400Hz. Constant-torque/variable-torque pattern can be selected.
	Starting torque		General-purpose motor control (General-purpose magnetic flux vector control or slip compensation): 120% (at 1Hz) IPM motor control: 50%
	Torque boost		Manual torque boost
	Acceleration/deceleration time setting		0.1 to 3600s (acceleration and deceleration can be set individually), linear and S-pattern acceleration/deceleration modes are available.
	Regenerative braking torque		General-purpose motor control: 15% *1 IPM motor control: 5% (10% for 1.5kW or less)*1
	DC injection brake		General-purpose motor control: Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) can be changed.
	Stall prevention operation level		Operation current level can be set (0 to 150% variable). Whether to use the function or not can be set.
Operation specifications	Frequency setting signal	Analog input	Two terminals Terminal 2: 0 to 10V and 0 to 5V are available Terminal 4: 0 to 10V, 0 to 5V, and 4 to 20mA are available
		Digital input	The signal is entered from the operation panel or parameter unit. Frequency setting increment can be set.
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
	Input signal (five terminals)		The following signals can be assigned to *Pr. 178 to Pr.182 (input terminal function selection)*: multi-speed selection, remote setting, second function selection, terminal 4 input selection, JOG operation selection, PID control valid terminal, external thermal input, PU-External operation switchover, V/F switchover, output stop, start self-holding selection, forward rotation, reverse rotation command, inverter reset, PID forward/reverse action switchover, PU-NET operation switchover, External-NET operation switchover, command source switchover, inverter operation enable signal, PU operation external interlock, PID integral value reset.
	Operational functions		Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, automatic restart after instantaneous power failure operation, forward/reverse rotation prevention, remote setting, second function, multi-speed operation, regeneration avoidance, slip compensation, operation mode selection, offline auto tuning function, PID control, computer link operation (RS-485), Optimum excitation control, power failure stop, speed smoothing control, Modbus-RTU
	Output signal Open collector output (one terminal) Relay output (one terminal)	Operating status	The following signals can be assigned to *Pr.190 and Pr.192 (output terminal function selection)*: inverter operation, up-to-frequency, overload alarm, output frequency detection, regenerative brake prealarm, electronic thermal relay function prealarm, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward/reverse rotation output, fan alarm.*2, heatsink overheat pre-alarm, deceleration at an instantaneous power failure, PID control activated, PID deviation limit, IPM motor control *3, PID output interruption, pulse train output of output power, during retry, life alarm, average current value monitor, remote output, alarm output, fault output, fault output 3, and maintenance timer alarm.
		For meter Pulse train output (MAX 2.4kHz: one terminal)	The following signals can be assigned to *Pr. 54 FM terminal function selection*: output frequency, output current (steady), output voltage, frequency setting, converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, reference voltage output, motor load factor, PID set point, energy saving effect, cumulative energy saving, PID measured value, output power, PID deviation, motor thermal load factor, and inverter thermal load factor. Pulse train output (1440 pulses/s/full scale)
Indication	Operation panel Parameter unit (FR-PU07)	Operating status	The following operating status can be displayed: output frequency, output current (steady), output voltage, frequency setting, cumulative energization time, actual operation time, converter output voltage, regenerative brake duty, electronic thermal relay function load factor, output current peak value, converter output voltage peak value, motor load factor, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, output power, cumulative power, motor thermal load factor, inverter thermal load factor, and PTC thermistor resistance.
		Fault record	Fault record is displayed when a fault occurs. Past 8 fault definitions (output voltage/current/frequency/cumulative energization time right before the fault occurs) are stored.
		Interactive guidance	Function (help) for operation guide *4

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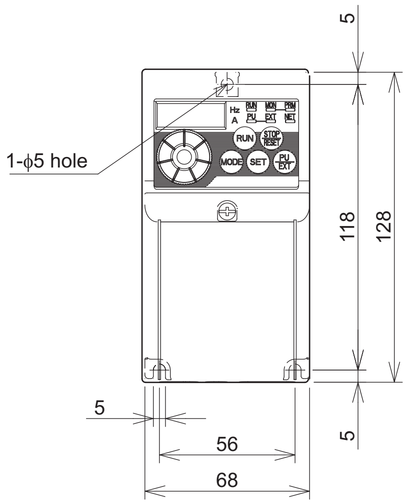
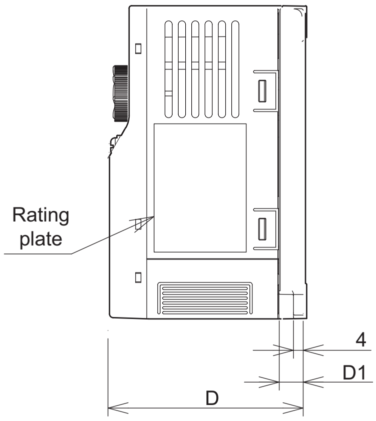
Protective/warning function		Protective function	Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, undervoltage *3, input phase loss *5, output side earth (ground) fault overcurrent at start *5, output phase loss, external thermal relay operation *5, PTC thermistor operation *5, parameter error, PU disconnection, retry count excess *5, CPU fault, brake transistor alarm, inrush resistance overheat, analog input error, overspeed occurrence *3 ,PID signal fault *5, stall prevention operation, output current detection value exceeded *5, loss of synchronism detection *3
		Warning function	Fan alarm *2, overcurrent stall prevention, overvoltage stall prevention, PU stop, parameter write error, regenerative brake prealarm *5, electronic thermal relay function prealarm, maintenance output *5, undervoltage, operation panel lock, password locked, inverter reset
Environment	Surrounding air temperature		-10°C to +50°C (non-freezing) *6
	Ambient humidity		90% RH or less (non-condensing)
	Storage temperature *7		-20°C to +65°C
	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt, etc.)
	Altitude/vibration		Maximum 1000m above sea level, 5.9m/s^2 or less *8 at 10 to 55Hz (directions of X, Y, Z axes)

