MITSUBISHI ELECTRIC

700 series

PRESSURE-RESISTANT, EXPLOSION-PROOF MOTOR DRIVING INVERTER

FR-B, B3

INSTRUCTION MANUAL (Applied)

(A700 SPECIFICATIONS)

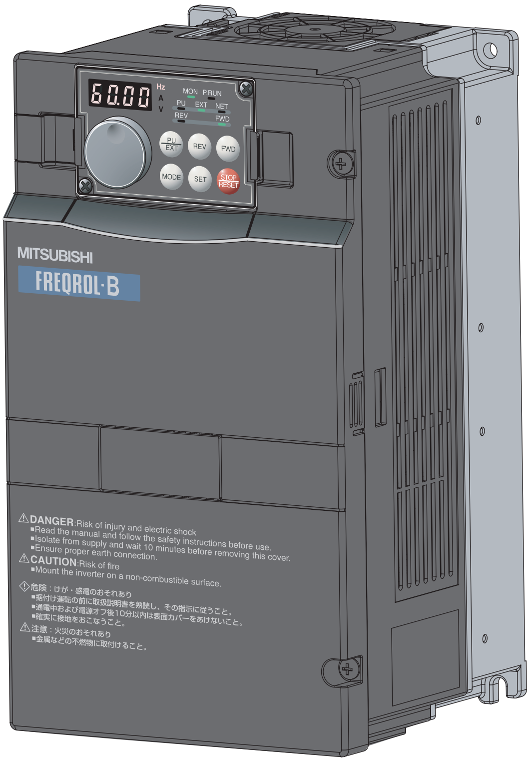
Reduced torque type

FR-B-750 to 75K (200V CLASS)
FR-B-750 to 110K (400V CLASS)

Constant torque type
(Standard or low acoustic noise)

FR-B3-(N)400 to 37K
FR-B3-(N)H400 to 37K

Be sure to perform offline auto tuning in the motor running mode and operate with the advanced magnetic flux vector control when using the FR-B3 series.



Thank you for choosing this Mitsubishi Inverter.
This Instruction Manual (applied) provides instructions for advanced use of the FR-B, B3 series inverters.
Incorrect handling might cause an unexpected fault. Before using the inverter, always read this instruction manual and the instruction manual (basic) [IB-0600271ENG] packed with the product carefully to use the equipment to its optimum.

This section is specifically about safety matters

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

⚠WARNING Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.

⚠CAUTION Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

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

1. Electric Shock Prevention

⚠WARNING

- While power is on or when the inverter is running, do not open the front cover. Otherwise you may get an electric shock.
- Do not run the inverter with the front cover or wiring cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry and get an electric shock.
- Even if power is off, do not remove the front cover except for wiring or periodic inspection.You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, check to make sure that the operation panel indicator is off, wait for at least 10 minutes after the power supply has been switched off, and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power off and it is dangerous.
- This inverter must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical codes. (JIS, NEC section 250, IEC 536 class 1 and other applicable standards)
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Perform setting dial and key operations with dry hands to prevent an electric shock. Otherwise you may get an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise you may get an electric shock.
- Do not replace the cooling fan while power is on. It is dangerous to replace the cooling fan while power is on.
- Do not touch the printed circuit board with wet hands. You may get an electric shock.

2. Fire Prevention **⚠CAUTION**

- Mount the inverter on an incombustible wall without holes, etc. Mounting it to or near combustible material can cause a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- When using a brake resistor, make up a sequence that will turn off power when an alarm signal is output. Otherwise, the brake resistor may excessively overheat due to damage of the brake transistor and such, causing a fire.
- Do not connect a resistor directly to the DC terminals P/+, N/–. This could cause a fire.

3. Injury Prevention **⚠CAUTION**

- Apply only the voltage specified in the instruction manual to each terminal. Otherwise, burst, damage, etc. may occur.
- Ensure that the cables are connected to the correct terminals. Otherwise, burst, damage, etc. may occur.
- Always make sure that polarity is correct to prevent damage, etc. Otherwise, burst, damage, etc. may occur.
- While power is on or for some time after power-off, do not touch the inverter as it is hot and you may get burnt.

4. Additional Instructions

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

(1) Transportation and installation

⚠CAUTION

- Since the inverter is non-explosion-proof, always install it in a non-hazardous place.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the instruction manual.
- Do not install or operate the inverter if it is damaged or has parts missing. This can result in breakdowns.
- When carrying the inverter, do not hold it by the front cover or setting dial; it may fall off or fail.
- Do not stand or rest heavy objects on the product.
- Check the inverter mounting orientation is correct.
- Prevent other conductive bodies such as screws and metal fragments or other flammable substance such as oil from entering the inverter.
- As the inverter is a precision instrument, do not drop or subject it to impact.
- Use the inverter under the following environmental conditions. Otherwise, the inverter may be damaged.

Environment	Ambient temperature	-10°C to +50°C (non-freezing)
	Ambient humidity	90% RH or less (non-condensing)
	Storage temperature	-20°C to +65°C *1
	Atmosphere	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude, vibration	Maximum 1000m above sea level for standard operation. 5.9m/s^2 or less *2 (conforming to JIS C 60068-2-6)

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

(2) Wiring **⚠CAUTION**

- Do not install a power factor correction capacitor or surge suppressor/radio noise filter (capacitor type filter) on the inverter output side.
- The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.

(3) Test operation and adjustment

⚠CAUTION

- For the FR-B3 series, operate with advanced magnetic flux vector control after performing offline auto tuning.
- Before starting operation, confirm and adjust the parameters. A failure to do so may cause some machines to make unexpected motions.

(4) Operation **⚠WARNING**

- Since this inverter is used in combination with the Mitsubishi inverter-driven, pressure-resistant, explosion-proof motor, note the driven motor used with the inverter.
- Note that this inverter cannot be used with the Mitsubishi increased-safety, explosion-proof motor.
- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- The STOP RESET key is valid only when the appropriate function setting *(refer to page 177)* has been made. Prepare an emergency stop circuit (power off, mechanical brake operation for an emergency stop, etc.) and switch separately.
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the inverter as well as 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 inverter.

⚠CAUTION

- The electronic thermal relay function does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/ stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power factor correction capacitor and generator.
- When parameter clear or all clear is performed, reset the required parameters before starting operations. Each parameter returns to the initial value.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.
- For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.

(5) Emergency stop **⚠CAUTION**

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.
- 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.
- When the protective function is activated, take the corresponding corrective action, then reset the inverter, and resume operation.

(6) Maintenance, inspection and parts replacement

⚠CAUTION

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

(7) Disposing of the inverter

⚠CAUTION

- Treat as industrial waste.

General instructions

Many of the diagrams and drawings in this instruction manual show the inverter without a cover, or partially open. Never run the inverter in this status. Always replace the cover and follow this instruction manual when operating the inverter.

CONTENTS

1 OUTLINE

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

<Abbreviations>

DU ....Operation panel (FR-DU07)
PU...Operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07)
Inverter ....Mitsubishi, pressure-resistant, explosion-proof motor driving inverter
FR-B,B3.................................Mitsubishi, pressure-resistant, explosion-proof motor driving inverter
Pr. ....Parameter Number
PU operation..........................Operation using the PU (FR-DU07/FR-PU04/FR-PU07).
External operation ....Operation using the control circuit signals
Combined operation ....Combined operation using the PU (FR-DU07/FR-PU04/FR-PU07) and external operation.
Explosion-proof motor ....XF-(N)E, XF-TH, XF-(N)ECA1,2

<Trademarks>

- LonWorks® is a registered trademark of Echelon Corporation in the U.S.A and other countries.
- DeviceNetTM is a registered trademark of ODVA (Open DeviceNet Vender Association, Inc.).
- Other company and product names herein are the trademarks and registered trademarks of their respective owners.

Harmonic suppression guideline
All models of general-purpose inverters used by specific consumers are convered by "Harmonic suppression guideline for consumer who receive high voltage or special high voltage" *(For further details, refer to page 45)*

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1.1 Product checking and parts identification

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

· Inverter Type

FR- B - 750

Symbol	Inverter Capacity
750 to 3700	Indicate capacity(W)
5.5K to 110K	Indicate capacity(kW)

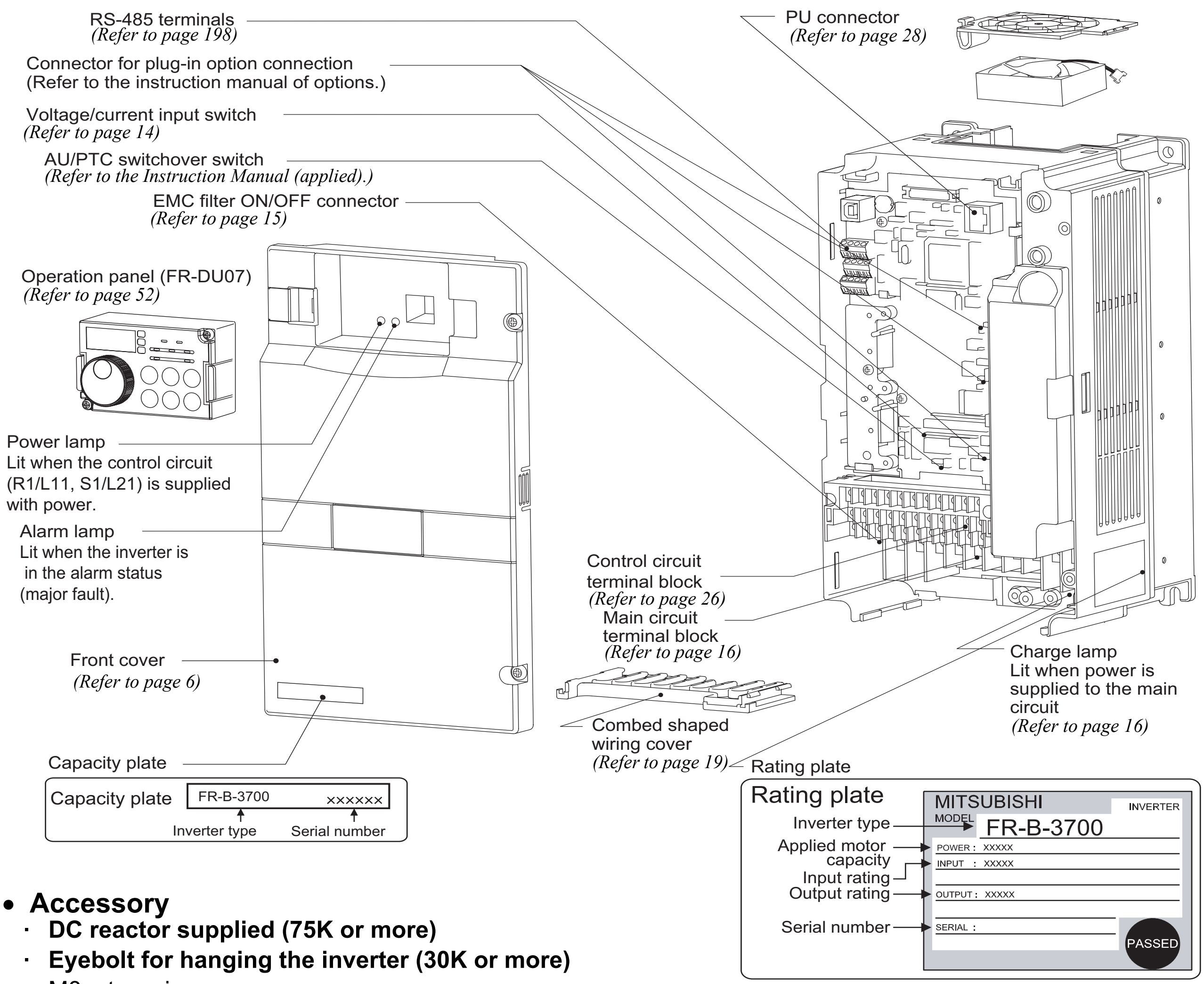
FR- B3- N H - 750

Symbol	Noise
None	Standard
N	Low noise

Symbol	Voltage Class
None	200V Class
H	400V Class

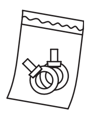
Symbol	Voltage Class
750 to 3700	Indicate capacity(W)
5.5K to 37K	Indicate capacity(kW)

As the name of the FR-B series does not include a symbol indicating voltage class, check the voltage class with the input rating on the rating plate.



• Accessory

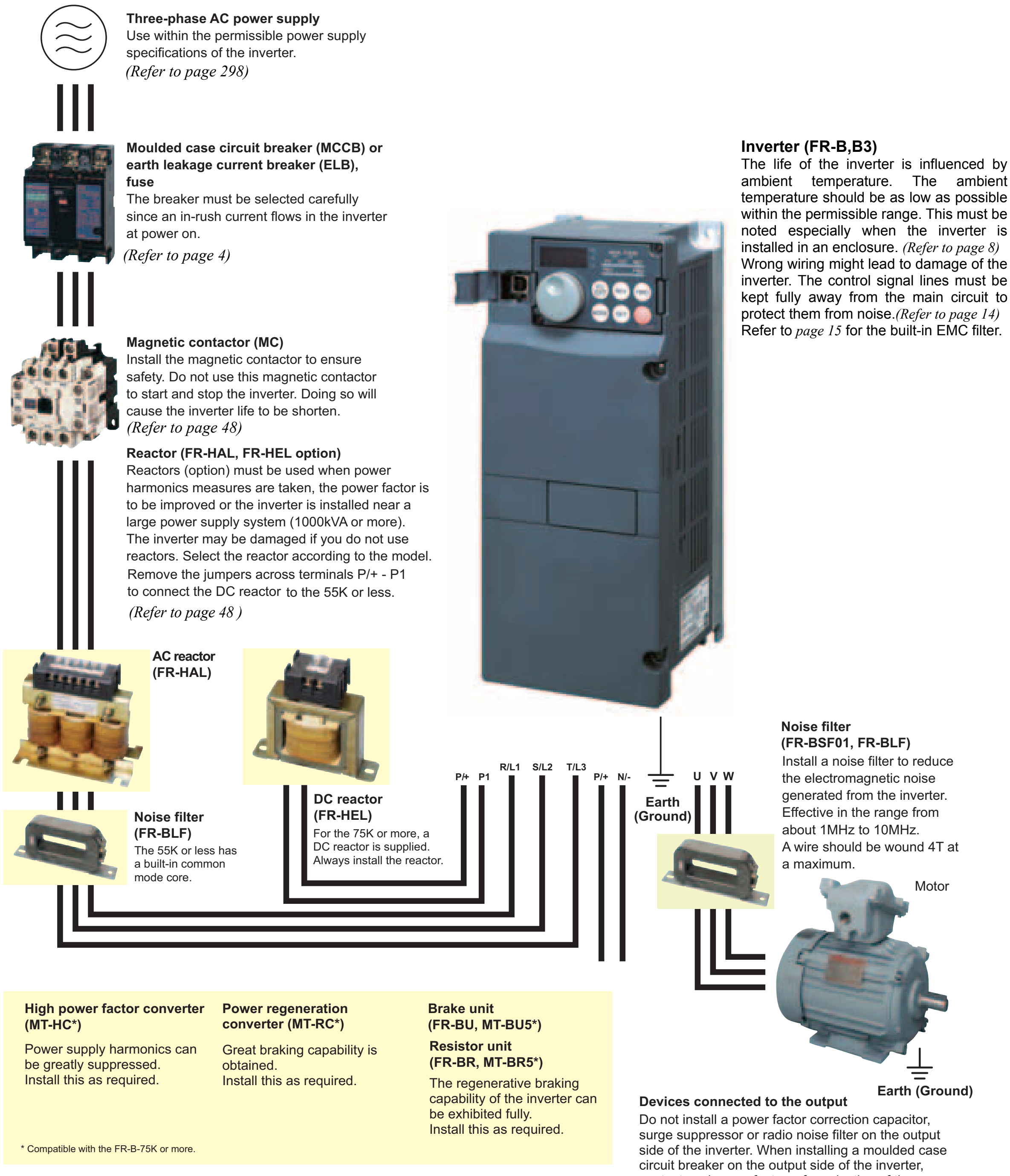
- **DC reactor supplied (75K or more)**
- **Eyebolt for hanging the inverter (30K or more)**
  M8 × two pieces



REMARKS

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

1.2 Inverter and peripheral devices



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

Earth (Ground)
To prevent an electric shock, always earth (ground) the motor and inverter. For reduction of induction noise from the power line of the inverter, it is recommended to wire the earth (ground) cable by returning it to the earth (ground) terminal of the inverter.

CAUTION

- Do not install a power factor correction capacitor, surge suppressor or radio noise filter on the inverter output side. This will cause the inverter to trip or the capacitor, and surge suppressor to be damaged. If any of the above devices are connected, immediately remove them.
- Electromagnetic wave interference
  The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, set the EMC filter valid to minimize interference.
  (Refer to page 15.)
- Refer to the instruction manual of each option and peripheral devices for details of peripheral devices.

1 OUTLINE

1.2.1 Peripheral devices

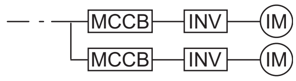
Check the motor capacity of the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the following list and prepare appropriate peripheral devices:

200V class

Motor Output (kW)*1	Applicable Inverter Type		Breaker Selection*2,4		Input Side Magnetic Contactor*3	
			Reactor connection		Reactor connection	
	FR-B	FR-B3	without	with	without	with
0.4	FR-B-750	FR-B3-(N)400	30AF 5A	30AF 5A	S-N10	S-N10
0.75	FR-B-750	FR-B3-(N)750	30AF 10A	30AF 10A	S-N10	S-N10
1.5	FR-B-1500	FR-B3-(N)1500	30AF 15A	30AF 15A	S-N10	S-N10
2.2	FR-B-2200	FR-B3-(N)2200	30AF 20A	30AF 15A	S-N10	S-N10
3.7	FR-B-3700	FR-B3-(N)3700	30AF 30A	30AF 30A	S-N20, N21	S-N10
5.5	FR-B-5.5K	FR-B3-(N)5.5K	50AF 50A	50AF 40A	S-N25	S-N20, N21
7.5	FR-B-7.5K	FR-B3-(N)7.5K	100AF 60A	50AF 50A	S-N25	S-N25
11	FR-B-11K	FR-B3-(N)11K	100AF 75A	100AF 75A	S-N35	S-N35
15	FR-B-15K	FR-B3-(N)15K	225AF 125A	100AF 100A	S-N50	S-N50
18.5	—	FR-B3-(N)18.5K	225AF 150A	225AF 125A	S-N65	S-N50
22	FR-B-22K	FR-B3-(N)22K	225AF 175A	225AF 150A	S-N80	S-N65
30	FR-B-30K	FR-B3-(N)30K	225AF 225A	225AF 175A	S-N95	S-N80
37	FR-B-37K	FR-B3-(N)37K	400AF 250A	225AF 225A	S-N150	S-N125
45	FR-B-45K	—	400AF 300A	400AF 300A	S-N180	S-N150
55	FR-B-55K	—	400AF 400A	400AF 350A	S-N220	S-N180
75	FR-B-75K	—	—	400AF 400A	—	S-N300

*1 Selections for use of the Mitsubishi explosion-proof motor with power supply voltage of 200VAC 50Hz.

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



*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stop during motor driving, the electrical durability is 25 times.
When using the MC for emergency stop during motor driving, select the MC with class AC-3 rated current for the motor rated current.

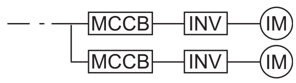
*4 When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.

400V class

Motor Output (kW)*1	Applicable Inverter Type		Breaker Selection*2,4		Input Side Magnetic Contactor*3	
			Reactor connection		Reactor connection	
	FR-B	FR-B3	without	with	without	with
0.4	FR-B-750	FR-B3-(N)H400	30AF 5A	30AF 5A	S-N10	S-N10
0.75			30AF 5A	30AF 5A	S-N10	S-N10
1.5	FR-B-1500	FR-B3-(N)H1500	30AF 10A	30AF 10A	S-N10	S-N10
2.2	FR-B-2200	FR-B3-(N)H2200	30AF 10A	30AF 10A	S-N10	S-N10
3.7	FR-B-3700	FR-B3-(N)H3700	30AF 20A	30AF 15A	S-N10	S-N10
5.5	FR-B-7.5K	FR-B3-(N)H5.5K	30AF 30A	30AF 20A	S-N20	S-N11, N12
7.5	FR-B-7.5K	FR-B3-(N)H7.5K	30AF 30A	30AF 30A	S-N20	S-N20
11	FR-B-15K	FR-B3-(N)H11K	50AF 50A	50AF 40A	S-N20	S-N20
15	FR-B-15K	FR-B3-(N)H15K	100AF 60A	50AF 50A	S-N25	S-N20
18.5	—	FR-B3-(N)H18.5K	100AF 75A	100AF 60A	S-N25	S-N25
22	FR-B-22K	FR-B3-(N)H22K	100AF 100A	100AF 75A	S-N35	S-N25
30	FR-B-37K	FR-B3-(N)H30K	225AF 125A	100AF 100A	S-N50	S-N50
37	FR-B-37K	FR-B3-(N)H37K	225AF 150A	225AF 125A	S-N65	S-N50
45	FR-B-55K	—	225AF 175A	225AF 150A	S-N80	S-N65
55	FR-B-55K	—	225AF 200A	225AF 175A	S-N80	S-N80
75	FR-B-75K	—	—	225AF 225A	—	S-N95
90	FR-B-90K	—	—	225AF 225A	—	S-N150
110	FR-B-110K	—	—	225AF 225A	—	S-N180

*1 Selections for use of the Mitsubishi explosion-proof motor with power supply voltage of 400VAC 50Hz.