*1 The regenerative braking torque indicates the average short-time torque (which varies by the motor loss) that is generated when a motor decelerates in the shortest time by itself from the rated speed. It is not the continuous regenerative torque. When a motor decelerates from a speed higher than the rated speed, the average deceleration torque decreases. When the regenerative power is large, use an option brake unit.
*2 As the 0.75K or lower are not provided with the cooling fan, this alarm does not function.
*3 This function is available only when an IPM motor is connected.
*4 This operation guide is only available with option parameter unit (FR-PU07).
*5 This protective function is not available in the initial status.
*6 When using the inverters at the surrounding air temperature of 40°C or less, the inverters can be installed closely attached (0cm clearance). Side-by-side installation is not available for Filterpacks.
*7 Temperatures applicable for a short time, e.g. in transit.
*8 When installing Filterpack of 11K or 15K on the rear side of an inverter, do not install to a moving object or place where vibrates (exceeding 1.96m/s^2)

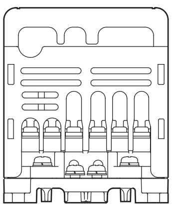
7.3 Outline dimension drawings

●FR-F720PJ-0.4K, 0.75K



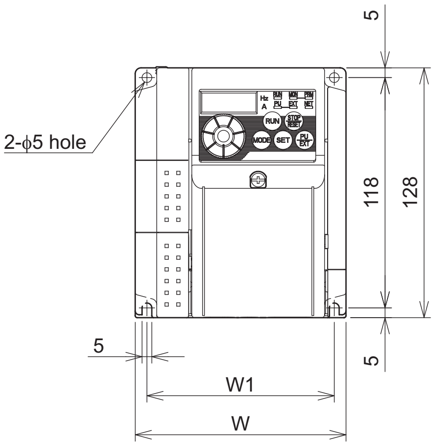


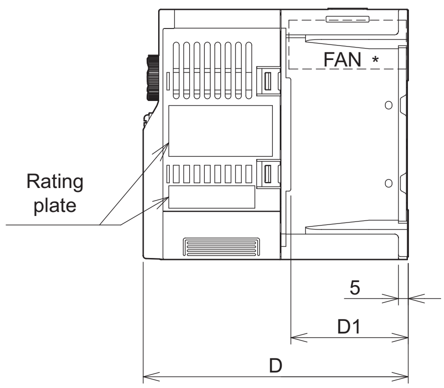
Inverter Model	D	D1
FR-F720PJ-0.4K	112.5	42
FR-F720PJ-0.75K	132.5	62



(Unit: mm)

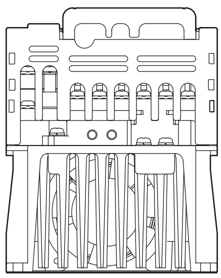
●FR-F720PJ-1.5K to 3.7K
●FR-F740PJ-0.4K to 3.7K





* FR-F740PJ-0.4K and 0.75K are not provided with the cooling fan.

<table>
<tr><th>Inverter Model</th><th>W</th><th>W1</th><th>D</th><th>D1</th></tr>
<tr><td>FR-F740PJ-0.4K, 0.75K</td><td rowspan="4">108</td><td rowspan="4">96</td><td>129.5</td><td>54</td></tr>
<tr><td>FR-F720PJ-1.5K, 2.2K
FR-F740PJ-1.5K</td><td>135.5</td><td>60</td></tr>
<tr><td>FR-F740PJ-2.2K</td><td>155.5</td><td rowspan="2">60</td></tr>
<tr><td>FR-F740PJ-3.7K</td><td>165.5</td></tr>
<tr><td>FR-F720PJ-3.7K</td><td>170</td><td>158</td><td>142.5</td><td>66.5</td></tr>
</table>



(Unit: mm)

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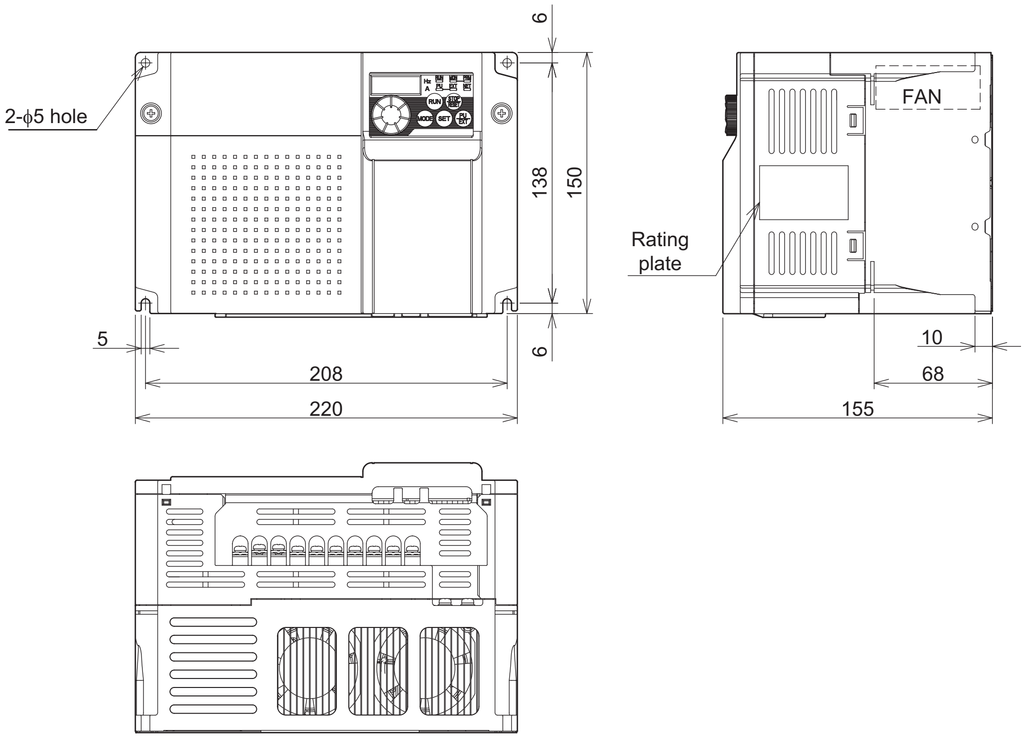
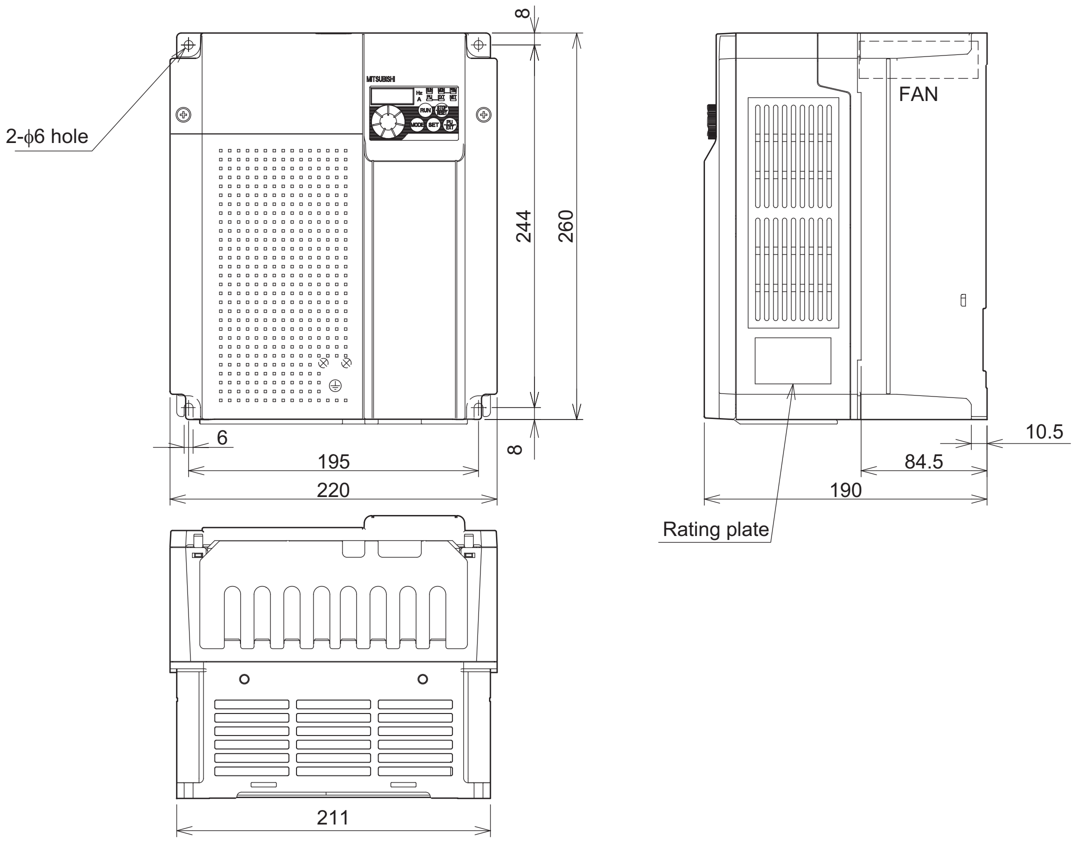
- FR-F720PJ-5.5K, 7.5K
- FR-F740PJ-5.5K, 7.5K



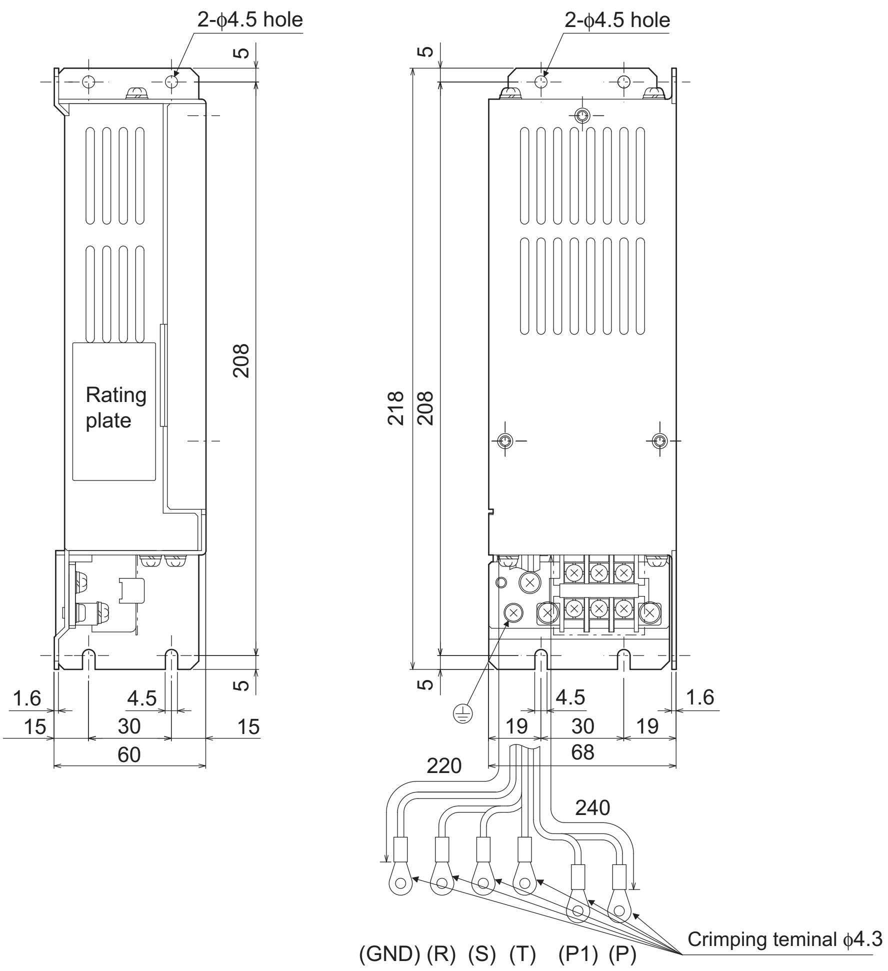
(Unit: mm)