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



*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stop during motor driving, the electrical durability is 25 times.
When using the MC for emergency stop during motor driving, select the MC with class AC-3 rated current for the motor rated current.

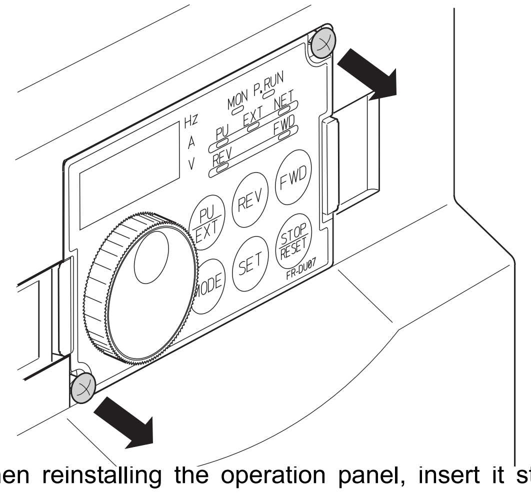
*4 When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.

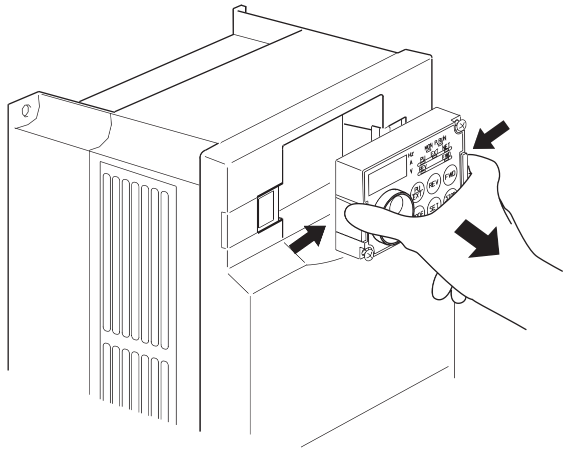
1.3 Method of removal and reinstallation of the front cover

•Removal of the operation panel

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

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





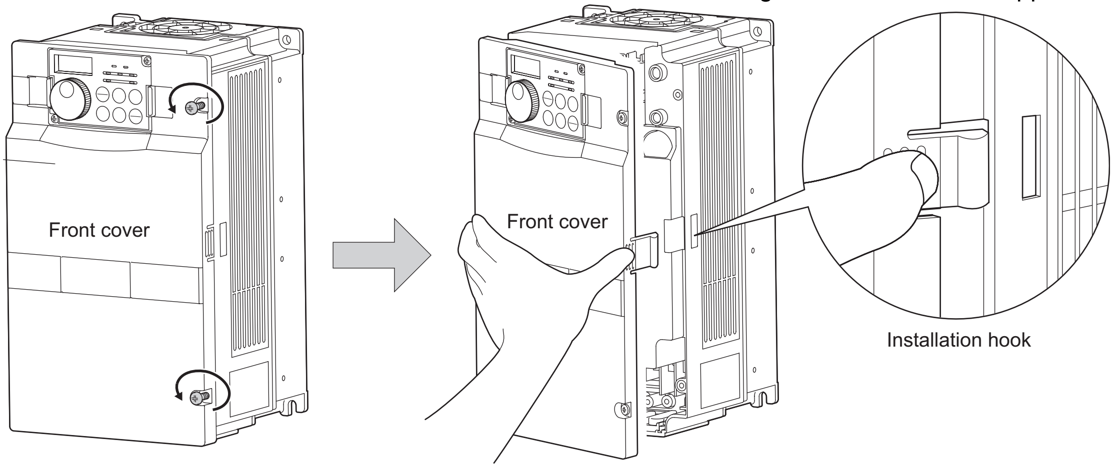
When reinstalling the operation panel, insert it straight to reinstall securely and tighten the fixed screws of the operation panel.

22K or less

•Removal

1) Loosen the installation screws of the front cover.

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

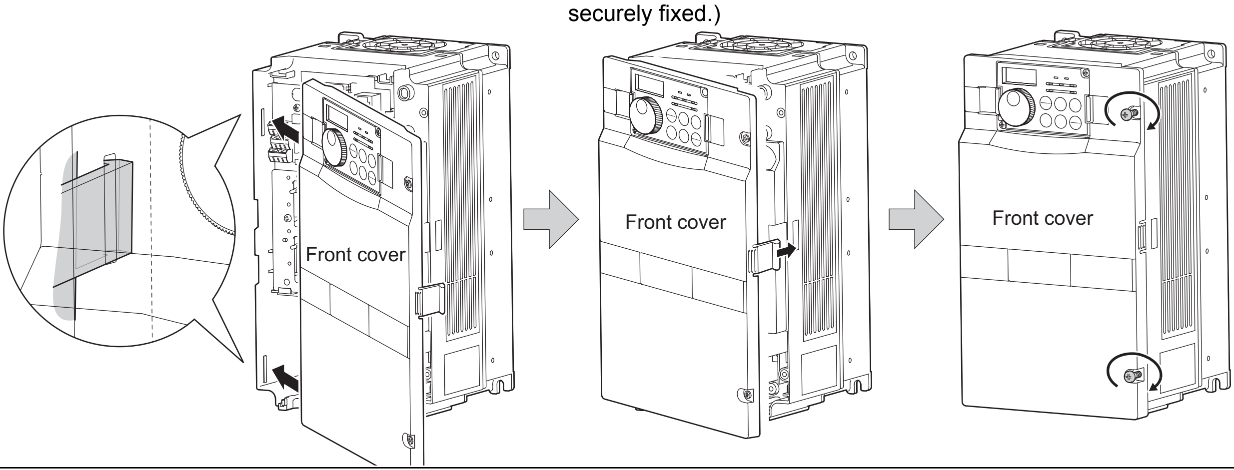


•Reinstallation

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

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

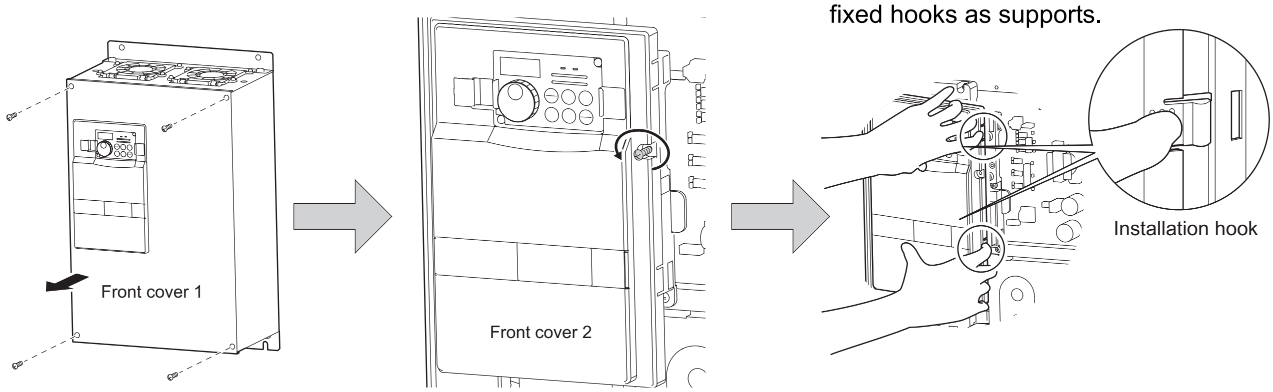
3) Tighten the installation screws and fix the front cover.



30K or more

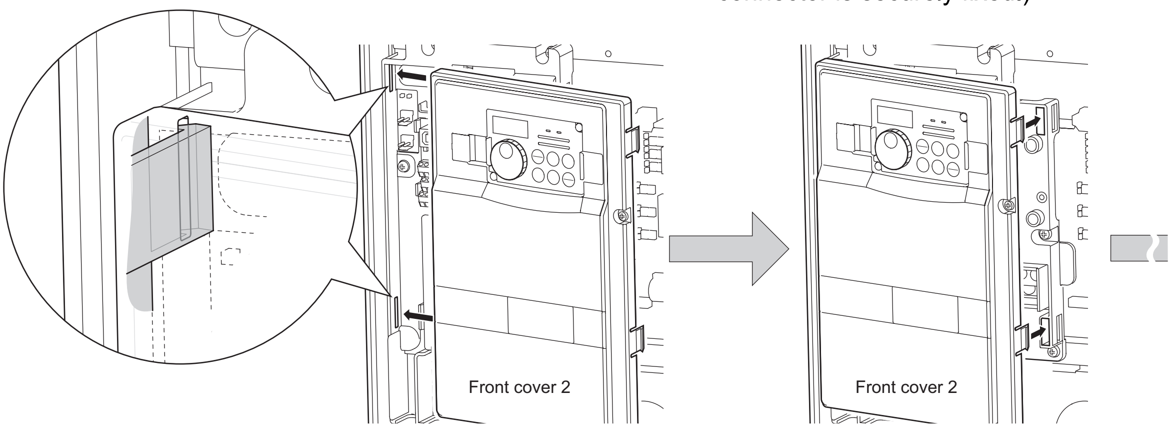
•Removal

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

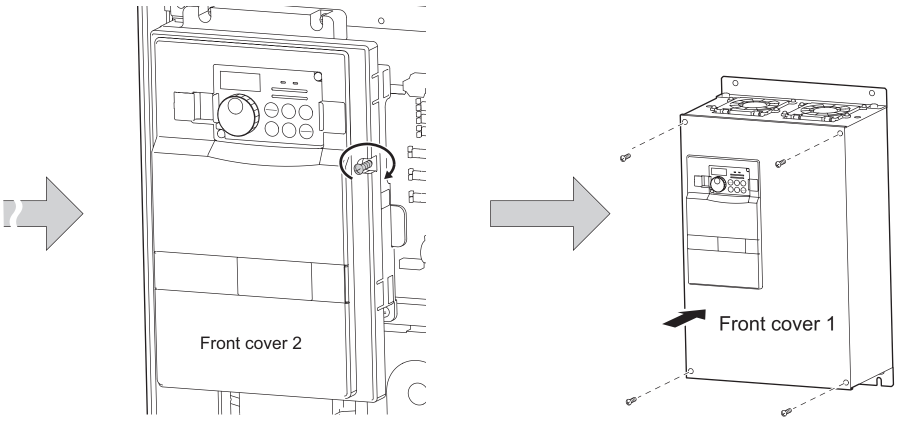


•Reinstallation

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



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



REMARKS

· For the FR-B-55K(200V class) or more, the front cover 1 is separated into two parts.

CAUTION

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

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 Inverter installation environment

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

Environmental standard specifications of inverter

Item	Description
Ambient temperature	-10 to +50°C (non-freezing)
Ambient humidity	90% RH maximum (non-condensing)
Atmosphere	Free from corrosive and explosive gases, dust and dirt
Maximum Altitude	1,000m or less
Vibration	5.9m/s^2 or less (JIS C 60068-2-6 compliant)

(1) Temperature

The permissible ambient 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 ambient temperature of the inverter falls within the specified range.

1) Measures against high temperature
- Use a forced ventilation system or similar cooling system. *(Refer to page 10.)*
- Install the enclosure 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 enclosure 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 enclosure 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 10.)*
- Purge air.
  Pump clean air from outside to make the in-enclosure pressure higher than the outside-air pressure.

(4) Corrosive gas, salt damage

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

(5) Explosive, flammable gases

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

(6) Highland

Use the inverter at the altitude of within 1000m.
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.

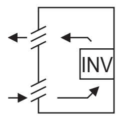
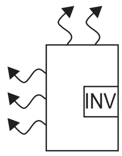
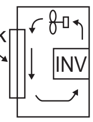
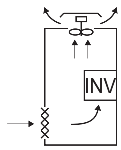
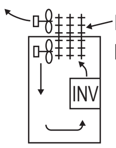
(7) Vibration, impact

The vibration resistance of the inverter is up to 5.9m/s^2 at 10 to 55Hz frequency and 1mm amplitude as specified in JIS C 60068-2-6.
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 enclosure 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 heat sink (Aluminum fin, etc.)
3) Cooling by ventilation (Forced ventilation type, pipe ventilation type)
4) Cooling by heat exchanger or cooler (Heat pipe, cooler, etc.)

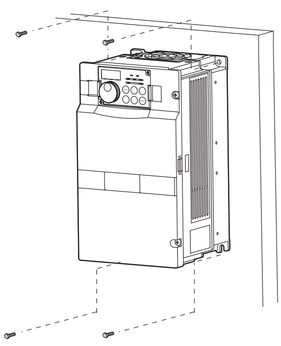
Cooling System		Enclosure Structure	Comment
Natural cooling	Natural ventilation (Enclosed, open type)		Low in cost and generally used, but the enclosure size increases as the inverter capacity increases. For relatively small capacities.
	Natural ventilation (Totally enclosed type)		Being a totally enclosed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

1.4.3 Inverter placement

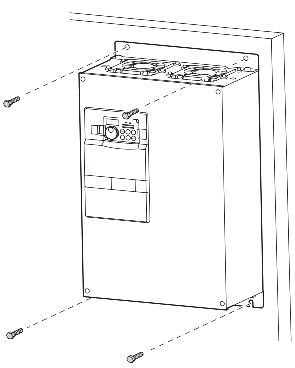
(1) Installation of the Inverter

Installation on the enclosure

22K or less

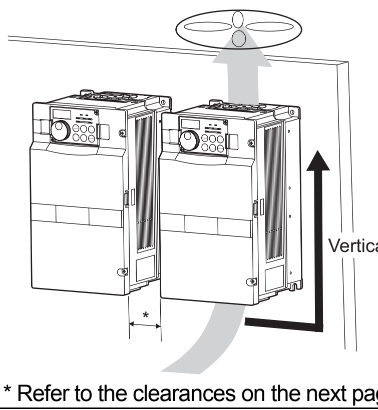


30K or more



CAUTION

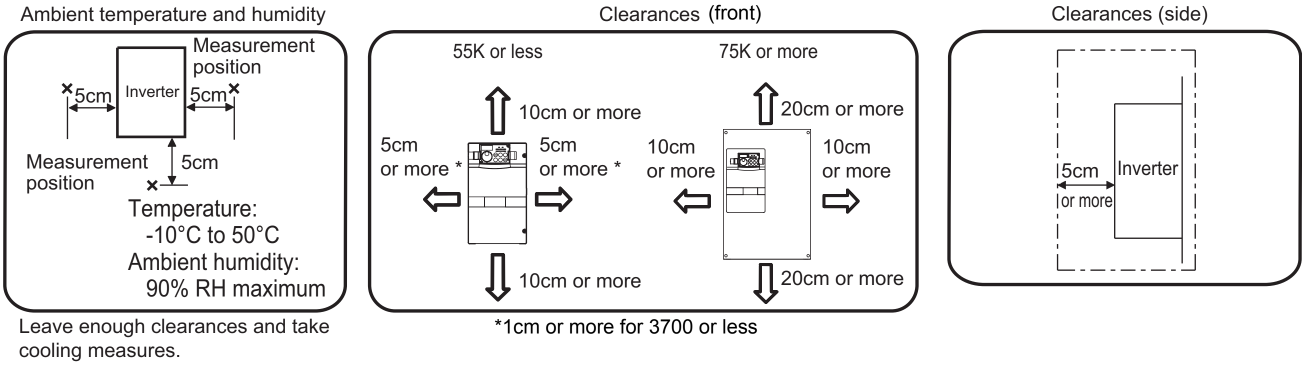
When encasing multiple inverters, install them in parallel as a cooling measure. Install the inverter vertically.



* Refer to the clearances on the next page.