- FR-F720PJ-11K, 15K
- FR-F740PJ-11K, 15K



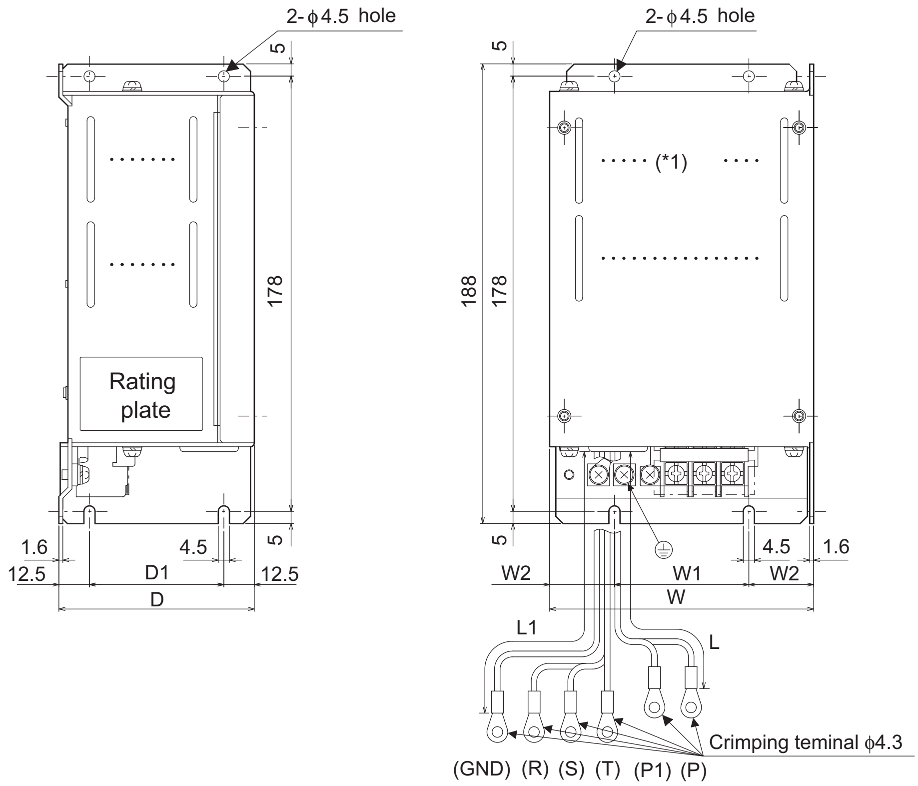
(Unit: mm)

●FR-BFP2-0.4K, 0.75K



(Unit: mm)

●FR-BFP2-1.5K, 2.2K, 3.7K
●FR-BFP2-H0.4K, H0.75K, H1.5K, H2.2K, H3.7K



●200V class

Capacity	W	W1	W2	D	D1	L	L1
1.5K, 2.2K	108	55	26.5	80	55	200	220
3.7K	170	120	25	65	40	220	240

(Unit : mm)

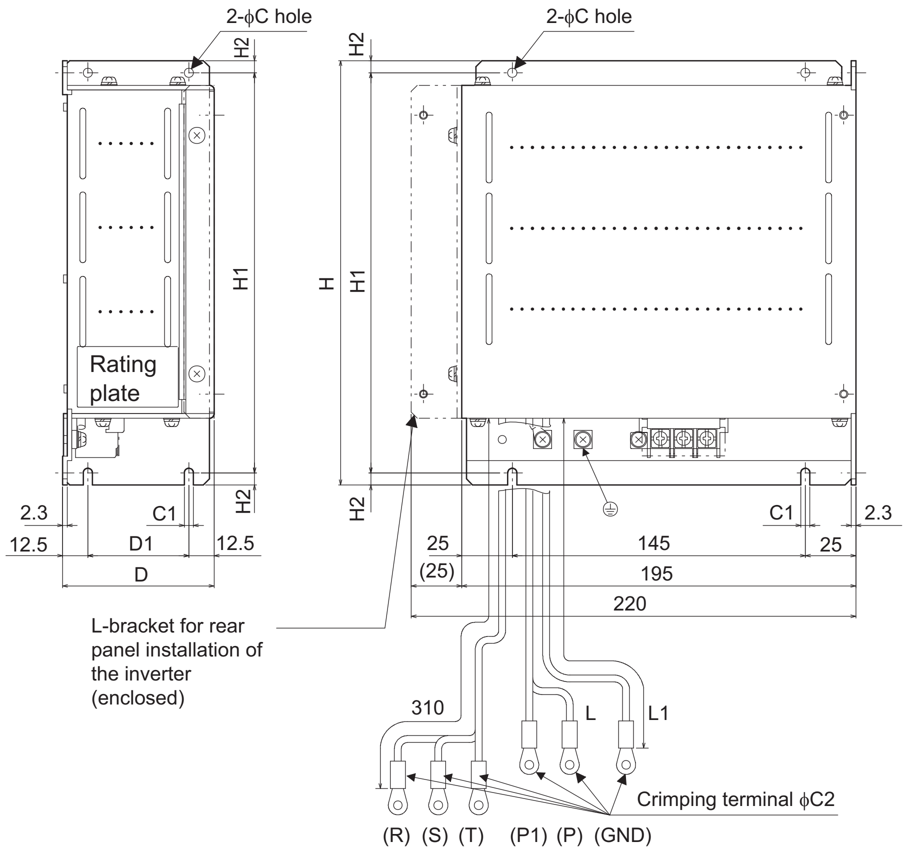
●400V class

Capacity	W	W1	W2	D	D1	L	L1
H0.4K, H0.75K *	108	55	26.5	55	30	200	220
H1.5K, H2.2K, H3.7K				80	55		

(Unit : mm)

* The 400V class H0.4K and H0.75K have no slit.