(2) Clearances around the inverter

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



(3) Inverter mounting orientation

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

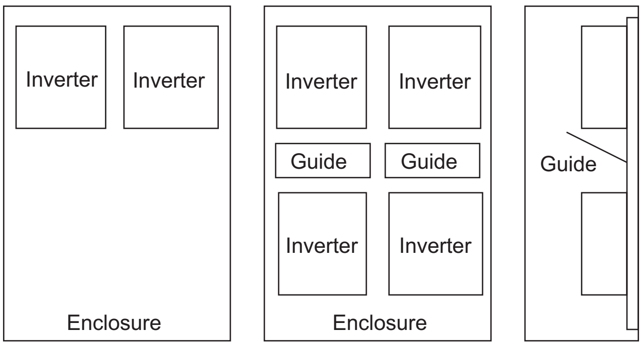
(4) Above the inverter

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

(5) Arrangement of multiple inverters

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

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

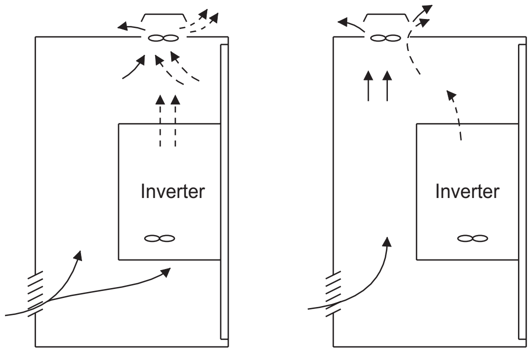


(a) Horizontal arrangement (b) Vertical arrangement

Arrangement of multiple inverters

(6) Placement of ventilation fan and inverter

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



<Good example> <Bad example>

Placement of ventilation fan and inverter

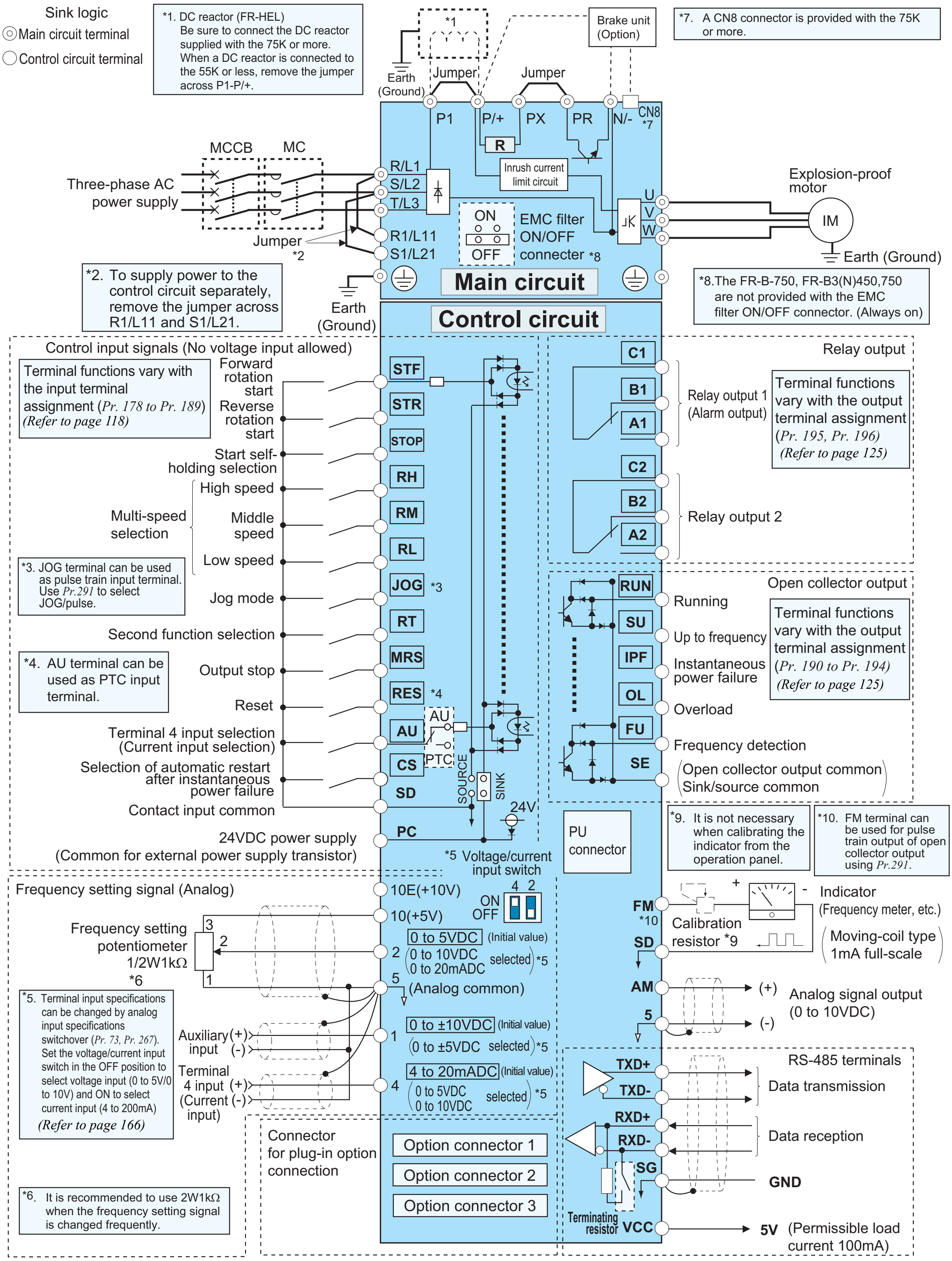
MEMO

2 WIRING

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

2.1 Wiring

2.1.1 Terminal connection diagram

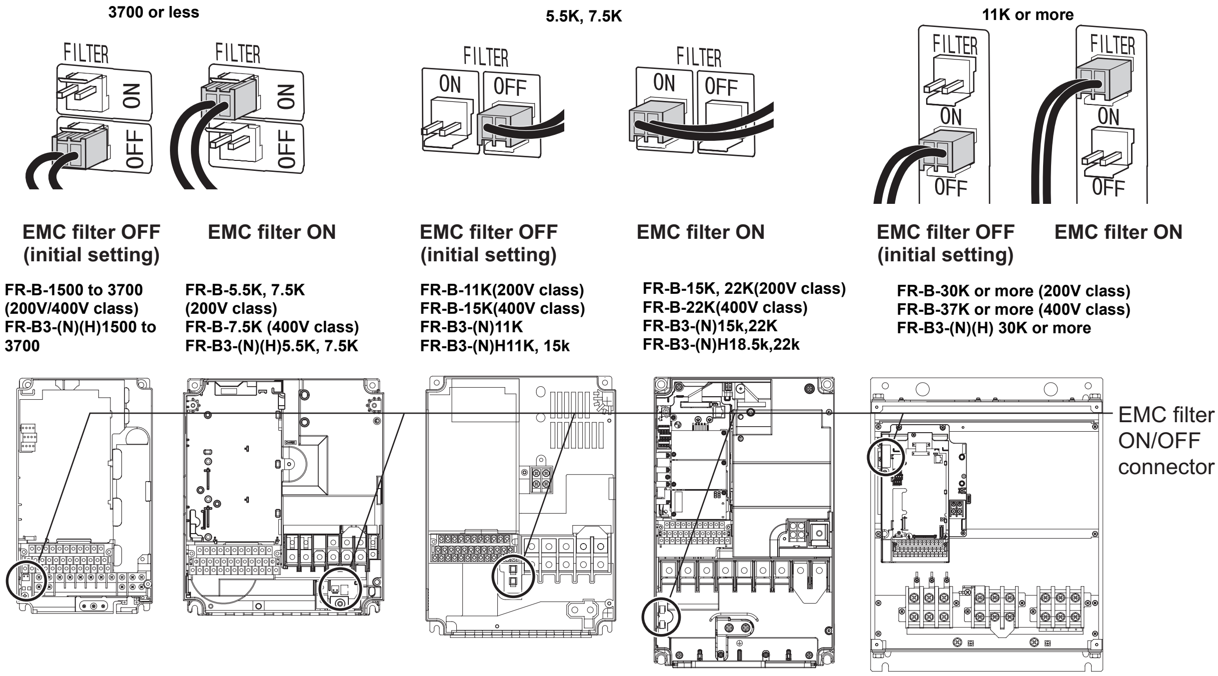


CAUTION

- It is mandatory to use the Mitsubishi pressure-resistant, explosion-proof motor with the inverter which has been approved for combination by the Labor Ministry's explosion-proof certification. Therefore, always use the Mitsubishi pressure-resistant, explosion-proof motor in combination with its approved driving inverter.
- To prevent a malfunction due to noise, keep the signal cables more than 10cm away from the power cables.
- After wiring, wire offcuts must not be left in the inverter.
  Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
  When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch in right position. Operation with a wrong setting may cause a fault, failure or malfunction.

2.1.2 EMC filter

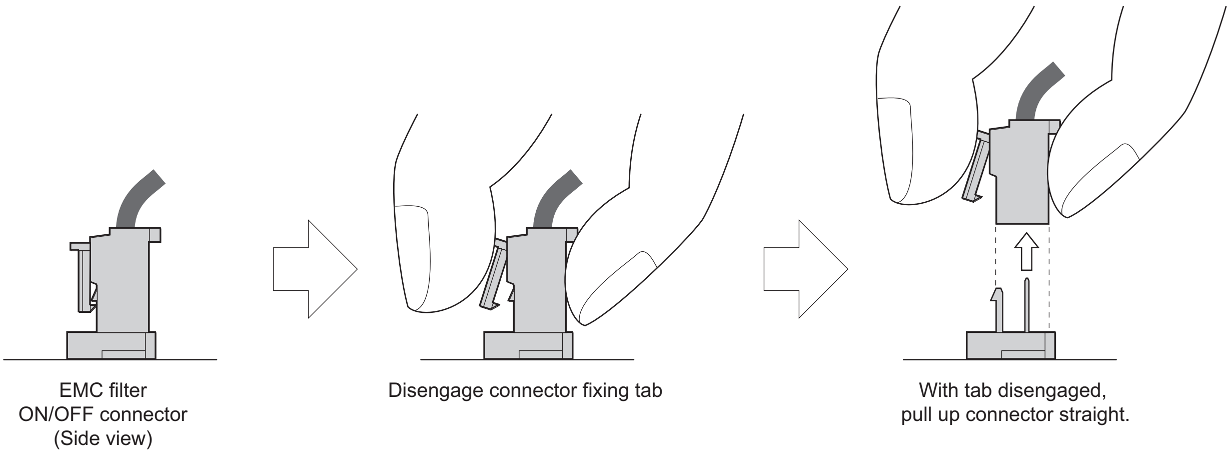
This inverter is equipped with a built-in EMC filter (capacitive filter) and common mode core.
The EMC filter is effective for reduction of air-propagated noise on the input side of the inverter.
The EMC filter is factory-set to disable (OFF). To enable it, fit the EMC filter ON/OFF connector to the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



The FR-B-750(200V class), FR-B3-(N)400, (N)750 are not provided with the EMC filter ON/OFF connector. (The EMC filter is always valid.)

<How to disconnect the connector>

(1) Before removing a front cover, check to make sure that the indication of the inverter operation panel is off, wait for at least 10 minutes after the power supply has been switched off, and check that there are no residual voltage using a tester or the like. (*Refer to page 6.*)
(2) When disconnecting the connector, push the fixing tab and pull the connector straight without pulling the cable or forcibly pulling the connector with the tab fixed. When installing the connector, also engage the fixing tab securely. (If it is difficult to disconnect the connector, use a pair of long-nose pliers, etc.)



CAUTION

· Fit the connector to either ON or OFF.
· Enabling (turning on) the EMC filter increase leakage current. *(Refer to page 41)*

⚠ WARNING

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

2.2 Main circuit terminal specifications

2.2.1 Specification of main circuit terminal

Terminal Symbol	Terminal Name	Description
R/L1, S/L2, T/L3	**AC power input**	Connect to the commercial power supply. Keep these terminals open when using the high power factor converter (MT-HC)*1.
U, V, W	**Inverter output**	Connect a pressure-resistant, explosion-prrof motor.
R1/L11, S1/L21	**Power supply for control circuit**	Connected to the AC power supply terminals R/L1 and S/L2. To retain the alarm display and alarm output or when using the high power factor converter (MT-HC)*1, remove the jumpers from terminals R/L1-R1/L11 and S/L2-S1/L21 and apply external power to these terminals. Do not turn off the power supply for control circuit (R1/L11, S1/L21) with the main circuit power (R/L1, S/L2, T/L3) on. Doing so may damage the inverter. The circuit should be configured so that the main circuit power (R/L1, S/L2, T/L3) is also turned off when the power supply for control circuit (R1/L11, S1/L21) is off. 15K or less : 60VA, 18.5K or more : 80VA
P/+, PR	**22K or less**	Keep these terminals open.
P/+, N/-	**Brake unit connection**	Connect the brake unit (FR-BU and MT-BU5)*1, high power factor converter (MT-HC)*1 or power regeneration converter (MT-RC)*1.
P/+, P1	**DC reactor connection**	For the 55K or less, remove the jumper across terminals P/+ - P1 and connect the DC reactor. (For the 75K or more, a DC reactor is supplied as standard.)
PR, PX	**Built-in brake circuit connection**	When the jumper is connected across terminals PX-PR (initial status), the built-in brake circuit is valid. (Provided for the 7.5K or less.)
⏚	**Earth (ground)**	For earthing (grounding) the inverter chassis. Must be earthed (grounded).

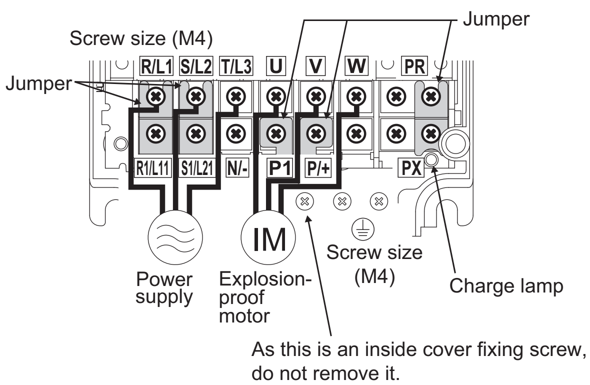
CAUTION

*1 Supports capacities of the FR-B-75K or more.

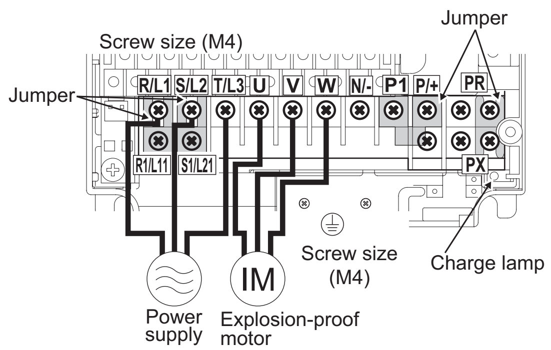
2.2.2 Terminal arrangement of the main circuit terminal, power supply and the motor wiring.

200V class

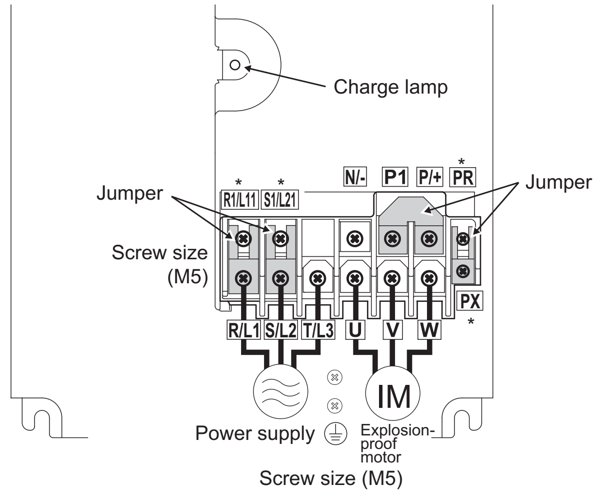
FR-B-750
FR-B3-(N)400, 750



FR-B-1500, 2200, 3700
FR-B3-(N)1500, 2200, 3700

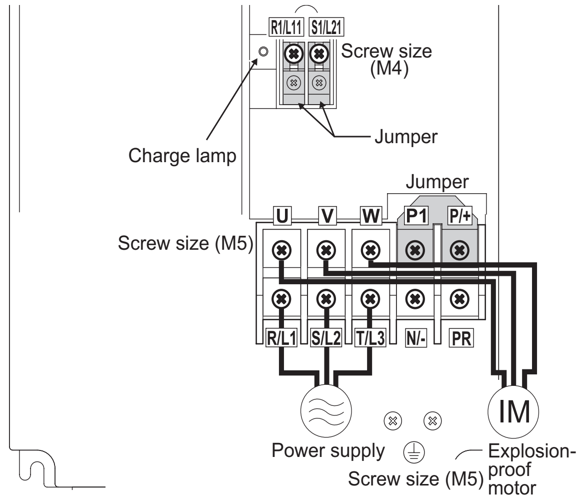


FR-B-5.5K, 7.5K
FR-B3-(N)5.5K, 7.5K

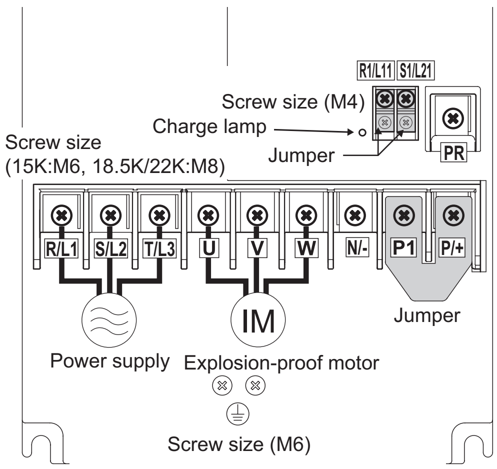


* Screw size of terminal R1/L11, S1/L21, PR, and PX is M4.

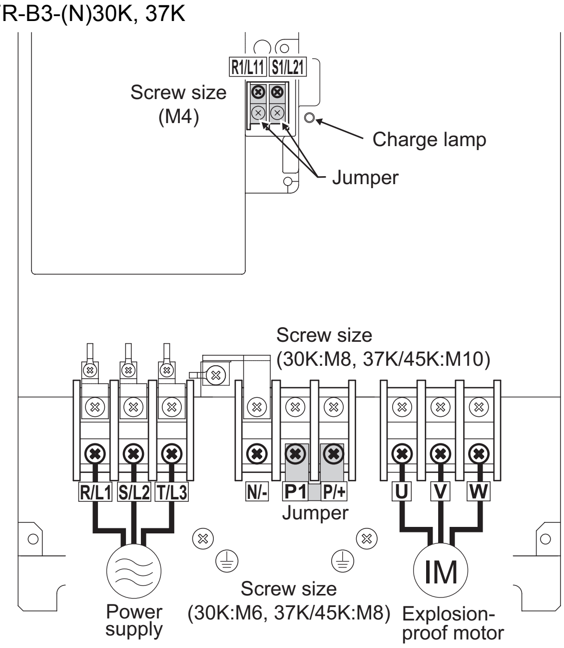
FR-B-11K
FR-B3-(N)11K



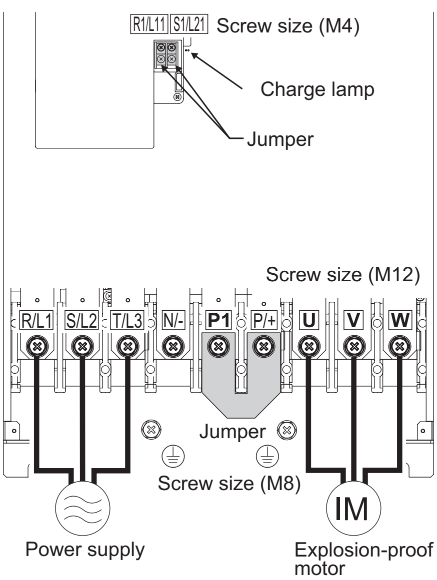
FR-B-15K, 22K
FR-B3-(N)15K, 18.5K, 22K



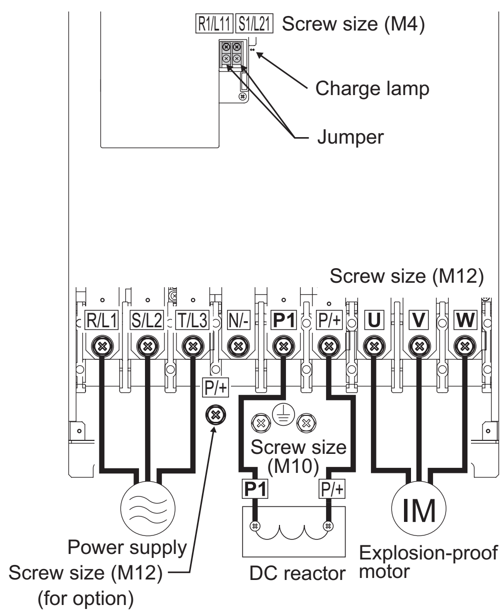
FR-B-30K, 37K, 45K
FR-B3-(N)30K, 37K



FR-B-55K



FR-B-75K

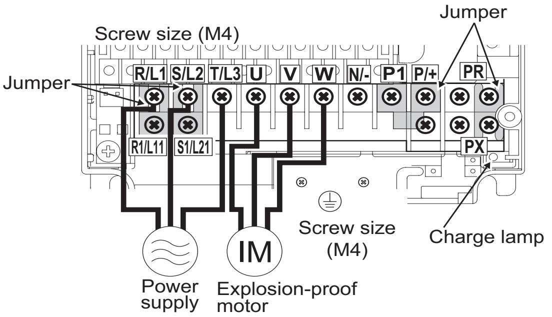


2

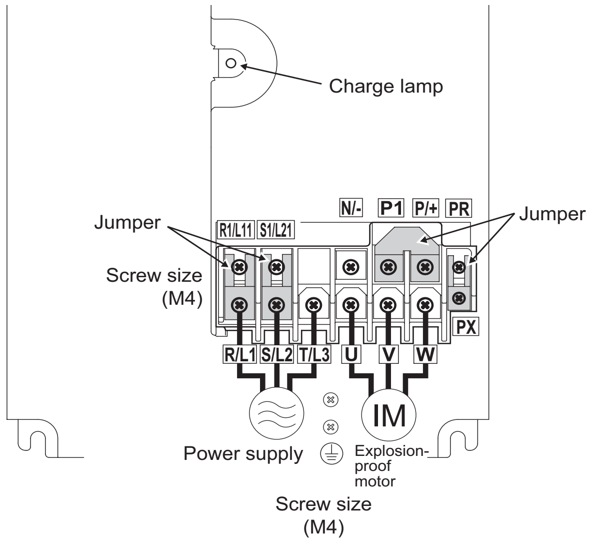
WIRING

400V class

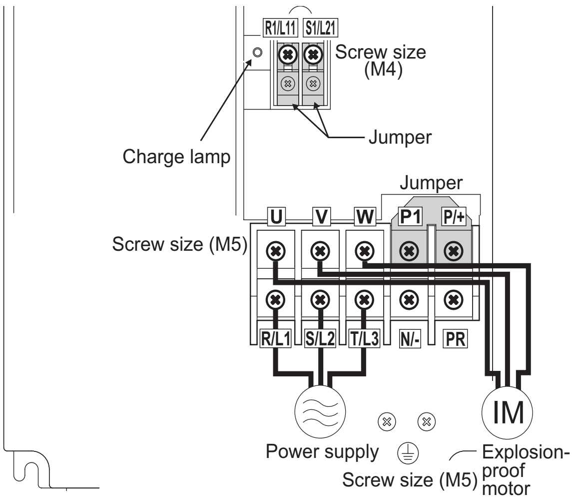
FR-B-750 to 3700
FR-B3-(N)H400 to 3700



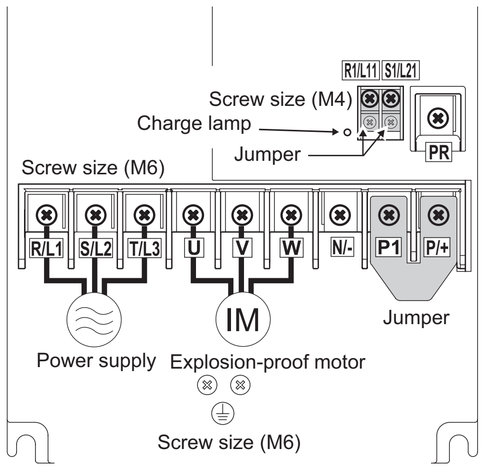
FR-B-7.5K
FR-B3-(N)H5.5K 7.5K



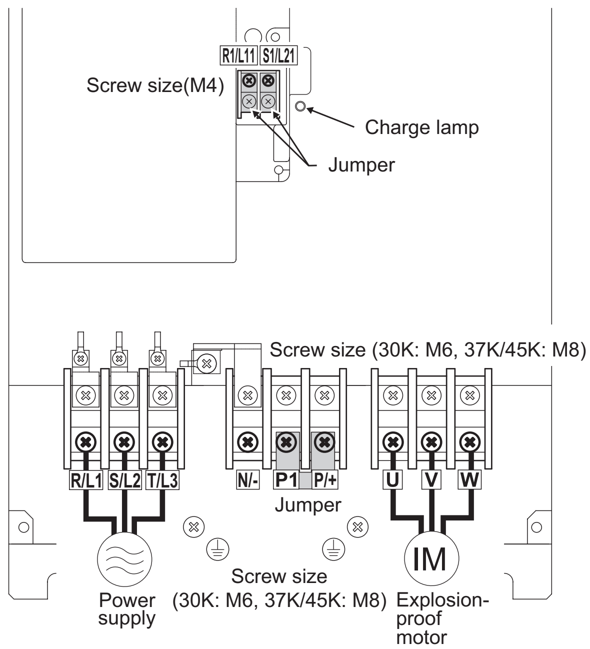
FR-B-15K
FR-B3-(N)H11K, 15K



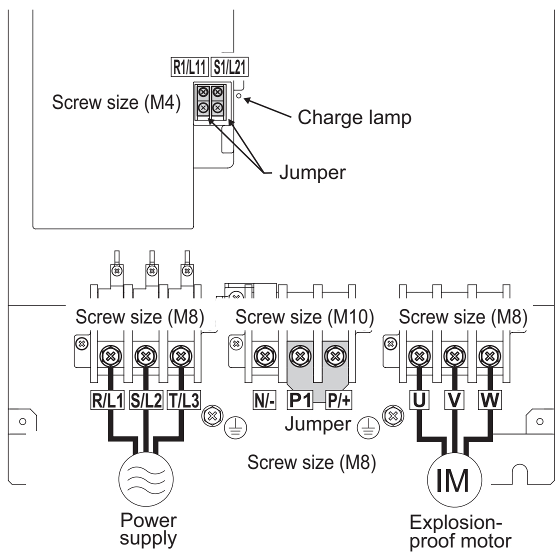
FR-B-22K
FR-B3-(N)H18.5K, 22K



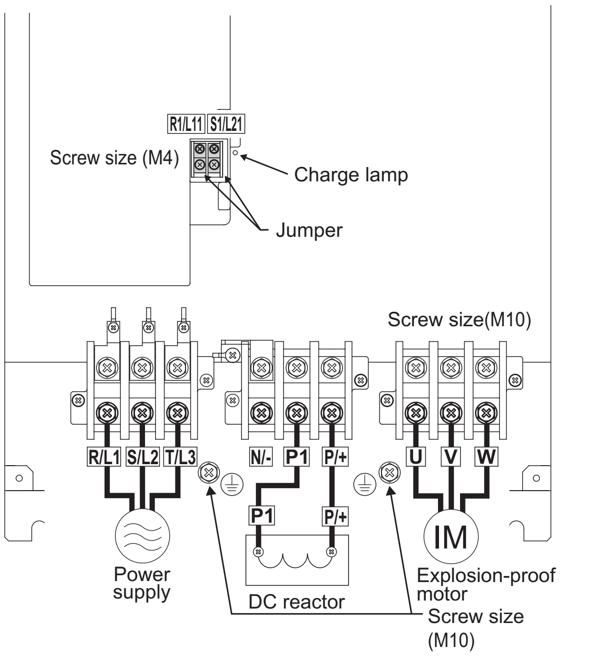
FR-B-37K
FR-B3-(N)H30K, 37K



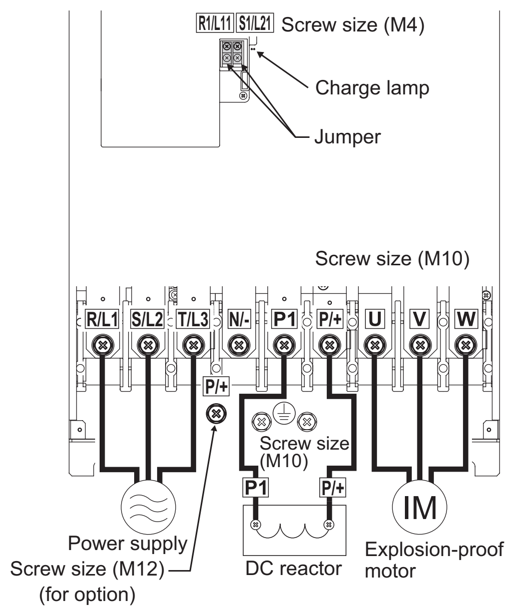
FR-B-55K



FR-B-75K, 90K



FR-B-110K



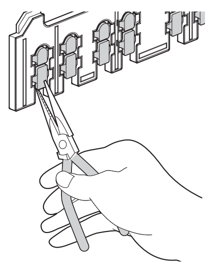
CAUTION

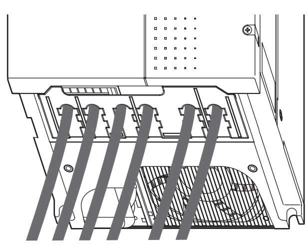
- The power supply cables must be connected to R/L1, S/L2, T/L3. Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter. (Phase sequence needs not to be matched.)
- Connect the motor to U, V, W. At this time, turning on the forward rotation switch (signal) rotates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

- Handling of the wiring cover
  (FR-B-15K,22K(200V), FR-B-22K(400V),
  FR-B3-(N)15K, 18.5K, 22K, FR-B3-(N)H 18.5K, 22K)
  For the hook of the wiring cover, cut off the necessary parts using a pair of long-nose pliers etc.

CAUTION

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





2.2.3 Cables and wiring length

(1) Applied cable size

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

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

Applicable Inverter Type		Terminal Screw Size *2	Tightening Torque N·m	Crimping Terminal		Cable Sizes HIV, etc. (mm^2) *1			
FR-B	FR-B3			R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earth (Ground) cable
FR-B-750 to 2200	FR-B3-(N)400 to 2200	M4	1.5	2-4	2-4	2	2	2	2
FR-B-3700	FR-B3-(N)3700	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5
FR-B-5.5K	FR-B3-(N)5.5K	M4-M5	2.5	5.5-5	5.5-5	5.5	5.5	5.5	5.5
FR-B-7.5K	FR-B3-(N)7.5K	M4-M5	2.5	14-5	8-5	14	8	14	14
FR-B-11K	FR-B3-(N)11K	M5	2.5	14-5	14-5	14	14	14	14
FR-B-15K	FR-B3-(N)15K	M6	4.4	22-6	22-6	22	22	22	14
-	FR-B3-(N)18.5K	M8-M6	7.8	38-8	38-8	38	38	38	22
FR-B-22K	FR-B3-(N)22K	M8-M6	7.8	38-8	38-8	38	38	38	22
FR-B-30K	FR-B3-(N)30K	M8-M6	7.8	60-8	60-8	60	60	60	38
FR-B-37K	FR-B3-(N)37K	M10-M8	14.7	80-10	80-10	80	80	80	38
FR-B-45K	-	M10-M8	14.7	100-10	100-10	100	100	100	60
FR-B-55K	-	M12-M8	24.5	100-12	100-12	100	100	100	60
FR-B-75K	-	M12-M10	24.5	150-12	150-12	125	125	125	38

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

*2 The terminal screw size indicates the terminal size for R/L1, S/L2, T/L3, U, V, W, and a screw for earthing (grounding). For the 5.5K and 7.5K, screw sizes are different (R1/L11, S1/L21, PR, PX - R/L1, S/L2, T/L3, U, V, W, a screw for earthing (grounding)). For the 18.5K or more, screw sizes are different. (R/L1, S/L2, T/L3, U, V, W - a screw for earthing (grounding))

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

Applicable Inverter Type		Terminal Screw Size *2	Tightening Torque N·m	Crimping Terminal		Cable Sizes HIV, etc. (mm^2) *1			
FR-B	FR-B3			R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earth (Ground) Cable
FR-B-750 to 3700	FR-B3-(N)H400 to 3700	M4	1.5	2-4	2-4	2	2	2	2
-	FR-B3-(N)H5.5K	M4	1.5	2-4	2-4	2	2	3.5	3.5
FR-B-7.5K	FR-B3-(N)H7.5K	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	3.5
-	FR-B3-(N)H11K	M5	2.5	5.5-5	5.5-5	5.5	5.5	5.5	8
FR-B-15K	FR-B3-(N)H15K	M5	2.5	8-5	8-5	8	8	8	8
-	FR-B3-(N)H18.5K	M6	4.4	14-6	8-6	14	8	14	14
FR-B-22K	FR-B3-(N)H22K	M6	4.4	14-6	14-6	14	14	22	14
-	FR-B3-(N)H30K	M6	4.4	22-6	22-6	22	22	22	14
FR-B-37K	FR-B3-(N)H37K	M8	7.8	22-8	22-8	22	22	22	14
FR-B-55K	-	M8	7.8	60-8	60-8	60	60	60	22
FR-B-75K	-	M10	14.7	60-10	60-10	60	60	60	38
FR-B-90K	-	M10	14.7	60-10	60-10	60	60	80	38
FR-B-110K	-	M10-M12	14.7	80-10	80-10	80	80	80	38

*1 For the 55K or less, 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 ambient temperature is 50°C or less and the wiring distance is 20m or less.
For the 75K or more, the recommended cable size is that of the cable (LMFC (heat resistant flexible cross-linked polyethylene insulated cable) etc.) with continuous maximum permissible temperature of 90°C. Assumes that the ambient temperature is 50°C or less and wiring is performed in an enclosure.
*2 The terminal screw size indicates the terminal size for R/L1, S/L2, T/L3, U, V, W, and a screw for earthing (grounding).
For the 110K , screw sizes are different (R/L1, S/L2, T/L3, U, V, W, a screw for earthing (grounding) - P/+ for option connection)

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

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

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

CAUTION

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

(2) Notes on earthing (grounding)

- Always earth (ground) the motor and inverter.

  1)Purpose of earthing (grounding)

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

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

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

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

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

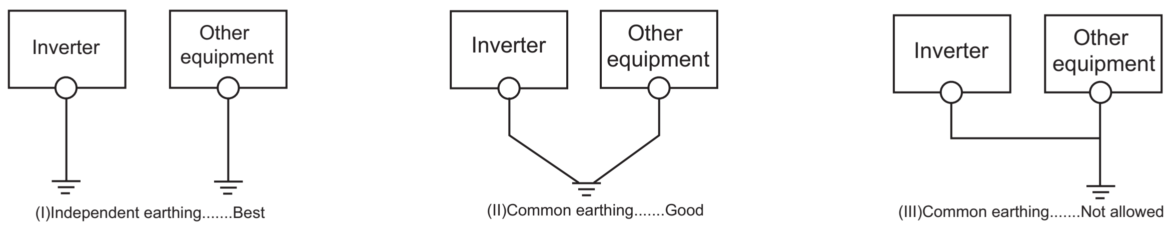
  (a) Where possible, use independent earthing (grounding) for the inverter. If independent earthing (grounding) (I) is impossible, use joint earthing (grounding) (II) where the inverter is connected with the other equipment at an earthing (grounding) point. Joint earthing (grounding) as in (III) must be avoided as the inverter is connected with the other equipment by a common earth (ground) cable.
  Also a leakage current including many high frequency components flows in the earth (ground) cables of the inverter and inverter-driven motor. Therefore, they must use the independent earthing (grounding) method and be separated from the earthing (grounding) of equipment sensitive to the aforementioned noises.
  In a tall building, it will be a good policy to use the noise malfunction prevention type earthing (grounding) with steel frames and carry out electric shock prevention type earthing (grounding) in the independent earthing (grounding) method.

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

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

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

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

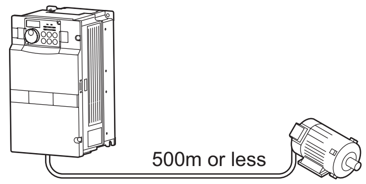


(3) Total wiring length

The overall wiring length for connection of a motor should be within the value in the table below.
(An explosion-proof test is not performed for the multiple motor connection.)

Inverter Capacity	400	750	1500 or more
FR-B, B3 (at normal operation)	300m	500m	500m
FR-B3-N (at low noise operation)	200m	300m	500m

Total wiring length (1500 or more)

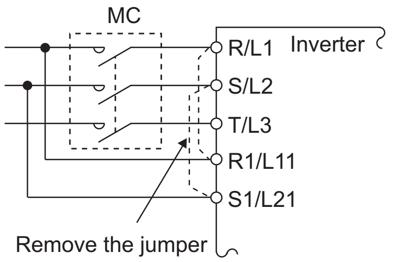


(4) Cable size of the control circuit power supply (terminal R1/L11, S1/L21)

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

2.2.4 When connecting the control circuit and the main circuit separately to the power supply (separate power)

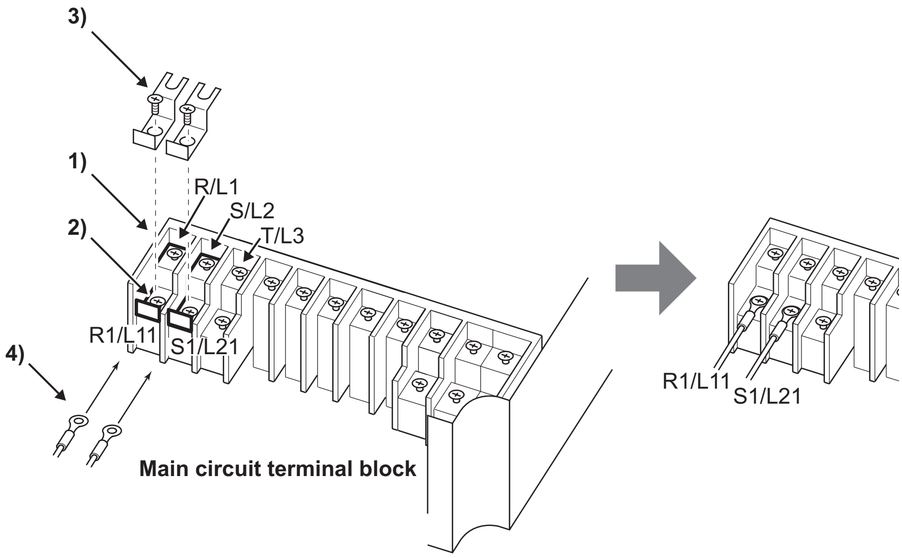
<Connection diagram>



When the protected circuit is activated, opening of the electromagnetic contactor (MC) on the inverter power supply side results in power loss in the control circuit, disabling the alarm output signal retention. Terminals R1/L11 and S1/L21 are provided to hold an alarm signal. In this case, connect the power supply terminals R1/L11 and S1/L21 of the control circuit to the primary side of the MC.

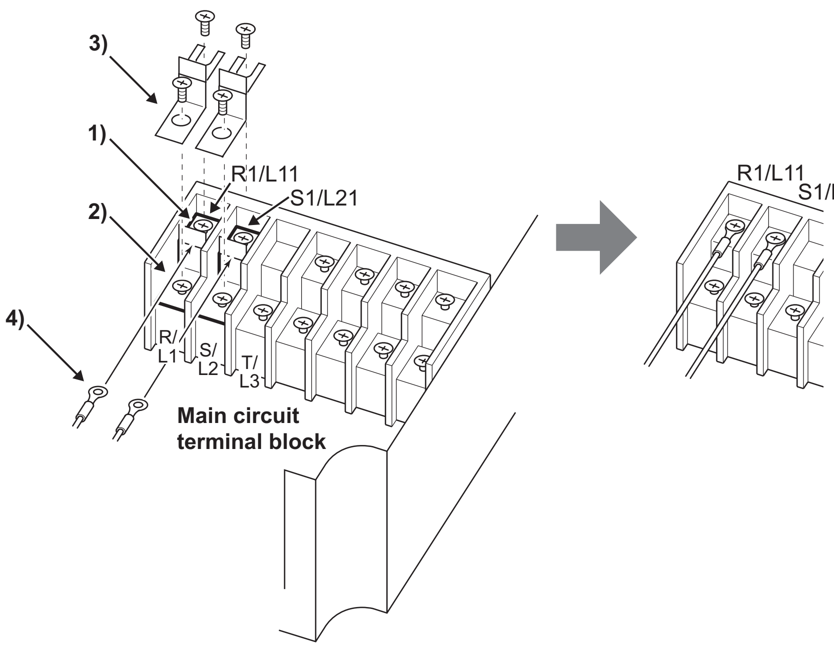
• FR-B-750 to 3700 (200V/400V class), FR-B3-(N)(H) 400 to 3700

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



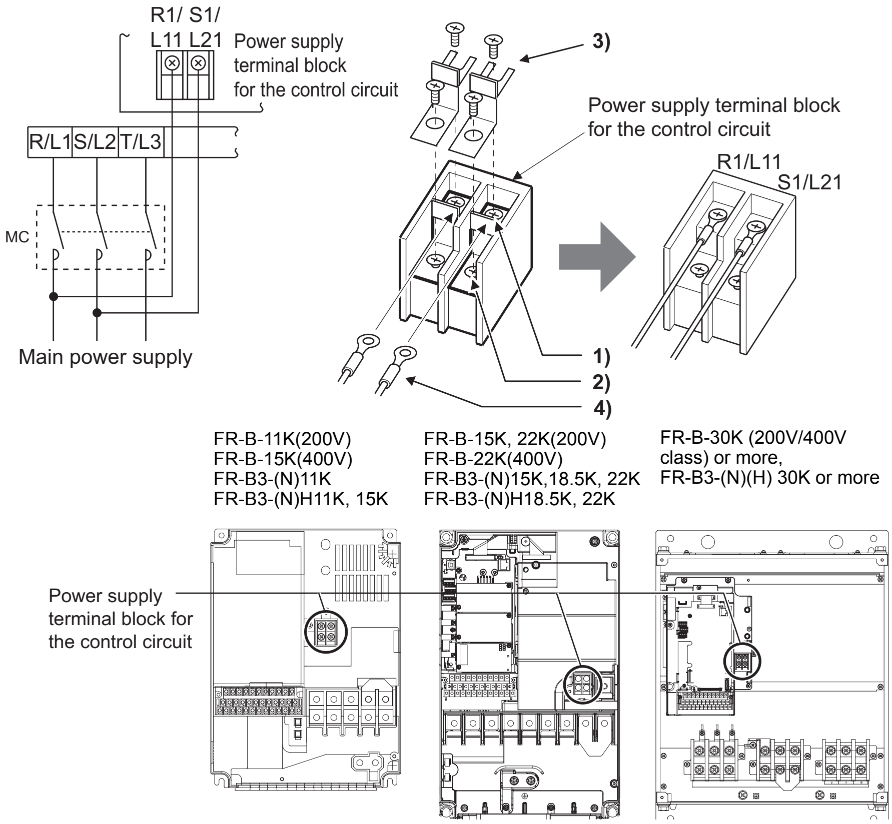
• FR-B-5.5K, 7.5K (200V class), FR-B-7.5K(400V class), FR-B3-(N)(H)5.5K, 7.5K

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



• FR-B-11K(200V/400V class) or more, FR-B3-(N)(H)11K or more

1) Remove the upper screws.
2) Remove the lower screws.
3) Pull the jumper toward you to remove.
4) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21). Never connect the power cable to the terminals in the lower stand. Doing so will damage the inverter.



CAUTION

· Do not turn off the control power (terminals R1/L11 and S1/L21) with the main circuit power (R/L1, S/L2, T/L3) on. Doing so may damage the inverter.

· Be sure to use the inverter with the jumpers across terminals R/L1-R1/L11 and S/L2-S1/L21 removed when supplying power from other sources. The inverter may be damaged if you do not remove the jumper.

· The voltage should be the same as that of the main control circuit when the control circuit power is supplied from other than the primary side of the MC.

· The power capacity is 60VA or more for 15K or less, 80VA or more for 18.5K or more when separate power is supplied from R1/L11, S1/L21.

· When the power supply used with the control circuit is different from the one used with the main circuit, make up a circuit which will switch off the main circuit power supply terminals R/L1, S/L2, T/L3 when the control circuit power supply terminals R1/L11, S1/L21 are switched off.

· If the main circuit power is switched off (for 0.1s or more) then on again, the inverter resets and an alarm output will not be held.