●FR-BFP2-5.5K, 7.5K, 11K, 15K
●FR-BFP2-H5.5K, H7.5K, H11K, H15K



●200V class

Capacity	H	H1	H2	D	D1	C	C1	C2	L	L1
5.5K, 7.5K	210	198	6	75	50	4.5	4.5	5.3	270	400
11K	320	305	7.5	85	60	6	6		280	280
15K								6.4	260	260

(Unit : mm)

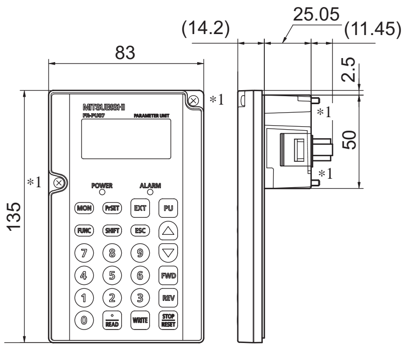
●400V class

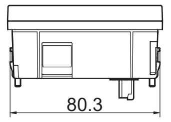
Capacity	H	H1	H2	D	D1	C	C1	C2	L	L1
H5.5K, H7.5K	210	198	6	75	50	4.5	4.5	4.3	270	400
H11K	320	305	7.5	85	60	6	6		280	280
H15K								6.4	260	260

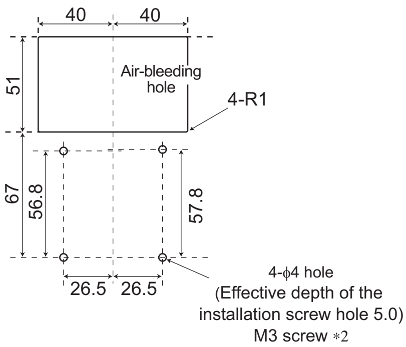
(Unit : mm)

●Parameter unit (option) (FR-PU07)

<Outline drawing> <Panel cut dimension drawing>







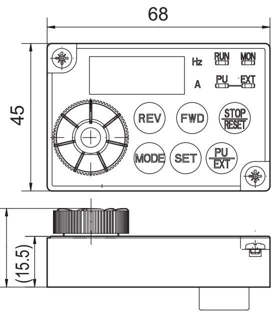
*1 When installing the FR-PU07 on the enclosure, etc., remove screws or fix the screws to the FR-PU07 with M3 nuts.

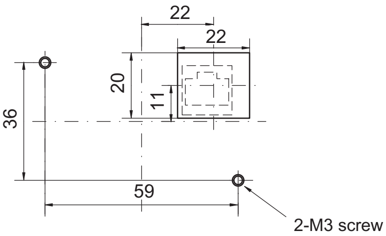
*2 Select the installation screw whose length will not exceed the effective depth of the installation screw hole.

(Unit: mm)

●Enclosure surface operation panel (option) (FR-PA07)

<Outline drawing> <Panel cut dimension drawing>





(Unit: mm)

7.4 Specification of the premium high-efficiency IPM motor [MM-EFS (1500r/min) series]

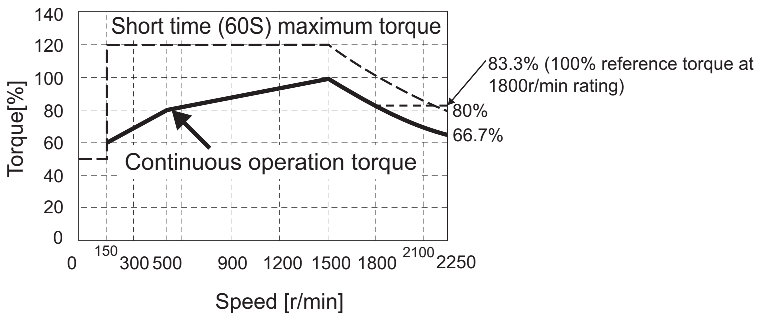
7.4.1 Motor specification

Motor model	200V class MM-EFS□1M / 400V class MM-EFS□1M4	7	15	22	37	55	75	11K	15K
Compatible inverter	200V class FR-F720PJ-□K / 400V class FR-F740PJ-□K	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Continuous characteristic *1	Rated output (kW)	0.75	1.5	2.2	3.7	5.5	7.5	11	15
	Rated torque (N•m)	4.77	9.55	14	23.6	35	47.7	70	95.5
Rated speed (r/min)		1500							
Maximum speed (r/min)		2250							
Number of poles		6							
Maximum torque		120% 60s							
Frame number		80M	90L	100L	112M	132S	132M	160M	160L
Moment of inertia J ($\times 10^{-4}$kg•m^2)		20	40	55	110	275	280	760	770
Rated current (A)	200V class	3	6.0	8.2	13.4	20	27	40	54
	400V class	1.5	3.0	4.1	6.7	10	13.5	20	27
Structure		Totally-enclosed fan-cooled motor. With steel framed legs. (protective structure IP44 *2)							
Insulation class		F class							
Vibration class		V-15							
Environment	Surrounding air temperature and humidity	-10°C to +40°C (non-freezing) 90%RH or less (non-condensing)							
	Storage temperature and humidity	-20°C to +70°C (non-freezing) 90%RH or less (non-condensing)							
	Atmosphere	Indoors (not under direct sunlight), and free from corrosive gas, flammable gas, oil mist, dust and dirt.							
	Altitude	Maximum 1,000m above sea level							
	Vibration	4.9m/s^2							
Mass(kg)		11	15	22	31	50	53	95	100

*1 The above characteristics apply when the rated AC voltage is input from the inverter. (Refer to page 330)
Output and rated motor speed are not guaranteed when the power supply voltage drops.
*2 This excludes the part where the axis passes through.

Motor torque characteristic

The following figure shows the torque characteristic of the premium high-efficiency IPM motor [MM-EFS (1500r/min)series] when used with an inverter.



REMARKS

The motor can also be used for applications where the rated speed is 1800r/min.

NOTE

- **The torque characteristic is when the armature winding temperature is 20°C, and the input voltage to the inverter is 200VAC or 400VAC.**
- **Constant-speed operation cannot be performed for the speed less than 150r/min.**