2

WIRING

2.3 Control circuit specifications

2.3.1 Control circuit terminals

(shaded box) indicates that terminal functions can be selected using *Pr. 178 to Pr. 196 (I/O terminal function selection) (Refer to page 118.)*

(1) Input signals

Type	Terminal Symbol	Terminal Name	Description	Rated Specifications	Refer to page
Contact input	STF	Forward rotation start	Turn on the STF signal to start forward rotation and turn it off to stop. When the STF and STR signals are turned on simultaneously, the stop command is given.	Input resistance 4.7kΩ Voltage at opening: 21 to 27VDC Contacts at short-circuited: 4 to 6mADC	*118*
	STR	Reverse rotation start	Turn on the STR signal to start reverse rotation and turn it off to stop.		
	STOP	Start self-holding selection	Turn on the STOP signal to self-hold the start signal.		*118*
	RH, RM, RL	Multi-speed selection	Multi-speed can be selected according to the combination of RH, RM and RL signals.		*118*
	JOG	Jog mode selection	Turn on the JOG signal to select Jog operation (initial setting) and turn on the start signal (STF or STR) to start Jog operation.		*118*
		Pulse train input	JOG terminal can be used as pulse train input terminal. To use as pulse train input terminal, the *Pr. 291* setting needs to be changed. (maximum input pulse: 100kpulses/s)	Input resistance 2kΩ Contacts at short-circuited: 8 to 13mADC	*118*
	RT	Second function selection	Turn on the RT signal to select second function.	Input resistance 4.7kΩ Voltage at opening: 21 to 27VDC Contacts at short-circuited: 4 to 6mADC	*118*
	MRS	Output stop	Turn on the MRS signal (20ms or more) to stop the inverter output. Use to shut off the inverter output when stopping the motor by electromagnetic brake.		*118*
	RES	Reset	Used to reset alarm output provided when protective circuit is activated. Turn on the RES signal for more than 0.1s, then turn it off. Initial setting is for reset always. By setting *Pr. 75*, reset can be set to enabled only at an inverter alarm occurrence. Recover about 1s after reset is cancelled.		*118*
	AU	Terminal 4 input selection	Terminal 4 is made valid only when the AU signal is turned on. (The frequency setting signal can be set between 4 and 20mADC.) Turning the AU signal on makes terminal 2 (voltage input) invalid.		*166*
		PTC input	AU terminal is used as PTC input terminal (thermal protection of the motor). When using it as PTC input terminal, set the AU/PTC switch to PTC.		*98*
	CS	Selection of automatic restart after instantaneous power failure	When the CS signal is left on, the inverter restarts automatically at power restoration. Note that restart setting is necessary for this operation. In the initial setting, a restart is disabled. *(Refer to Pr. 57 Restart coasting time page 148)*		*118*
	SD	Contact input common (sink)	Common terminal for contact input terminal (sink logic) and terminal FM. Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE.	——	—
	PC	External transistor common, 24VDC power supply, contact input common (source)	When connecting the transistor output (open collector output), such as a programmable controller (PLC), when sink logic is selected, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by undesirable currents. Can be used as 24VDC 0.1A power supply. When source logic has been selected, this terminal serves as a contact input common.	Power supply voltage range 19.2 to 28.8VDC Current consumption 100mA	30

Type	Terminal Symbol	Terminal Name	Description	Rated Specifications	Refer to page
Frequency setting	10E	Frequency setting power supply	When connecting the frequency setting potentiometer at an initial status, connect it to terminal 10. Change the input specifications of terminal 2 when connecting it to terminal 10E.	10VDC±0.4V Permissible load current 10mA	*166*
	10			5.2VDC±0.2V Permissible load current 10mA	*166*
	2	Frequency setting (voltage)	Inputting 0 to 5VDC (or 0 to 10V, 4 to 20mA) provides the maximum output frequency at 5V (10V, 20mA) and makes input and output proportional. Use *Pr.73* to switch from among input 0 to 5VDC (initial setting), 0 to 10VDC, and 0 to 20mA. Set the voltage/current input switch in the ON position to select current input (0 to 20mA) *1	Voltage input: Input resistance 10kΩ ± 1kΩ Maximum permissible voltage 20VDC Current input: Input resistance 245Ω ± 5Ω Maximum permissible current 30mA	*166*
	4	Frequency setting (current)	Inputting 4 to 20mADC (or 0 to 5V, 0 to 10V) provides the maximum output frequency at 20mA (5V, 10V) makes input and output proportional. This input signal is valid only when the AU signal is on (terminal 2 input is invalid). Use *Pr.267* to switch from among input 4 to 20mA (initial setting), 0 to 5VDC, and 0 to 10VDC. Set the voltage/current input switch in the OFF position to select voltage input (0 to 5V/0 to10V) *1 Use *Pr. 858* to switch terminal functions.		*166*
	1	Frequency setting auxiliary	Inputting 0 to ±5 VDC or 0 to ±10VDC adds this signal to terminal 2 or 4 frequency setting signal. Use *Pr. 73* to switch between the input 0 to ±5VDC and 0 to ±10VDC (initial setting). Use *Pr. 868* to switch terminal functions.	Input resistance 10kΩ ± 1kΩ Maximum permissible voltage ± 20VDC	*166*
	5	Frequency setting common	Common terminal for frequency setting signal (terminal 2, 1 or 4) and analog output terminal AM. Do not earth (ground).	——	*166*

*1 Set *Pr.73*, *Pr.267* and the voltage/current input switch correctly and input the analog signals in accordance with the setting.
When a voltage is input with the switch ON (current input specification) or a current is input with the switch OFF (voltage input specification), a failure may occur in the inverter or the analog circuit of the external device. *(Refer to page 166)*

(2) Output signals

Type	Terminal Symbol	Terminal Name	Description		Rated Specifications	Refer to page
Relay	A1, B1, C1	Relay output 1 (alarm output)	1 changeover contact output indicates that the inverter protective function has activated and the output stopped. Abnormal: No conduction across B-C (Across A-C Continuity), Normal: Across B-C Continuity (No conduction across A-C)		Contact capacity: 230VAC 0.3A (Power factor=0.4) 30VDC 0.3A	*125*
	A2, B2, C2	Relay output 2	1 changeover contact output			*125*
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.*1		Permissible load 24VDC 0.1A (A voltage drop is 2.8V maximum when the signal is on.)	*125*
	SU	Up to frequency	Switched low when the output frequency reaches within the range of ±10% (initial value) of the set frequency. Switched high during acceleration/deceleration and at a stop. *2	Alarm code (4bit) output *(Refer to page 157)*		*125*
	OL	Overload alarm	Switched low when stall prevention is activated by the stall prevention function. Switched high when stall prevention is cancelled. *2			*125*
	IPF	Instantaneous power failure	Switched low when an instantaneous power failure and under voltage protections are activated. *2			*125*
	FU	Frequency detection	Switched low when the inverter output frequency is equal to or higher than the preset detected frequency and high when less than the preset detected frequency. *2			*125*
	SE	Open collector output common	Common terminal for terminals RUN, SU, OL, IPF, FU		——	—

Type	Terminal Symbol	Terminal Name	Description		Rated Specifications	Refer to page
Pulse	FM	For meter	Select one e.g. output frequency from monitor items. *3 The output signal is proportional to the magnitude of the corresponding monitoring item.	Output item: Output frequency (initial setting)	Permissible load current 2mA 1440pulses/s at 60Hz	*137*
		NPN open collector output		Signals can be output from the open collector terminals by setting *Pr. 291*.	Maximum output pulse: 50kpulses/s Permissible load current : 80mA	*239*
Analog	AM	Analog signal output		Output item: Output frequency (initial setting)	Output signal 0 to 10VDC Permissible load current 1mA (load impedance 10kΩ or more) Resolution 8 bit	*137*

*2 Low indicates that the open collector output transistor is on (conducts).
High indicates that the transistor is off (does not conduct).
*3 Not output during inverter reset.

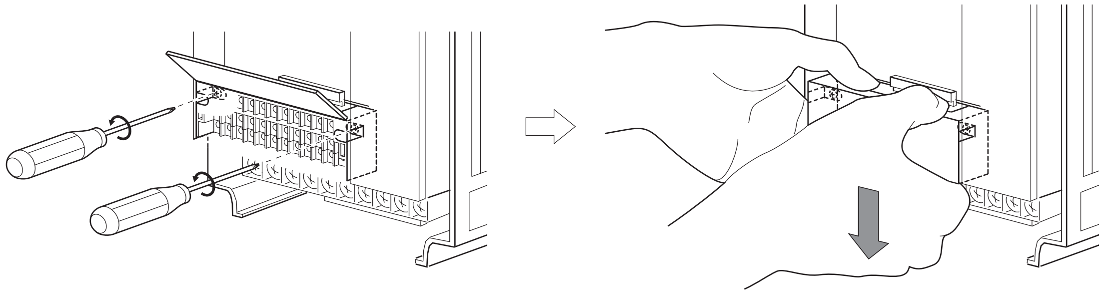
(3) Communication

Type	Terminal Symbol		Terminal Name	Description	Refer to page
RS-485	——		PU connector	With the PU connector, communication can be made through RS-485. (for connection on a 1:1 basis only) . Conforming standard : EIA-485(RS-485) . Transmission format : Multidrop link . Communication speed : 4800 to 38400bps . Overall length : 500m	*196*
	RS-485 terminals	TXD+	Inverter transmission terminal	With the RS-485 terminals, communication can be made through RS-485. Conforming standard : EIA-485(RS-485) Transmission format : Multidrop link Communication speed : 300 to 38400bps Overall length : 500m	*198*
		TXD-			
		RXD+	Inverter reception terminal		
		RXD-			
		SG	Earth (Ground)		

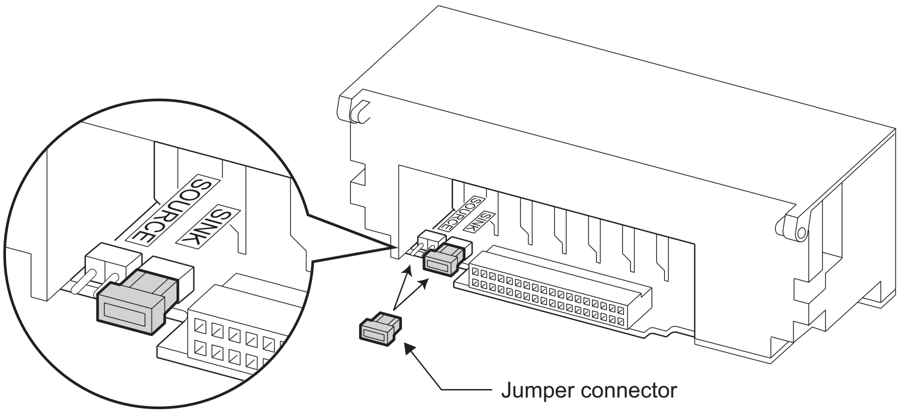
2.3.2 Changing the control logic

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

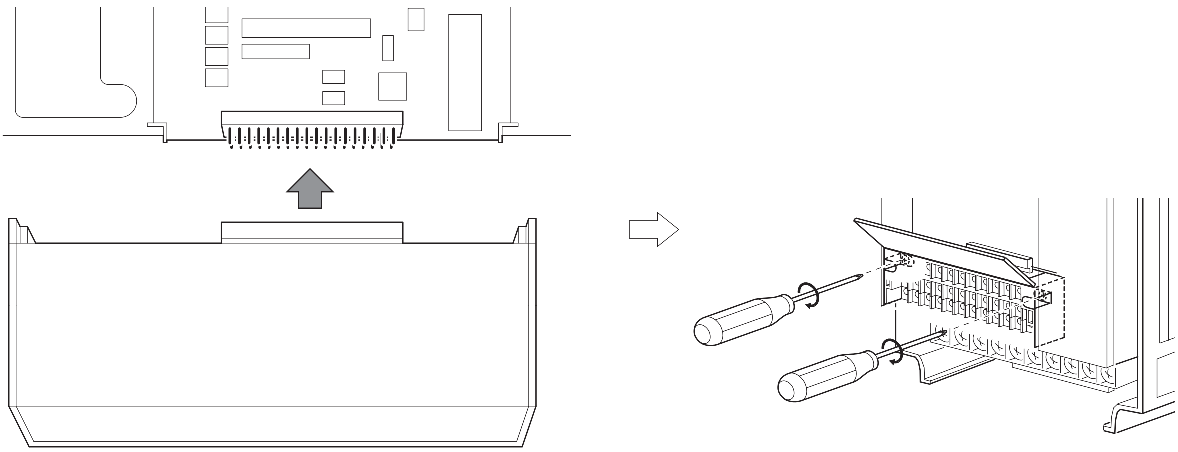
1) Loosen the two installation screws in both ends of the control circuit terminal block. (These screws cannot be removed.)
Pull down the terminal block from behind the control circuit terminals.



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



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

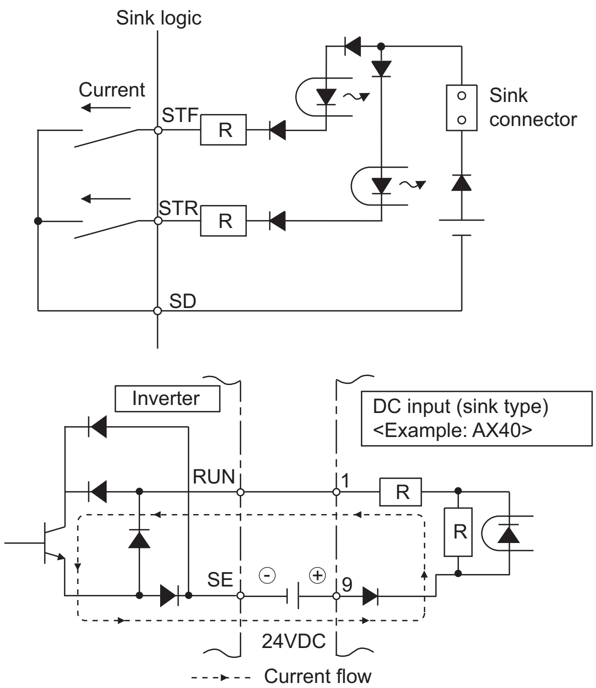


CAUTION

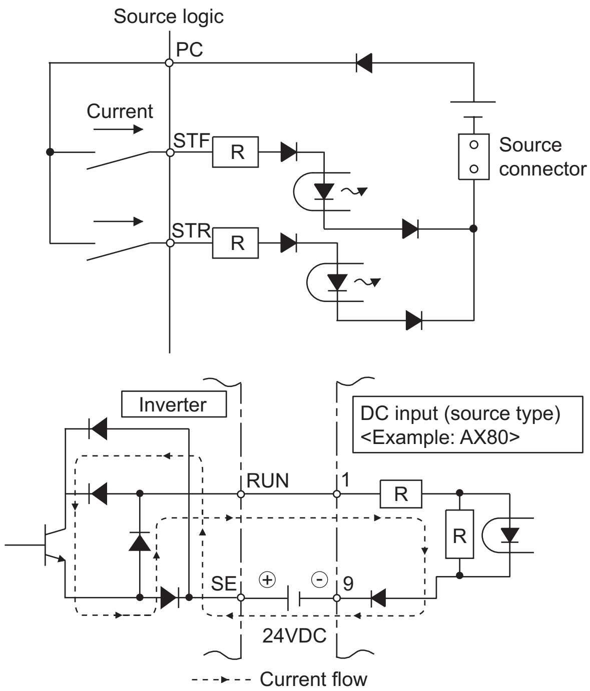
1. Make sure that the control circuit connector is fitted correctly.
2. While power is on, never disconnect the control circuit terminal block.

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

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



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



- When using an external power supply for transistor output

<table>
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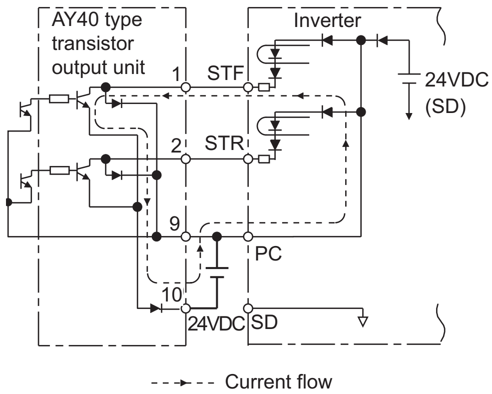
· Sink logic type
Use terminal PC as a common terminal to prevent a malfunction caused by undesirable current. (Do not connect terminal SD of the inverter with terminal 0V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install a power supply in parallel in the outside of the inverter. Doing so may cause a malfunction due to undesirable current.)



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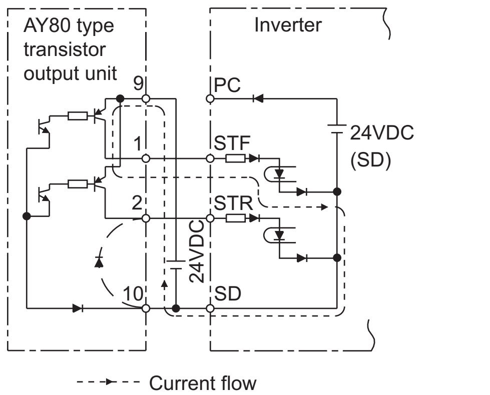
· Source logic type
When using an external power supply for transistor output, use terminal SD as a common to prevent misoperation caused by undesirable current.



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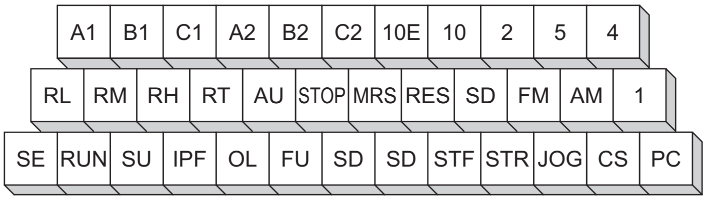
2.3.3 Control circuit terminal layout

Terminal screw size: M3.5
Tightening torque: 1.2N·m



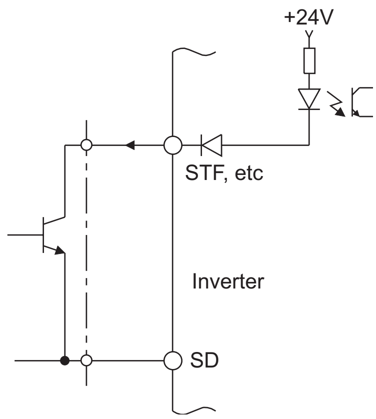
(1) Common terminals of the control circuit (SD, 5, SE)

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

(2) Signal inputs by contactless switches

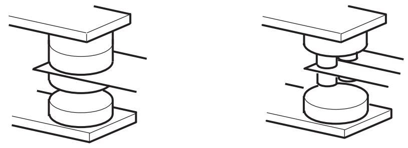
The contacted input terminals of the inverter (STF, STR, STOP, RH, RM, RL, JOG, RT, MRS, RES, AU, CS) can be controlled using a transistor instead of a contacted switch as shown on the right.

External signal input using transistor



2.3.4 Wiring instructions

1) Terminals 5, SD and SE are common to the I/O signals and isolated from each other. Do not earth (ground). Avoid connecting the terminal SD and 5 and the terminal SE and 5.
2) 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).
3) Use two or more parallel micro-signal contacts or twin contacts to prevent a contact faults when using contact inputs since the control circuit input signals are micro-currents.

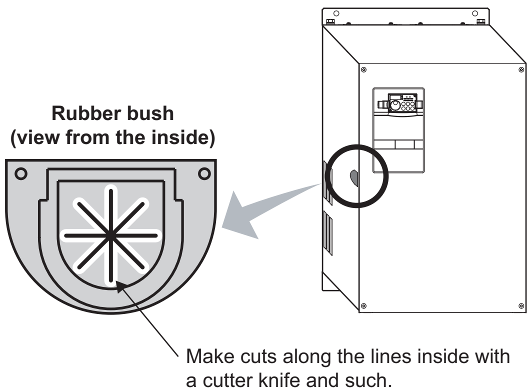


Micro signal contacts   Twin contacts

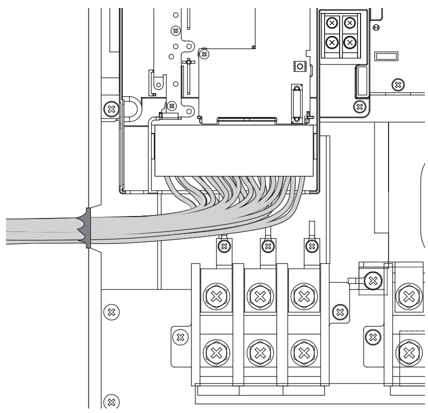
4) Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
5) Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp, etc.
6) It is recommended to use the cables of $0.75mm^2$ gauge for connection to the control circuit terminals.
   If the cable gauge used is $1.25mm^2$ or more, the front cover may be lifted when there are many cables running or the cables are run improperly, resulting in an operation panel contact fault.
7) The maximum wiring length should be 30m (200m for terminal FM).

● Wiring of the control circuit of the 75K or more

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

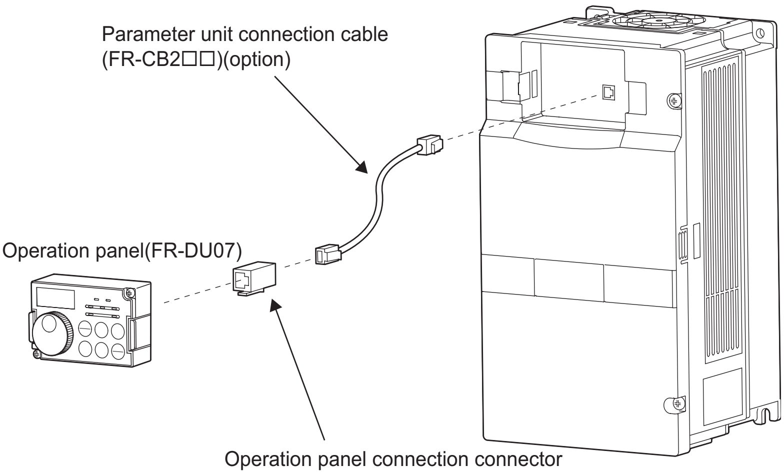


<Wiring>



2.3.5 When connecting the operation panel using a connection cable

When connecting the operation panel (FR-DU07) to the inverter using a cable, the operation panel can be mounted on the enclosure surface and operationality improves.



REMARKS

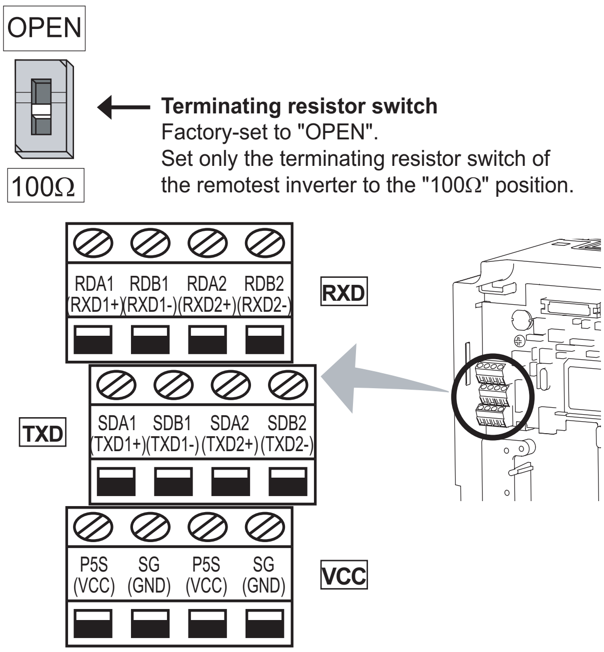
- Overall wiring length when the operation panel is connected: 20m
- Refer to the following when fabricating the cable on the user side.
  Commercially available product examples (as of Apr, 2004)

	Product	Type	Maker
1)	10BASE-T cable	SGLPEV-T 0.5mm × 4P	Mitsubishi Cable Industries, Ltd.
2)	RJ-45 connector	5-554720-3	Tyco Electronics Corporation

☞Refer to *page 201* for RS-485 communication.

2.3.6 RS-485 terminal block

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



2.3.7 Communication operation

Using the PU connector or RS-485 terminal, you can perform communication operation from a personal computer etc. When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the inverter or read and write to parameters.
For the Mitsubishi inverter protocol (computer link operation), communication can be performed with the PU connector and RS-485 terminal.
For the Modbus RTU protocol, communication can be performed with the RS-485 terminal.
For further details, *refer to 196*.

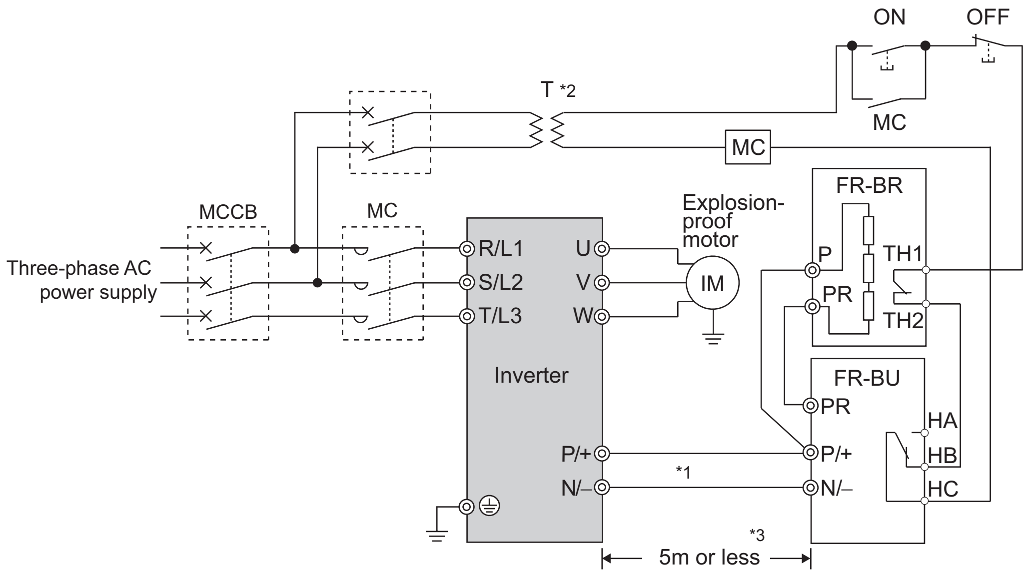
2.4 Connection of stand-alone option units

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

2.4.1 Connection of the brake unit (FR-BU/MT-BU5)(FR-B-75K or more)

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

(1) Connection with the FR-BU



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

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

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

CAUTION

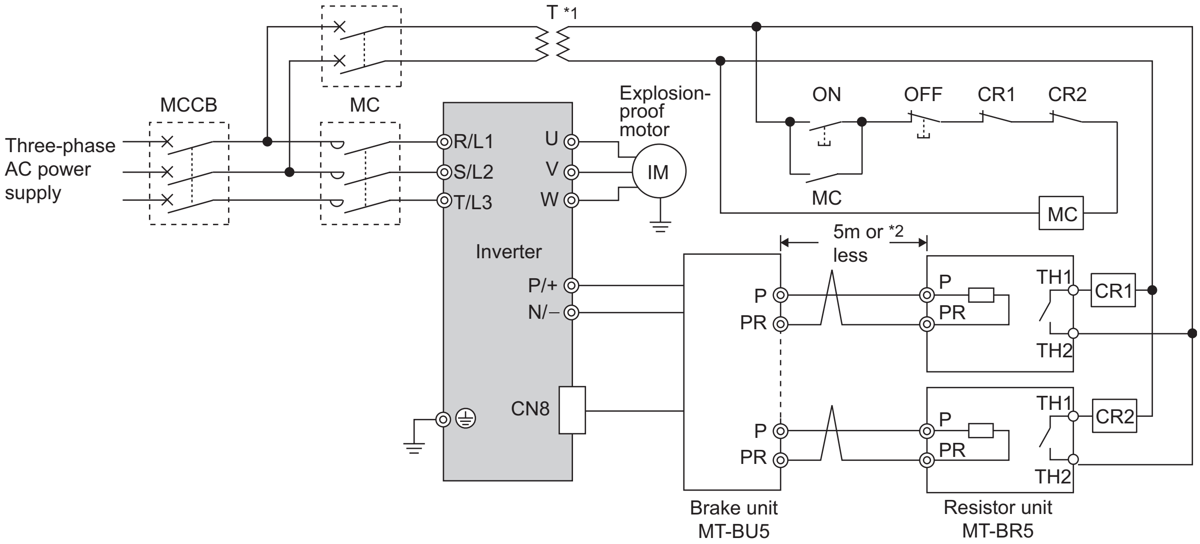
- When used with the 55K or less, another explosion-proof test is necessary.
- If the transistors in the brake unit should become faulty, the resistor can be unusually hot, causing a fire. Therefore, install a magnetic contactor on the inverter's input side to configure a circuit so that a current is shut off in case of fault.

(2) Connection with the MT-BU5

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

Pr. 30 Regenerative function selection = "1"

Pr. 70 Special regenerative brake duty = "10%" (*Refer to page 102*)



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

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

CAUTION

· Install the brake unit in a place where a cooling air reaches the brake unit heatsink and within a distance of the cable supplied with the brake unit reaches the inverter.

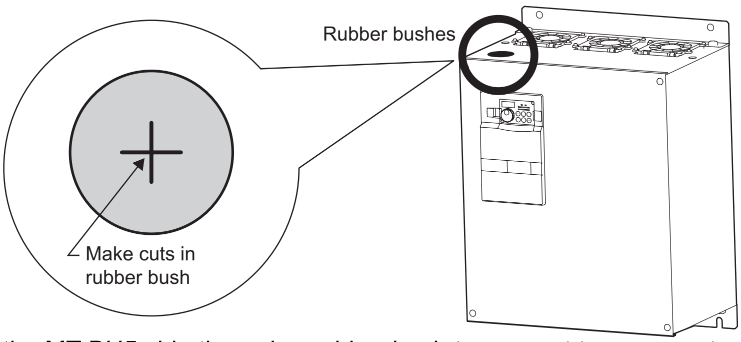
· For wiring of the brake unit and inverter, use an accessory cable supplied with the brake unit. Connect the main circuit cable to the inverter terminals P/+ and N/- and connect the control circuit cable to the CN8 connector inside by making cuts in the rubber bush at the top of the inverter for leading the cable.

· The brake unit which uses multiple resistor units has terminals equal to the number of resistor units. Connect one resistor unit to one pair of terminal (P, PR).

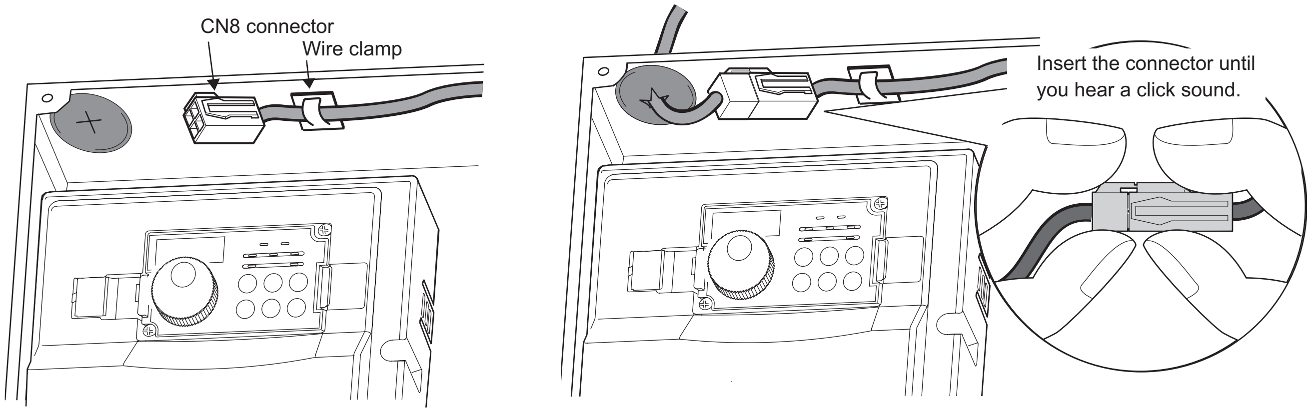
<Inserting the CN8 connector>

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

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



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



CAUTION

Clamp the CN8 connector cable on the inverter side with a wire clamp securely.

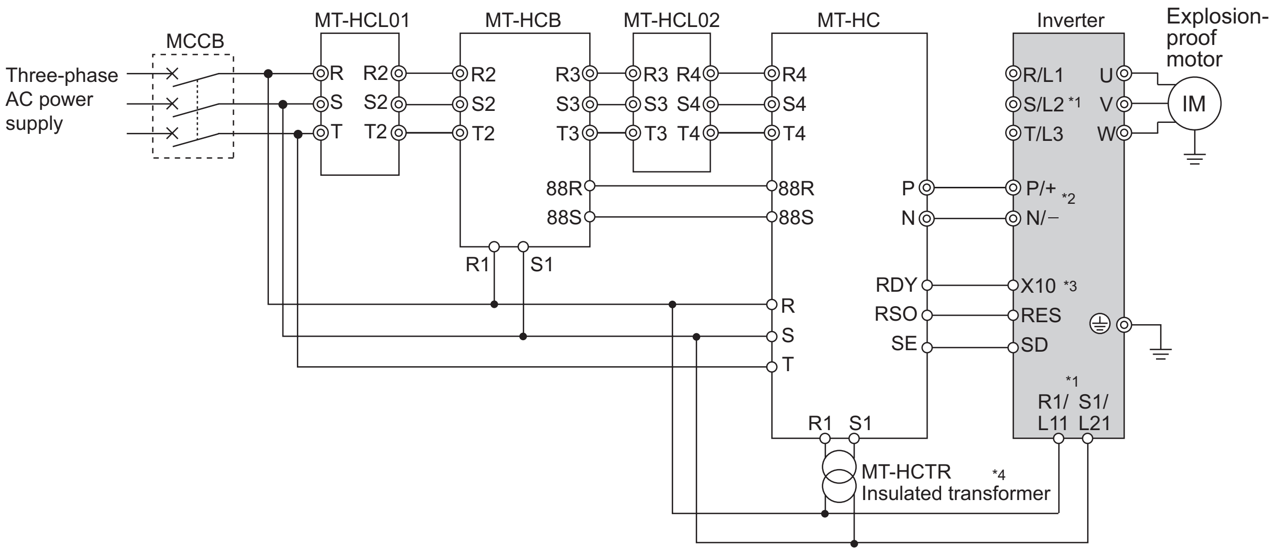
Do not connect the MT-BU5 to a CN8 connector of the FR-B-55K (400V class), FR-B3-(N)H55K.

2

WIRING

2.4.2 Connection of the high power factor converter (MT-HC)(FR-B-75K or more)

When connecting the high power factor converter (MT-HC) to suppress power harmonics, perform wiring securely as shown below.
Incorrect connection will damage the high power factor converter and inverter.
After making sure that the wiring is correct, set "2" in *Pr. 30 Regenerative function selection*. (*Refer to page 102.*)



*1 Remove the jumper across terminals R/L1 - R1/L11, S/L2 - S1/L21 of the inverter, and connect the control circuit power supply to the R1/L11 and S1/L21 terminals. The power input terminals R/L1, S/L2, T/L3 must be open. Incorrect connection will damage the inverter. (E.OPT (option alarm) will occur. (*Refer to page 273.*)

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

*3 Use *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the terminals used for the X10 (X11) signal. (*Refer to page 118.*) For communication where the start command is sent only once, e.g. RS-485 communication operation, use the X11 signal when making setting to hold the mode at occurrence of an instantaneous power failure. (*Refer to page 103.*)

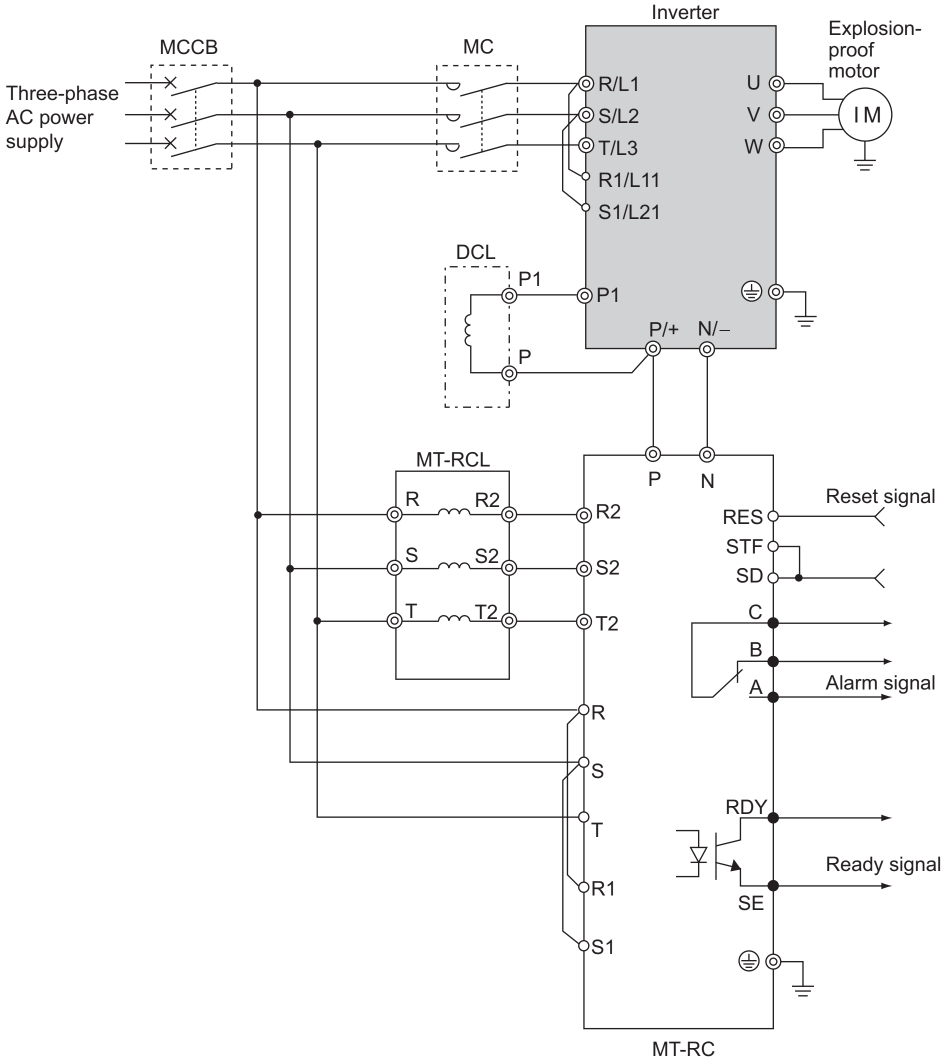
*4 Connect the power supply to terminals R1 and S1 of the MT-HC via an insulated transformer.

CAUTION

- The voltage phases of terminals R/L1, S/L2, T/L3 and terminals R4, S4, T4 must be matched.
- Use sink logic (factory setting) when the MT-HC is connected. The MT-HC cannot be connected when source logic is selected.
- When connecting the inverter to the MT-HC, do not connect the DC reactor provided to the inverter.

2.4.3 Connection of power regeneration converter (MT-RC) (75K or more)

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

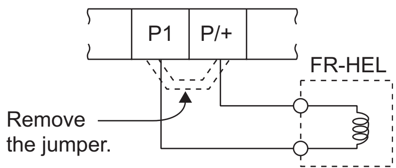


CAUTION

· Refer to the MT-RC manual for precautions for connecting the power coordination reactor and others.

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

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



CAUTION

1. The wiring distance should be within 5m.
2. The size of the cables used should be equal to or larger than that of the power supply cables (R/L1, S/L2, T/L3). *(Refer to page 20)*

MEMO

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 Noise 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 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 breaker according to its rated sensitivity current, independently of the carrier frequency setting.

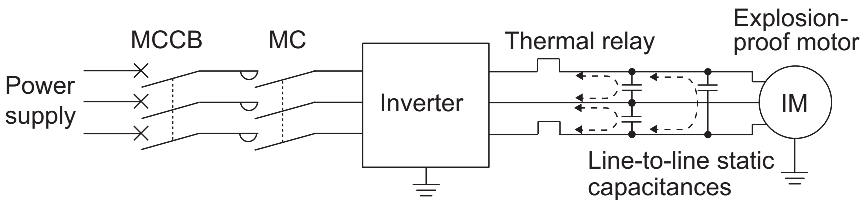
(1) To-earth (ground) leakage currents

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.

- Countermeasures
  - · For leakage breakers for the inverter's own line and other line, select the ones designed for harmonic and surge suppression.
- To-earth (ground) leakage currents
  - · Take caution as long wiring will increase the leakage current. Decreasing the carrier frequency of the inverter reduces the leakage current.
  - · Increasing the motor capacity increases the leakage current. The leakage current of the 400V class is larger than that of the 200V class.

(2) Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacities 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 (7.5K 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 currents path

- Countermeasures
  - · Use *Pr. 9 Electronic thermal O/L relay*.
  - · 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 (ground) leakage breaker, use the Mitsubishi earth (ground) leakage breaker designed for harmonics and surge suppression.

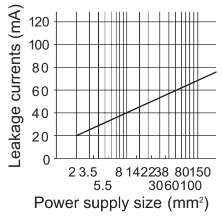
(3) Selection of rated sensitivity current of earth (ground) leakage breaker

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

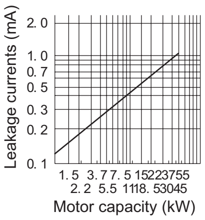
- Breaker designed for harmonic and surge suppression
  Rated sensitivity current:
  IΔn ≥ 10 × (Ig1 + Ign + Igi + Ig2 + Igm)
- Standard breaker
  Rated sensitivity current:
  IΔn ≥ 10 × {Ig1 + Ign + Igi + 3 × (Ig2 + Igm)}

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

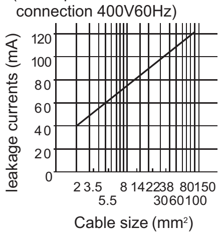
Example of leakage current of cable path per 1km during the commercial power supply operation when the CV cable is routed in metal conduit
(200V 60Hz)



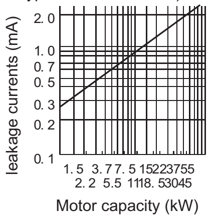
Leakage current example of three-phase induction motor during the commercial power supply operation
(200V 60Hz)



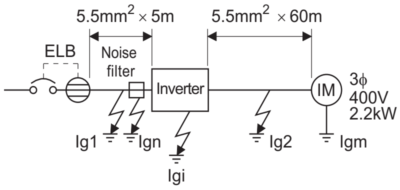
Example of leakage current per 1km during the commercial power supply operation when the CV cable is routed in metal conduit
(Three-phase three-wire delta connection 400V60Hz)



Leakage current example of Three-phase induction motor during the commercial power supply operation
(Totally-enclosed fan-cooled type motor 400V60Hz)



<Example>

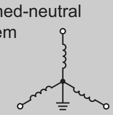


	Breaker Designed for Harmonic and Surge Suppression	Standard Breaker
Leakage current Ig1 (mA)	$33 \times \frac{5m}{1000m} = 0.17$	
Leakage current Ign (mA)	0 (without noise filter)	
Leakage current Igi (mA)	1 (without EMC filter) Refer to the following table for the leakage current of the inverter*	
Leakage current Ig2 (mA)	$33 \times \frac{50m}{1000m} = 1.65$	
Motor leakage current Igm (mA)	0.18	
Total leakage current (mA)	3.00	6.66
Rated sensitivity current (mA) (≥ Ig × 10)	30	100

* *Refer to page 15* for the EMC filter.

●Inverter leakage current (with and without EMC filter)

Input power conditions
(200V class: 220V/60Hz, 400V class: 440V/60Hz, power supply unbalance within 3%)

	Voltage (V)	EMC Filter	
		ON (mA)	OFF (mA)
Phase grounding 	200	22(1)*	1
	400	30	1
Earthed-neutral system 	400	1	1

*For the FR-B-750 (200V class), FR-B3-(N)400,750 the EMC filter is always valid.
The leakage current is 1mA.