7.5 Specification of dedicated IPM motor [MM-EF(1800r/min) series]

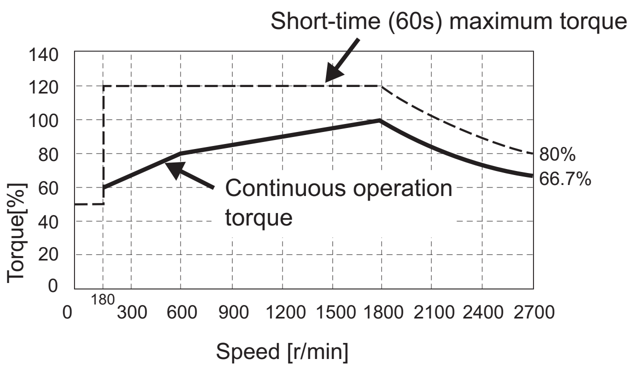
7.5.1 Motor specification

Motor model	200V class MM-EF□2 / 400V class MM-EF□24	4	7	15	22	37	55	75	11K	15K
Compatible inverter	200V class FR-F720PJ-□K / 400V class FR-F740PJ-□K	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Continuous characteristic*1	Rated output (kW)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
	Rated torque (N · m)	2.12	3.98	7.96	11.7	19.6	29.2	39.8	58.4	79.6
Rated speed (r/min)		1800 (90Hz)								
Maximum speed (r/min)		2700 (135Hz)								
Number of poles		6								
Maximum torque		120% 60s								
Moment of inertia ($\times 10^{-4}$kg·m^2)		10.4	10.4	18.4	36.9	51.2	125	153	274	354
Rated current (A)	200V class	1.6	3.0	5.9	8.7	14.4	22	29	43	55
	400V class	0.8	1.5	3.0	4.4	7.2	11	14.5	21.5	27.5
Structure		Totally-enclosed fan-cooled motor (protective structure IP44*2)								
Insulation class		B class								
Environment	Surrounding air temperature and humidity	-10°C to +40°C (non-freezing)/90%RH or less (non-condensing)								
	Storage temperature and humidity	-20°C to +70°C (non-freezing)/90%RH or less (non-condensing)								
	Atmosphere	Indoors (avoid direct sun light) and free from corrosive gas, flammable gas, oil mist, dust and dirt								
	Altitude	Maximum 1,000m above sea level								
	Vibration	4.9m/s^2 (0.5G)								
Mass (kg)		8.5	9.0	11	15	23	33	38	52	60

*1 The above characteristics apply when the rated AC voltage is input from the inverter. *(Refer to page 330)*
Output and rated motor speed are not guaranteed when the power supply voltage drops.
*2 This excludes the part where the axis passes through.

Motor torque characteristic

The following figure shows the torque characteristic of a dedicated IPM motor [MM-EF (1800r/min) series] when used with an inverter.



NOTE

- **The torque characteristic is when the armature winding temperature is 20°C, and the input voltage to the inverter is 200VAC or 400VAC.**
- **Constant-speed operation cannot be performed for the speed of 180r/min or less.**

APPENDIX

This chapter provides the "APPENDIX" of this product.
Always read the instructions before using the equipment.

APPENDIX

Appendix 1 For customers replacing the conventional model with this inverter

Appendix 1-1 Replacement of the FR-F500J series

(1) Instructions for installation

Removal procedure of the front cover and wiring cover was changed. (*Refer to page 6*)

(2) Instructions for continuous use of the FR-PU04 (parameter unit)

1) For the FR-F700PJ series, many functions (parameters) have been added. When setting these parameters, the parameter name and setting range are not displayed. User initial value list and user clear of the HELP function can not be used.
2) For the FR-F700PJ series, many protective functions have been added. These functions activate, but all faults are displayed as "Fault 14". When the faults history has been checked, "E.14" appears. Added faults display will not appear on the parameter unit.
3) User initial value setting can not be used.
4) User registration/clear can not be used.
5) Parameter copy/verification function can not be used.

(3) Main differences and compatibilities with the FR-F500J series

Item	FR-F500J	FR-F700PJ
Control method	V/F control Automatic torque boost	V/F control General-purpose magnetic flux vector control Optimum excitation control IPM motor control
Output frequency range	0.5 to 120Hz	0.2 to 400Hz
Changed initial value	*Pr. 0 Torque boost* FR-F520J-1.5K to 3.7K: 6% FR-F540J-1.5K, 2.2K: 5%	FR-F720PJ-1.5K to 3.7K: 4% FR-F740PJ-1.5K, 2.2K: 4%
	Pr. 1 Maximum frequency 60Hz	120Hz
	Pr. 88 PID action selection 20 (PID reverse action) Turn the X14 signal ON to enable PID control.	*Pr. 128 PID action selection* 0 (PID control disabled) Set *Pr. 128* $\neq$ "0" to enable PID control. (An X14 signal input is not required when X14 is unassigned.)
Changed setting increments	*Pr. 37 Speed display* 0.1	0.001
	H1(Pr. 503) Maintenance timer *H2(Pr. 504) Maintenance timer alarm output set time* Time per increments: 1000h *H2(Pr. 504)* Initial value: 87 (87000h) (Example) To set 87000h, set *H2 (Pr. 504)* = "87."	*Pr. 503 Maintenance timer* *Pr. 504 Maintenance timer alarm output set time* Time per increments: 100h Initial value: 9999 (no function) (Example) To set 87000h, set *Pr. 504* = "870."
Changed setting value	*Pr. 52 Control panel display data selection* 1: Output current	*Pr. 52 DU/PU main display data selection* 0/100: Output current (select with SET)
	Pr.54 FM terminal function selection 0: Output frequency (initial value), 1: Output current	1: Output frequency (initial value), 2: Output current
	Pr. 60 to Pr. 63 Input terminal function selection 5: STOP signal (start self-holding selection) 6: MRS signal (output stop) 9: JOG signal (Jog operation selection) 10: RES signal (reset) ---: STR signal (reverse rotation command)	*Pr. 178 to Pr. 182 Input terminal function selection* 5: JOG signal (Jog operation selection) 6: None 24: MRS signal (output stop) 25: STOP signal (start self-holding selection) 61: STR signal (reverse rotation command) 62: RES signal (reset)
	Pr. 73 Terminal 2 0 to 5V, 0 to 10V selection 0: 0 to 5V (initial value), 1: 0 to 10V	*Pr. 73 Analog input selection* 0: 0 to 10V, 1: 0 to 5V (initial value)
Deleted functions	*Pr. 98 Automatic torque boost selection* *Pr. 99 Motor primary resistance*	Replacement function (General-purpose magnetic flux vector control) *(Pr. 80 Motor capacity)* *(Pr. 90 Motor constant)*
	Long wiring mode (setting value 10, 11 of *Pr. 70*)	Setting unnecessary (setting values 10 and 11 of *Pr. 240* are deleted)