CAUTION

- Install the earth leakage breaker (ELB) on the input side of the inverter.
- In the 人 connection earthed-neutral system, the sensitivity current is purified 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. (JIS, 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.
- The following models are standard breakers....BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA and 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

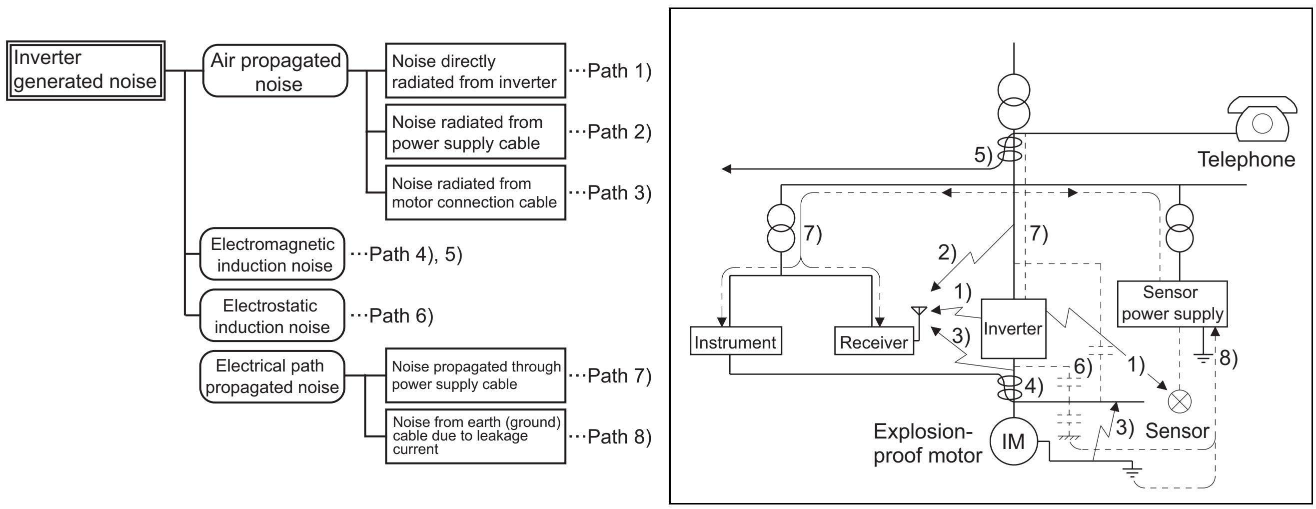
3.1.2 Inverter-generated noises and their reduction techniques

Some noises enter the inverter to malfunction it and others are radiated by the inverter to malfunction peripheral devices. Though the inverter is designed to be insusceptible to noises, 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 noises. If these noises cause peripheral devices to malfunction, measures should be taken to suppress noises. These techniques differ slightly depending on noise propagation 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 pair shielded cables for the detector connection 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 noises that enter and malfunction the inverter
When devices that generate many noises (which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter and the inverter may be malfunctioned by noises, the following measures must be taken:
- Provide surge suppressors for devices that generate many noises to suppress noises.
- Fit data line filters (*page 43*) to signal cables.
- Earth (Ground) the shields of the detector connection and control signal cables with cable clamp metal.

3) Techniques to reduce noises that are radiated by the inverter to malfunction peripheral devices
Inverter-generated 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.

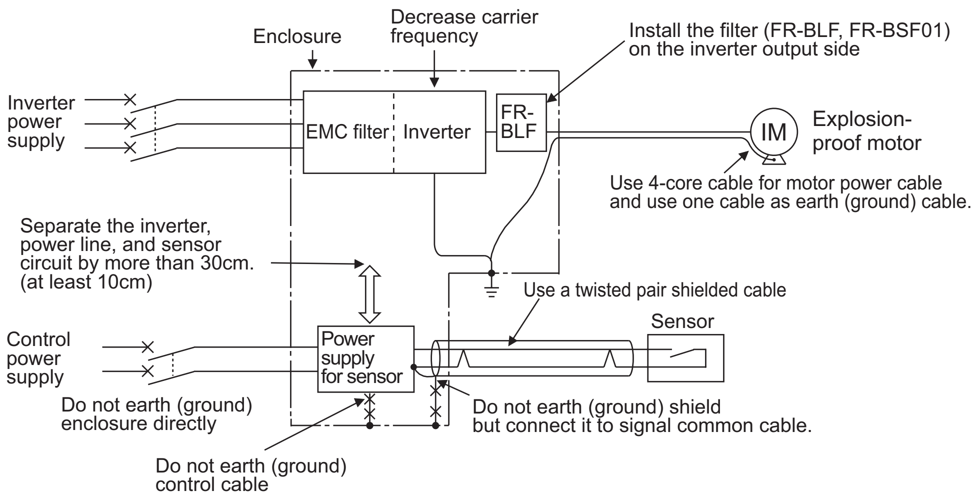


Noise Propagation Path	Measures
1) 2) 3)	When devices that handle low-level signals and are liable to malfunction due to noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or when their signal cables are run near the inverter, the devices may be malfunctioned by air-propagated noises. The following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the inverter and its I/O cables. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Set the EMC filter ON/OFF connector of the inverter to the ON position. *(Refer to page 15)* (5) Inserting a line noise filter into the output suppresses the radiation noise from the cables. (6) Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
4) 5) 6)	When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables to malfunction the devices and the following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the I/O cables of the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) 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: (1) Set the EMC filter ON/OFF connector of the inverter to the ON position. *(Refer to page 15)* (2) Install the line noise filter (FR-BLF, FR-BSF01) to the power cables (I/O cables) 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

Noise entry can be prevented by providing a data line filter for the detector cable etc.

●Noise reduction examples



3

PRECAUTIONS FOR USE OF THE INVERTER

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.

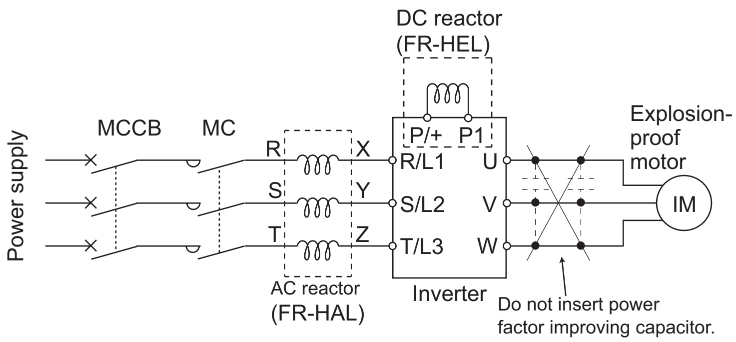
●The differences between harmonics and noises are indicated below:

Item	Harmonics	Noise
Frequency	Normally number 40 to 50 max. (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	Depending on the current fluctuation ratio (larger as switching is faster)
Affected equipment immunity	Specified in standard per equipment	Different depending on maker's equipment specifications
Suppression example	Provide reactor.	Increase distance.

●Measures

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

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



CAUTION

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

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The harmonic suppression guideline was established to protect other consumers from these outgoing harmonic currents.
The three-phase 200V input specifications 3.7kW or less are previously covered by "Harmonic suppression guideline for household appliances and general-purpose products" and other models are covered by "Harmonic suppression guideline for consumers who receive high voltage or special high voltage". However, the general-purpose inverter has been excluded from the target products covered by "Harmonic suppression guideline for household appliances and general-purpose products" in January 2004. Later, this guideline was repealed on September 6, 2004. All capacities of all models are now target products of "Harmonic suppression guideline for consumers who receive high voltage or special high voltage".

"Guideline for specific consumers"
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 is exceeded, this guideline requires that 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 of the harmonic suppression guideline for specific consumers

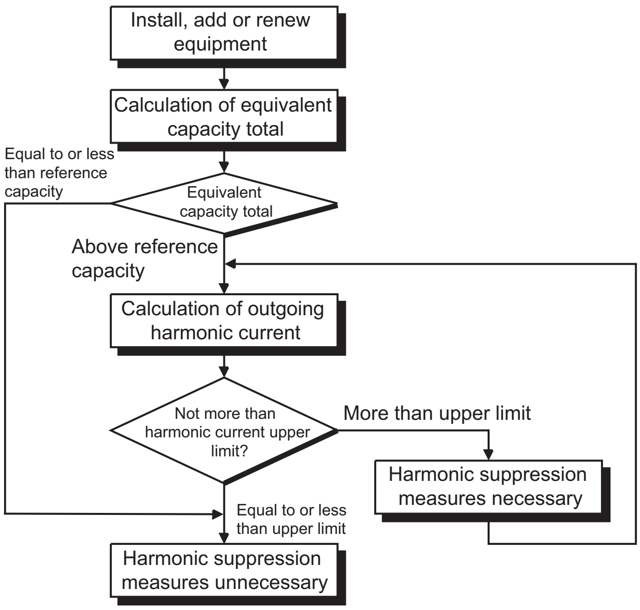


Table 2 Conversion factors for FR-B,B3 series

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)	K33 = 1.8
		With reactor (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
22/33kV	300kVA
66kV or more	2000kVA

Table 4 Harmonic content (Values of the fundamental current is 100%)

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

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(According 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 of inverter-driven motors

Applied 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	5.5	2.75	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2	7.93	3.96	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320
3.7	13.0	6.50	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092
5.5	19.1	9.55	579	6.77	376.1	237.4	49.22	44.58	24.90	17.95	15.05	10.42
7.5	25.6	12.8	776	9.07	504.4	318.2	65.96	59.75	33.37	24.06	20.18	13.97
11	36.9	18.5	1121	13.1	728.7	459.6	95.29	86.32	48.20	34.75	29.15	20.18
15	49.8	24.9	1509	17.6	980.9	618.7	128.3	116.2	64.89	46.78	39.24	27.16
18.5	61.4	30.7	1860	21.8	1209	762.6	158.1	143.2	79.98	57.66	48.36	33.48
22	73.1	36.6	2220	25.9	1443	910.2	188.7	170.9	95.46	68.82	57.72	39.96
30	98.0	49.0	2970	34.7	1931	1218	252.5	228.7	127.7	92.07	77.22	53.46
37	121	60.4	3660	42.8	2379	1501	311.1	281.8	157.4	113.5	95.16	65.88
45	147	73.5	4450	52.1	2893	1825	378.3	342.7	191.4	138.0	115.7	80.10
55	180	89.9	5450	63.7	3543	2235	463.3	419.7	234.4	169.0	141.7	98.10

Applied Motor (kW)	Rated Current (A)		Fundamental Wave Current Converted from 6.6kV (mA)	Rated Capacity (kVA)	Outgoing Harmonic Current Converted from 6.6kV (mA) (With DC reactor, 100% operation ratio)							
	200V	400V			5th	7th	11th	13th	17th	19th	23rd	25th
75	245	123	7455	87.2	2237	969	626	373	350	239	224	164
90	293	147	8909	104	2673	1158	748	445	419	285	267	196
110	357	179	10848	127	3254	1410	911	542	510	347	325	239

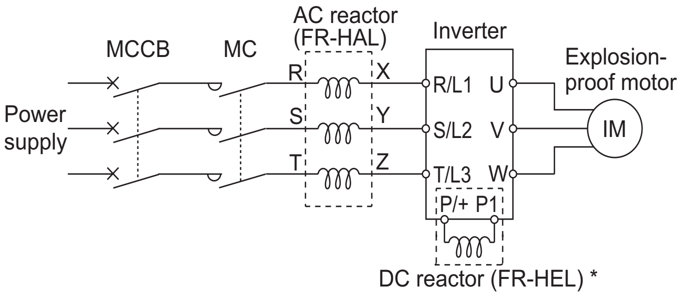
3) Harmonic suppression technique requirement
If the outgoing harmonic current is higher than the maximum value per 1kW (contract power) × contract power, a harmonic suppression technique is required.

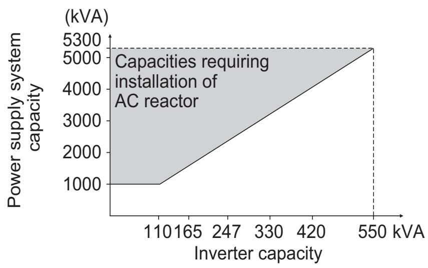
4) Harmonic suppression techniques

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.
2	High power factor converter (MT-HC)	The converter circuit is switched on-off to convert an input current waveform into a sine wave, suppressing harmonic currents substantially. The high power factor converter (MT-HC) 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 - △, △ - △ 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	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 a reactor

When the inverter is connected near a large-capacity power transformer (1000kVA or more and wiring length 10m max.) 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 the optional DC reactor (FR-HEL) or AC reactor (FR-HAL)





* When connecting the FR-HEL to the 55K or less, remove the jumper across terminals P/+ - P1. For the 75K or more, a DC reactor is supplied. Always install the reactor.

REMARKS

The wiring length between the FR-HEL and inverter should be 5m maximum and minimized. Use the same wire size as that of the power supply wire (R/L1, S/L2, T/L3). *(Refer to page 20)*

3.3 Power-off and magnetic contactor (MC)

(1) Inverter input side magnetic contactor (MC)

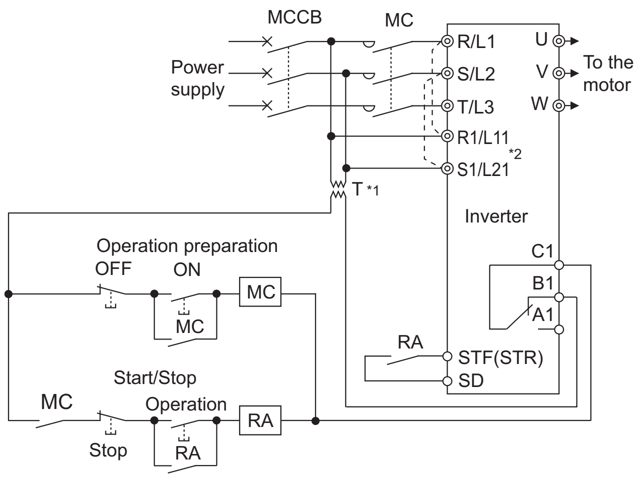
On the inverter input side, it is recommended to provide an MC for the following purposes.

(Refer to *page 4* for selection.)

1) To release the inverter from the power supply when the inverter's protective function is activated or when the drive is not functioning (e.g. emergency stop operation).
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 reset the inverter for an extended period of time
   The control power supply for inverter is always running and consumes a little power. When stopping the inverter for an extended period of time, powering off the inverter will save power slightly.
4) To separate the inverter from the power supply to ensure safe maintenance and inspection work
   The inverter's input side MC is used for the above purpose, select class JEM1038-AC3MC for the inverter input side current when making an emergency stop during normal operation.

REMARKS

Since repeated inrush currents at power on will shorten the life of the converter circuit (switching life is about 1,000,000 times. (For the 200V class 37K or more, switching life is about 500,000)), frequent starts and stops of the MC must be avoided. Turn on/off the inverter start controlling terminals (STF, STR) to run/stop the inverter.



• Inverter start/stop circuit example

As shown on the left, always use the start signal (ON or OFF across terminals STF or STR-SD) to make a start or stop. *(Refer to page 123)*

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

*2 Connect the power supply terminals R1/L11, S1/L21 of the control circuit to the primary side of the MC to hold an alarm signal when the inverter's protective circuit is activated. At this time, remove jumpers across terminals R/L1-R1/L11 and S/L2-S1/L21. (Refer to *page 24* for removal of the jumper.)

(2) Handling of the inverter output side magnetic contactor

Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned on while the inverter is operating, overcurrent protection of the inverter and such will activate.

3.4 Precautions for use of the inverter

The FR-B, B3 series is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product.
Before starting operation, always recheck the following items.

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

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

(3) After wiring, wire offcuts must not be left in the inverter.
Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the inverter.

(4) Use cables of the size to make a voltage drop 2% maximum.
If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.
Refer to *page 20* for the recommended cable sizes.

(5) The overall wiring length should be 500m maximum.
Especially for long distance wiring, the fast-response current limit function may decrease or the equipment connected to the secondary side may malfunction or become faulty under the influence of a charging current due to the stray capacity of the wiring. Therefore, note the overall wiring length. *(Refer to page 23.)*

(6) Electromagnetic wave interference
The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, set the EMC filter valid to minimize interference. *(Refer to page 15)*

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

(8) Before starting wiring or other work after the inverter is operated, 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.

(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 inter-phase insulation of the inverter output side before power-on. Especially for an old motor or use in hostile atmosphere, securely check the motor insulation resistance etc.

(10) Do not use the inverter input side magnetic contactor to start/stop the inverter.
Always use the start signal (ON/OFF of STF and STR signals) to start/stop the inverter. *(Refer to page 48)*

(11) Do not apply a voltage higher than the permissible voltage to the inverter I/O signal circuits.
Contact 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 10E-5.

(12) 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.

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

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

4 PARAMETERS

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

The abbreviations in the explanations below are as follows:

B ...FR-B series,

B3 ...FR-B3 series,

Parameters with the above abbreviations are supported by the corresponding series.
(Parameters without abbreviations are supported by both FR-B and FR-B3 series.)

4.1 Operation panel (FR-DU07)

4.1.1 Parts of the operation panel (FR-DU07)

Operation mode indication
PU: Lit to indicate PU operation mode.
EXT: Lit to indicate external operation mode.
NET: Lit to indicate network operation mode.

Rotation direction indication
FWD: Lit during forward rotation
REV: Lit during reverse rotation

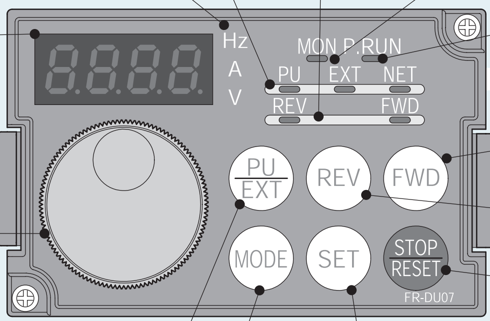
On:	Forward/reverse operation
Flickering:	When the frequency command is not given even if the forward/reverse command is given.

Unit indication
· Hz: Lit to indicate frequency.
· A: Lit to indicate current.
· V: Lit to indicate voltage.
(Flicker when the set frequency monitor is displayed.)

Monitor indication
Lit to indicate monitoring mode.

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

No function

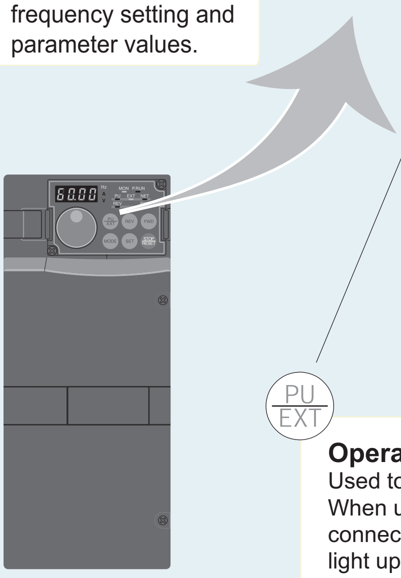


FWD **Start command forward rotation**

REV **Start command reverse rotation**

Setting dial
(Setting dial: Mitsubishi inverter dial)
Used to change the frequency setting and parameter values.