Item	FR-F500J		FR-F700PJ	
	Parameter Number	Name	Parameter Number	Name
Changed parameter number and name	Pr. 17	RUN key rotation direction selection	Pr. 40	RUN key rotation direction selection
	Pr. 21	Stall prevention function selection	Pr. 156	Stall prevention operation selection
	Pr. 28	Stall prevention operation reduction starting frequency	Pr. 66	Stall prevention operation reduction starting frequency
	Pr. 30	Extended function display selection	Pr. 160	Extended function display selection
	Pr. 38	Frequency setting voltage gain frequency	Pr. 125	Terminal 2 frequency setting gain frequency
	Pr. 39	Frequency setting current gain frequency	Pr. 126	Terminal 4 frequency setting gain frequency
	Pr. 40	Start-time ground fault detection selection	Pr. 249	Earth (ground) fault detection at start
	Pr. 48	Output current detection level	Pr. 150	Output current detection level
	Pr. 49	Output current detection signal delay time	Pr. 151	Output current detection signal delay time
	Pr. 50	Zero current detection level	Pr. 152	Zero current detection level
	Pr. 51	Zero current detection time	Pr. 153	Zero current detection time
	Pr. 53	Frequency setting operation selection	Pr. 161	Frequency setting/key lock operation selection
	Pr. 60	AU terminal function selection	Pr. 180	AU terminal function selection
	Pr. 61	RM terminal function selection	Pr. 181	RM terminal function selection
	Pr. 62	RH terminal function selection	Pr. 182	RH terminal function selection
	Pr. 63	STR terminal function selection	Pr. 179	STR terminal function selection
	Pr. 64	RUN terminal function selection	Pr. 190	RUN terminal function selection
	Pr. 65	A, B, C terminal function selection	Pr. 192	A,B,C terminal function selection
	Pr. 66	Retry selection	Pr. 65	Retry selection
	Pr. 70	Soft-PWM setting	Pr. 240	Soft-PWM operation selection
	Pr. 76	Cooling fan operation selection	Pr. 244	Cooling fan operation selection
	Pr. 80	Multi-speed setting (speed 8)	Pr. 232	Multi-speed setting (speed 8)
	Pr. 81	Multi-speed setting (speed 9)	Pr. 233	Multi-speed setting (speed 9)
	Pr. 82	Multi-speed setting (speed 10)	Pr. 234	Multi-speed setting (speed 10)
	Pr. 83	Multi-speed setting (speed 11)	Pr. 235	Multi-speed setting (speed 11)
	Pr. 84	Multi-speed setting (speed 12)	Pr. 236	Multi-speed setting (speed 12)
	Pr. 85	Multi-speed setting (speed 13)	Pr. 237	Multi-speed setting (speed 13)
	Pr. 86	Multi-speed setting (speed 14)	Pr. 238	Multi-speed setting (speed 14)
	Pr. 87	Multi-speed setting (speed 15)	Pr. 239	Multi-speed setting (speed 15)
	Pr. 88	PID action selection	Pr. 128	PID action selection
	Pr. 89	PID proportional band	Pr. 129	PID proportional band
	Pr. 90	PID integral time	Pr. 130	PID integral time
	Pr. 91	PID upper limit	Pr. 131	PID upper limit
	Pr. 92	PID lower limit	Pr. 132	PID lower limit
	Pr. 93	PID action set point for PU operation	Pr. 133	PID action set point
	Pr. 94	PID differential time	Pr. 134	PID differential time
	Pr. 95	Rated motor slip	Pr. 245	Rated slip
	Pr. 96	Slip compensation time constant	Pr. 246	Slip compensation time constant
	Pr. 97	Constant power range slip compensation selection	Pr. 247	Constant-power range slip compensation selection
	n1(Pr. 331)	Communication station number	Pr. 117	PU communication station number
	n2(Pr. 332)	Communication speed	Pr. 118	PU communication speed
	n3(Pr. 333)	Stop bit length	Pr. 119	PU communication stop bit length
	n4(Pr. 334)	Parity check presence/absence	Pr. 120	PU communication parity check
	n5(Pr. 335)	Number of communication retries	Pr. 121	Number of PU communication retries
	n6(Pr. 336)	Communication check time interval	Pr. 122	PU communication check time interval
	n7(Pr. 337)	Waiting time setting	Pr. 123	PU communication waiting time setting
	n11(Pr. 341)	CR/LF setting	Pr. 124	PU communication CR/LF selection
	n16(Pr. 992)	PU main display screen data selection	Pr. 52	DU/PU main display data selection
	n17(Pr. 993)	Disconnected PU detection/PU setting lock	Pr. 75	Reset selection/disconnected PU detection/PU stop selection
Screw size of main circuit terminals	FR-F540J-15: M6		FR-F740PJ-15K: M5	
Control terminal block	Screw type terminal block Fix a wire with a flathead screw (Screw size: M2(M3 for terminal A, B, C)) Length of recommended blade terminal: 6mm		Spring clamp terminal block Fix a wire with a pressure of inside spring Length of recommended blade terminal: 10mm (Blade terminal of FR-F500J is unavailable)	
PU	FR-PU04		FR-PU07 FR-PU04 (some functions, such as parameter copy, are unavailable.)	
Installation size	Installation size is compatible for all capacities.			

Appendix 2 Options and products available on the market

Name		Model	Applications, Specifications, etc.	Applicable Inverter
Stand-alone type	Parameter unit (Eight languages)	FR-PU07 FR-PU04	Interactive parameter unit with LCD display	Applicable for all models
	Enclosure surface operation panel	FR-PA07	This operation panel enables inverter operation and monitoring of frequency, etc. from the enclosure surface	Applicable for all models
	Parameter unit connection cable	FR-CB20□	Cable for connection of operation panel or parameter unit □ indicates a cable length. (1m, 3m, 5m)	Applicable for all models
	DIN rail attachment	FR-UDA01 to 03	Attachment for installation on DIN rail	For the 3.7K or lower
	AC reactor	FR-HAL	For harmonic current reduction and inverter input power factor improvement	Applicable for the certain capacities
	DC reactor	FR-HEL		Applicable for the certain capacities
	EMC Directive compliant EMC filter	SF FR-E5NF	An EMC filter that complies with the EMC Directive (EN61800-3 C3).	Applicable for the certain capacities
	EMC filter installation attachment	FR-A5AT03 FR-AAT02 FR-E5T	An attachment used to mount an EMC compliant EMC filter (SF) to an inverter.	Applicable for the certain capacities
	Radio noise filter	FR-BIF(H)	For radio noise reduction (connect to the input side)	Applicable for all models
	Line noise filter	FR-BSF01 FR-BLF	For line noise reduction	Applicable for all models.
	Brake resistor	MRS type, MYS type	For increasing the regenerative braking capability (permissible duty 3%/6%ED)	200V: applicable for the certain capacities
	High-duty brake resistor	FR-ABR	For increasing the regenerative braking capability (permissible duty 10%/ 6%ED)	Applicable for the certain capacities.
	Brake unit Resistor unit Discharging resistor	FR-BU2 FR-BR GZG, GRZG type	For increasing the braking capability of the inverter (for high-inertia load or negative load) Brake unit, electrical-discharge resistor and resistor unit are used in combination	Applicable for the certain capacities
	Power regeneration common converter Stand-alone reactor dedicated for FR-CV	FR-CV FR-CVL	Unit which can return motor-generated braking energy back to the power supply in common converter system	Applicable for the certain capacities
	High power factor converter	FR-HC2	The high power factor converter switches the converter section on/off to reshape an input current waveform into a sine wave, greatly suppressing harmonics. (Used in combination with the standard accessory.)	Applicable for the certain capacities
	Surge voltage suppression filter	FR-ASF-H	Filter for suppressing surge voltage on motor *1	400V: applicable for the certain capacities
		FR-BMF-H		400V: applicable for the 5.5K or higher

	Name	Model	Applications, Specifications, etc.	Applicable Inverter
FR Series Manual Controller/Speed controller	Manual controller	FR-AX	For independent operation. With frequency meter, frequency potentiometer and start switch.	Applicable for all models
	DC tach. follower	FR-AL	For synchronous operation (1.5VA) by external signal (0 to 5V, 0 to 10V DC) *2	
	Three speed selector	FR-AT	For three speed switching, among high, middle and low speed operation (1.5VA) *2	
	Motorized speed setter	FR-FK	For remote operation. Allows operation to be controlled from several places (5VA)*2	
	Ratio setter	FR-FH	For ratio operation. The ratios of five inverters can be set (3VA) *2	
	Speed detector	FR-FP	For tracking operation by a pilot generator (PG) signal (3VA) *2	
	Master controller	FR-FG	Master controller (5VA) for parallel operation of multiple (maximum 35) inverters.*2	
	Soft starter	FR-FC	For soft start and stop. Enables acceleration/deceleration in parallel operation (3VA) *2	
	Deviation detector	FR-FD	For continuous speed control operation. Used in combination with a deviation sensor or synchro (5VA) *2	
	Preamplifier	FR-FA	Used as an A/V converter or arithmetic amplifier (3VA) *2	
Others	Pilot generator	QVAH-10	For tracking operation. 70V/35VAC 500Hz (at 2500r/min)	
	Deviation sensor	YVGC-500W-NS	For continuous speed control operation (mechanical deviation detection) Output 90VAC/90	
	Frequency setting potentiometer	WA2W 1kΩ	For frequency setting. Wire-wound 2W 1kΩ type B characteristic	
	Frequency meter (64mm × 60mm)	YM206NRI 1mA	Dedicated frequency meter (graduated to 120Hz). Moving-coil type DC ammeter	
	Calibration resistor	RV24YN 10kΩ	For frequency meter calibration. Carbon film type B characteristic	

*1 Not available under the IPM motor control.

*2 Rated power consumption.The power supply specifications of the FR series manual controllers and speed controllers are 200VAC 50Hz, 220/220VAC 60Hz, and 115VAC 60Hz.

Commercially available products (as of Feb. 2012)

Name	Model	Manufacturer	Structure, Specifications, etc.
Communication connector	5-554720-3	Tyco Electronics Corporation	RJ-45 connector
Communication cable	SGLPEV-T (Cat5e/300m) 24AWG × 4	Mitsubishi Cable Industries, Ltd.	Cat.5e cable that is compatible with TIA/EIA standards. (10BASE-T/100BASE-T/1000BASE-T)
Flathead screwdriver	SZF 0-0,4 × 25	Phoenix Contact Co., Ltd.	A flathead screwdriver suitable to push the open/close button when wiring to the control circuit.

Blade terminal

•Phoenix Contact Co.,Ltd.

Cable Size (mm²)	Blade Terminal Model			Blade Terminal Crimping Tool
	with insulation sleeve	without insulation sleeve	for UL wire*3	
0.3	AI 0,5-10WH	—	—	CRIMPFOX 6
0.5	AI 0,5-10WH	—	AI 0,5-10WH-GB	
0.75	AI 0,75-10GY	A 0,75-10	AI 0,75-10GY-GB	
1	AI 1-10RD	A 1-10	AI 1-10RD/1000GB	
1.25, 1.5	AI 1,5-10BK	A 1,5-10	AI 1,5-10BK/1000GB*4	
0.75 (for two cables)	AI-TWIN 2×0,75-10GY	—	—	

•NICHIFU Co.,Ltd.

Cable Size (mm²)	Blade Terminal Product Number	Insulation Product Number	Blade Terminal Crimping Tool
0.3 to 0.75	BT 0.75-11	VC 0.75	NH 69

Contact the manufacturer regarding the delivery schedule, price, specifications, and other information of the products listed here.

*3 A blade terminal with a insulation sleeve compatible with MTW wire which has a thick wire insulation.

*4 Applicable for the terminal ABC.

Appendix 3 Specification change

Check the SERIAL number indicated on the inverter rating plate or package. For how to find the SERIAL number, refer to *page 3*.

Changed functions

The following functions are available for the inverters manufactured in October 2012 or later.

Item	Changed functions
MM-EFS compatibility	Compatible with the MM-EFS 0.75kW to 55kW.
Added parameters	*Pr. 154 Voltage reduction selection during stall prevention operation* (*Refer to page 96*) *Pr. 374 Overspeed detection level* (*Refer to page 173*) *Pr. 552 Frequency jump range* (*Refer to page 102*)
Added faults	E.OS is added. The setting value "208" of *Pr. 997 Fault initiation* is added.

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