STOP/RESET **Stop operation**
Alarms can be reset



SET
Used to set each setting.
If pressed during operation, monitor changes as below;

Running frequency → Output current → Output voltage *

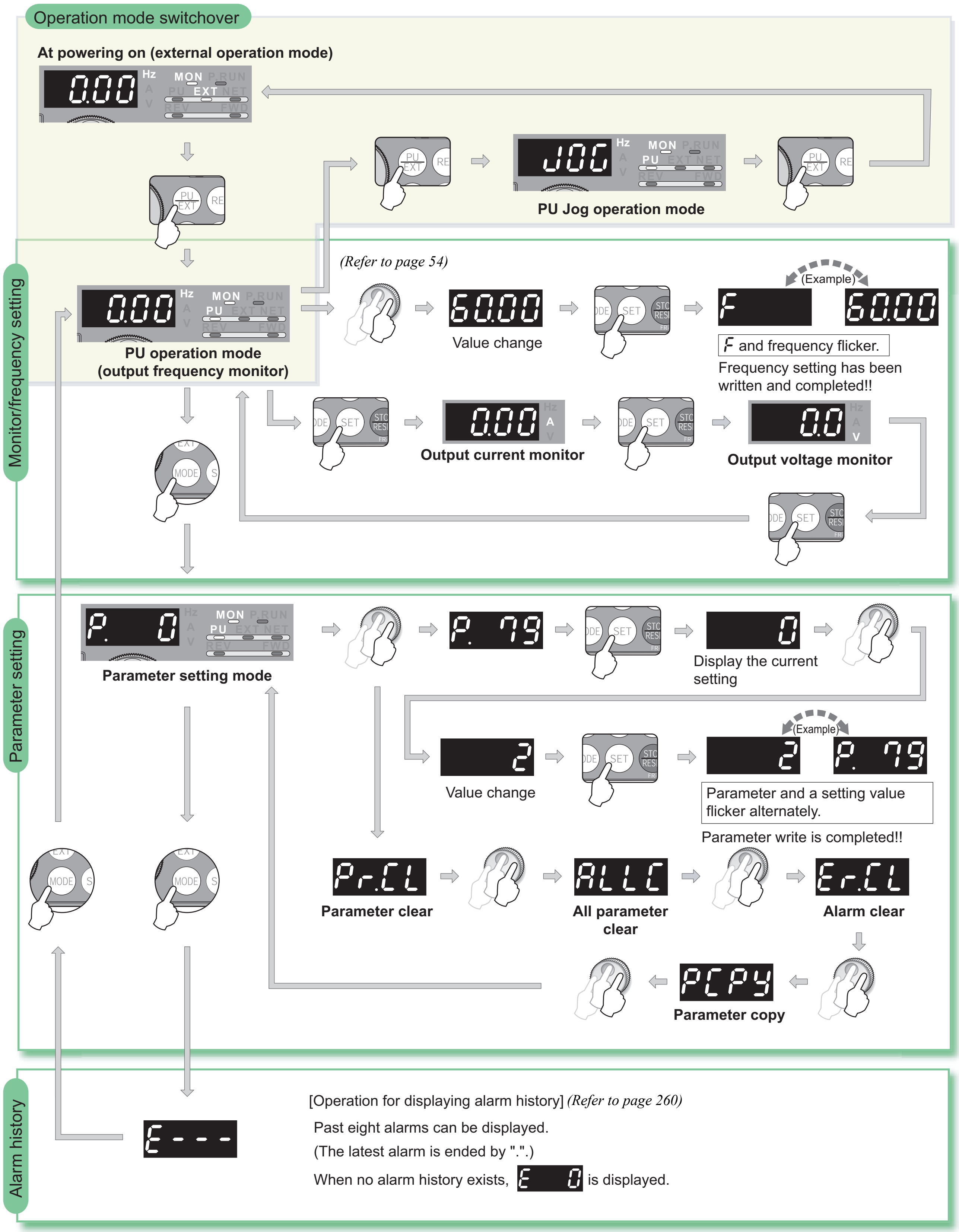
* Energy saving monitor is displayed when the energy saving monitor of *Pr. 52* is set.

MODE **Mode switchover**
Used to change each setting mode.

PU/EXT

Operation mode switchover
Used to switch between the PU and external operation mode.
When using the external operation mode (operation using a separately connected frequency setting potentiometer and start signal), press this key to light up the EXT indication. (Change the *Pr.79* value to use the combined mode.)
PU: PU operation mode
EXT: External operation mode

4.1.2 Basic operation (factory setting)

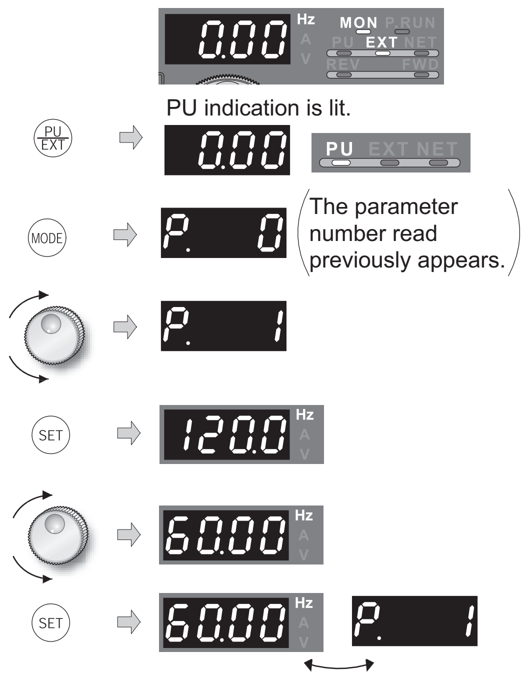


4.1.3 Change the parameter setting value

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

Operation — Display

1. Screen at powering 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 P. 1 (*Pr. 1*) appears.
5. Press (SET) to read the currently set value.
   " 120.0 "(initial value) appears.
6. Turn (dial) to change it to the set value "60.00".
7. Press (SET) to set.



Flicker ··· Parameter setting complete!!

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

? Er1 to Er4 are 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 266*.

4.1.4 Setting dial push

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

4.2 Parameter List

4.2.1 Parameter list

For simple variable-speed operation of the inverter, the initial setting of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel (FR-DU07).

REMARKS

- ◎ indicates simple mode parameters. (initially set to extended mode)
- The shaded parameters in the table allow its setting to be changed during operation even if "0" (initial value) is set in *Pr. 77 Parameter write selection.*
- Refer to the appendix 4 *(page 310)* for instruction codes for communication and availability of parameter clear, all clear, and parameter copy of each parameter.

Function	Parameter	Name	Setting Range		Minimum Setting Increments	Initial Value		Refer to Page	Customer Setting
			FR-B	FR-B3		FR-B	FR-B3		
Basic functions	◎ 1	Maximum frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz	120/60Hz *2	*79*	
Basic functions	◎ 2	Minimum frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	0Hz		*79*	
Basic functions	◎ 4	Multi-speed setting (high speed)	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		*81*	
Basic functions	◎ 5	Multi-speed setting (middle speed)	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	30Hz		*81*	
Basic functions	◎ 6	Multi-speed setting (low speed)	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	10Hz		*81*	
Basic functions	◎ 7	Acceleration time	0 to 3600/360s		0.1/0.01s	5/15s *3		*88*	
Basic functions	◎ 8	Deceleration time	0 to 3600/360s		0.1/0.01s	5/15s *3		*88*	
Basic functions	◎ 9	Electronic thermal O/L relay	0 to 500/0 to 3600A *2		0.01/0.1A *2	Inverter rated current		*96*	
DC injection brake	10	DC injection brake operation frequency	—	0 to 120Hz, 9999	0.01Hz	—	3Hz	*100*	
DC injection brake	11	DC injection brake operation time	0.5/0s *2	0 to 10s, 8888	0.1s	0.5s/ 0s *2	0.5s	*100*	
DC injection brake	12	DC injection brake operation voltage	—	0 to 30%	0.1%	—	4/2/1%*4	*100*	
—	13	Starting frequency	0 to 60Hz		0.01Hz	0.5Hz		*90*	
Jog operation	15	Jog frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	5Hz		*83*	
Jog operation	16	Jog acceleration/deceleration time	0 to 3600/360s		0.1/0.01s	0.5s		*83*	
—	17	MRS input selection	0, 2		1	0		*121*	
Acceleration/ deceleration times	20	Acceleration/deceleration reference frequency	1 to 120Hz/ 1 to 60Hz *1	1 to 120Hz	0.01Hz	60Hz		*88*	
Acceleration/ deceleration times	21	Acceleration/deceleration time increments	0, 1		1	0		*88*	
Stall prevention	22	Stall prevention operation level (torque limit level)	0 to 400%		0.1%	150%		*74*	
Stall prevention	23	Stall prevention operation level compensation factor at double speed	0 to 200%, 9999		0.1%	9999		*74*	
Multi-speed setting	24 to 27	Multi-speed setting (4 speed to 7 speed)	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*81*	
—	28	Multi-speed input compensation selection	0, 1		1	0		*85*	
—	29	Acceleration/deceleration pattern selection	0 to 5		1	0		*91*	
—	30	Regenerative function selection	0, 1, 2	—	1	0	—	*102*	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
Frequency jump	31	**Frequency jump 1A**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*80*	
	32	**Frequency jump 1B**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*80*	
	33	**Frequency jump 2A**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*80*	
	34	**Frequency jump 2B**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*80*	
	35	**Frequency jump 3A**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*80*	
	36	**Frequency jump 3B**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*80*	
—	37	**Speed display**	0, 1 to 9998		1	0		*135*	
Frequency detection	41	**Up-to-frequency sensitivity**	0 to 100%		0.1%	10%		*130*	
	42	**Output frequency detection**	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	6Hz		*130*	
	43	**Output frequency detection for reverse rotation**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*130*	
Second functions	44	**Second acceleration/deceleration time**	0 to 3600/360s		0.1/0.01s	5s		*88*	
	45	**Second deceleration time**	0 to 3600/360s, 9999		0.1/0.01s	9999		*88*	
	48	**Second stall prevention operation current**	0 to 220%		0.1%	150%		*74*	
	49	**Second stall prevention operation frequency**	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	0Hz		*74*	
	50	**Second output frequency detection**	0 to 120Hz/ 0 to 60Hz	0 to 120Hz	0.01Hz	30Hz		*130*	
Monitor functions	52	**DU/PU main display data selection**	0, 5, 6, 8 to 14, 17 to 20, 22 to 25, 50 to 57, 100	0, 5 to 14, 17 to 20, 22 to 25, 34, 50 to 57, 100	1	0		*137*	
	54	**FM terminal function selection**	1 to 3, 5, 6, 8 to 14, 17, 18, 21, 24, 50, 52, 53	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52, 53	1	1		*137*	
	55	**Frequency monitoring reference**	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		*142*	
	56	**Current monitoring reference**	0 to 500/0 to 3600A *2		0.01/0.1A *2	Inverter rated current		*142*	
Automatic restart	57	**Restart coasting time**	0, 0.1 to 5s, 9999/ 0, 0.1 to 30s, 9999 *2		0.1s	9999		*148*	
	58	**Fault definition**	0 to 60s		0.1s	1s		*148*	
—	59	**Remote function selection**	0, 1, 2, 3		1	0		*85*	
Automatic acceleration/ deceleration	61	**Reference current**	—	0 to 500A, 9999	0.01A	—	9999	*156, 94*	
	62	**Reference value at acceleration**	—	0 to 220%, 9999	0.1%	—	9999	*94*	
	63	**Reference value at deceleration**	—	0 to 220%, 9999	0.1%	—	9999	*94*	
—	65	**Retry selection**	0 to 5		1	0		*155*	
—	66	**Stall prevention operation reduction starting frequency**	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		*74*	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
Retry	67	Number of retries at alarm occurrence	0 to 10, 101 to 110		1	0		155	
	68	Retry waiting time	0 to 10s		0.1s	1s		155	
	69	Retry count display erase	0		1	0		155	
—	70	Special regenerative brake duty	0 to 10% *7	—	0.1%	0%	—	102	
—	71	Applied motor	0, 1	—	1	0	—	68, 99	
—	73	Analog input selection	0 to 7, 10 to 17		1	1		169	
—	74	Input filter time constant	0 to 8		1	1		171	
—	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17		1	14		177	
—	76	Alarm code output selection	0, 1, 2		1	0		157	
—	77	Parameter write selection	0, 1, 2		1	0		179	
—	78	Reverse rotation prevention selection	0, 1, 2		1	0		180	
—	◎ 79	Operation mode selection	0, 1, 2, 3, 4, 6, 7		1	0		182	
Motor constants	80	Motor capacity	—	Inverter capacity	0.01kW	—	Inverter capacity	68, 70	
	81	Number of motor poles	—	4	1	—	4	68, 70	
	82	Motor excitation current	—	Reading only. Not settable.	Reading only. Not settable.	—	9999	70	
	83	Motor rated voltage	—	0 to 1000V	0.1V	—	200/400V *5	70	
	84	Rated motor frequency	—	10 to 120Hz	0.01Hz	—	60Hz	70	
	89	Speed control gain (magnetic flux vector)	—	Reading only. Not settable.	Reading only. Not settable.	—	9999	68	
	90	Motor constant (R1)	—			—	9999	70	
	91	Motor constant (R2)	—			—	9999	70	
	92	Motor constant (L1)	—			—	9999	70	
	93	Motor constant (L2)	—			—	9999	70	
	94	Motor constant (X)	—			—	9999	70	
	96	Auto tuning setting/status	—	0, 1, 101	1	—	0	70	
Third functions	110	Third acceleration/deceleration time	0 to 3600/360s, 9999		0.1/0.01s	9999		88	
	111	Third deceleration time	0 to 3600/360s, 9999		0.1/0.01s	9999		88	
	114	Third stall prevention operation current	0 to 220%		0.1%	150%		74	
	115	Thrid stall prevention operation frequency	0 to 120Hz, / 0 to 60Hz *1	0 to 120Hz	0.01Hz	0		74	
	116	Third output frequency detection	0 to 120Hz, / 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		130	
PU connector communication	117	PU communication station number	0 to 31		1	0		201	
	118	PU communication speed	48, 96, 192, 384		1	192		201	
	119	PU communication stop bit length	0, 1, 10, 11		1	1		201	
	120	PU communication parity check	0, 1, 2		1	2		201	
	121	Number of PU communication retries	0 to10, 9999		1	1		201	
	122	PU communication check time interval	0, 0.1 to 999.8s, 9999		0.1s	9999		201	
	123	PU communication waiting time setting	0 to 150ms, 9999		1	9999		201	
	124	PU communication CR/LF selection	0, 1, 2		1	1		201	
—	◎ 125	Terminal 2 frequency setting gain frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		172	
—	◎ 126	Terminal 4 frequency setting gain frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		172	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
PID operation	127	PID control automatic switchover frequency	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		*228*	
	128	PID action selection	10, 11, 20, 21, 50, 51, 60, 61		1	10		*228*	
	129	PID proportional band	0.1 to 1000%, 9999		0.1%	100%		*228*	
	130	PID integral time	0.1 to 3600s, 9999		0.1s	1s		*228*	
	131	PID upper limit	0 to 100%, 9999		0.1%	9999		*228*	
	132	PID lower limit	0 to 100%, 9999		0.1%	9999		*228*	
	133	PID action set point	0 to 100%, 9999		0.01%	9999		*228*	
	134	PID differential time	0.01 to 10.00s, 9999		0.01s	9999		*228*	
Backlash measures	140	Backlash acceleration stopping frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	1Hz		*91*	
	141	Backlash acceleration stopping time	0 to 360s		0.1s	0.5s		*91*	
	142	Backlash deceleration stopping frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	1Hz		*91*	
	143	Backlash deceleration stopping time	0 to 360s		0.1s	0.5s		*91*	
—	144	Speed setting switchover	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110		1	4		*135*	
PU	145	PU display language selection	0 to 7		1	0		*253*	
Current detection	148	Stall prevention level at 0V input	0 to 220%		0.1%	150%		*74*	
	149	Stall prevention level at 10V input	0 to 220%		0.1%	200%		*74*	
	150	Output current detection level	0 to 220%		0.1%	150%		*132*	
	151	Output current detection signal delay time	0 to 10s		0.1s	0s		*132*	
	152	Zero current detection level	0 to 220%		0.1%	5%		*132*	
	153	Zero current detection time	0 to 1s		0.01s	0.5s		*132*	
—	154	Voltage reduction selection during stall prevention operation	0, 1		1	1		*74*	
—	155	RT signal function validity condition selection	0, 10		1	0		*122*	
—	156	Stall prevention operation selection	0 to 31, 100, 101		1	0		*74*	
—	157	OL signal output timer	0 to 25s, 9999		0.1s	0s		*74*	
—	158	AM terminal function selection	1 to 3, 5, 6, 8 to 14, 17, 18, 21, 24, 50, 52, 53	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52, 53	1	1		*137*	
—	◎ 160	User group read selection	0, 1, 9999		1	0		*180*	
—	161	Frequency setting/key lock operation selection	0, 1, 10, 11		1	0		*253*	
Automatic restart functions	162	Automatic restart after instantaneous power failure selection	0, 1, 2, 10, 11, 12		1	0		*148*	
	163	First cushion time for restart	0 to 20s		0.1s	0s		*148*	
	164	First cushion voltage for restart	0 to 100%		0.1%	0%		*148*	
	165	Stall prevention operation level for restart	0 to 220%		0.1%	150%		*148*	
Current detection	166	Output current detection signal retention time	0 to 10s, 9999		0.1s	0.1s		*132*	
	167	Output current detection operation selection	0, 1		1	0		*132*	
—	168	Parameter for manufacturer setting. Do not set.							
—	169								
Cumulative monitor clear	170	Watt-hour meter clear	0, 10, 9999		1	9999		*137*	
	171	Operation hour meter clear	0, 9999		1	9999		*137*	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
User group	172	User group registered display/batch clear	9999, (0 to 16)		1	0		180	
	173	User group registration	0 to 999, 9999		1	9999		180	
	174	User group clear	0 to 999, 9999		1	9999		180	
input terminal function assignment	178	STF terminal function selection	0 to 12, 14, 16, 19, 20, 22, 24, 25, 60, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 60, 62, 64 to 67, 9999	1	60		118	
	179	STR terminal function selection	0 to 12, 14, 16, 19, 20, 22, 24, 25, 61, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 22, 24, 25, 61, 62, 64 to 67, 9999	1	61		118	
	180	RL terminal function selection	0 to 12, 14, 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999	1	0		118	
	181	RM terminal function selection			1	1		118	
	182	RH terminal function selection			1	2		118	
	183	RT terminal function selection			1	3		118	
	184	AU terminal function selection	0 to 12, 14, 16, 19, 20, 22, 24, 25, 62 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 62 to 67, 9999	1	4		118	
	185	JOG terminal function selection	0 to 12, 14, 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999	1	5		118	
	186	CS terminal function selection			1	6		118	
	187	MRS terminal function selection			1	24		118	
	188	STOP terminal function selection			1	25		118	
	189	RES terminal function selection			1	62		118	
Output terminal function assignment	190	RUN terminal function selection	0 to 8, 10 to 16, 25 to 28, 34, 45 to 47, 64, 70, 90 to 99, 100 to 108, 110 to 116, 125 to 128, 134, 145 to 147, 164, 170, 190 to 199, 9999	0 to 6, 8, 10 to 16, 20, 25 to 28, 34, 35, 45 to 47, 64, 70, 90 to 99, 100 to 106, 108, 110 to 116, 120, 125 to 128, 134, 135, 145 to 147, 164, 170, 190 to 199, 9999	1	0		125	
	191	SU terminal function selection			1	1		125	
	192	IPF terminal function selection			1	2		125	
	193	OL terminal function selection			1	3		125	
	194	FU terminal function selection			1	4		125	
	195	ABC1 terminal function selection	0 to 8, 10 to 16, 25 to 28, 34, 45 to 47, 64, 70, 90, 91, 94 to 99, 100 to 108, 110 to 116, 125 to 128, 134, 145 to 147, 164, 170, 190, 191, 194 to 199, 9999	0 to 6, 8, 10 to 16, 20, 25 to 28, 34, 35, 45 to 47, 64, 70, 90, 91, 94 to 99, 100 to 106, 108, 110 to 116, 120, 125 to 128, 134, 135, 145 to 147, 164, 170, 190, 191, 194 to 199, 9999	1		99	125	
	196	ABC2 terminal function selection			1		9999	125	
Multi-speed setting	232 to 239	Multi-speed setting (8 speed to 15 speed)	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		125	
—	241	Analog input display unit switchover	0, 1		1	0		269	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
—	242	Terminal 1 added compensation amount (terminal 2)	0 to 100%		0.1%	100%		172	
—	243	Terminal 1 added compensation amount (terminal 4)	0 to 100%		0.1%	75%		169	
—	244	Cooling fan operation selection	0, 1		1	1		169	
—	250	Stop selection	0 to 100s,1000 to 1100s 8888, 9999		0.1s	9999		104	
—	251	Output phase failure protection selection	0, 1		1	1		158	
Frequency compensation function	252	Override bias	0 to 200%		0.1%	50%		169	
Frequency compensation function	253	Override gain	0 to 200%		0.1%	150%		169	
Life check	255	Life alarm status display	(0 to 15)		1	0		247	
Life check	256	Inrush current limit circuit life display	(0 to 100%)		1%	100%		247	
Life check	257	Control circuit capacitor life display	(0 to 100%)		1%	100%		247	
Life check	258	Main circuit capacitor life display	(0 to 100%)		1%	100%		247	
Life check	259	Main circuit capacitor life measuring	0, 1		1	0		247	
Power failure stop	261	Power failure stop selection	0, 1, 2, 11, 12		1	0		152	
Power failure stop	262	Subtracted frequency at deceleration start	0 to 20Hz		0.01Hz	3Hz		152	
Power failure stop	263	Subtraction starting frequency	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	60Hz		152	
Power failure stop	264	Power-failure deceleration time 1	0 to 3600/360s		0.1/0.01s	5s		152	
Power failure stop	265	Power-failure deceleration time 2	0 to 3600s/360s, 9999		0.1/0.01s	9999		152	
Power failure stop	266	Power failure deceleration time switchover frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		152	
—	267	Terminal 4 input selection	0, 1, 2		1	0		166	
—	268	Monitor decimal digits selection	0,1, 9999		1	9999		137	
—	269	Parameter for manufacturer setting. Do not set.							
—	270	Stop-on contact/load torque high-speed frequency control selection	0, 2	0, 1, 2, 3	1	0		105, 236	
Load torque high speed frequency control	271	High-speed setting maximum current	0 to 220%		0.1%	50%		236	
Load torque high speed frequency control	272	Middle-speed setting minimum current	0 to 220%		0.1%	100%		236	
Load torque high speed frequency control	273	Current averaging range	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		236	
Load torque high speed frequency control	274	Current averaging filter time constant	1 to 4000		1	16		236	
Stop-on contact control	275	Stop-on contact excitation current low-speed multiplying factor	—	0 to 1000%, 9999	0.1%	—	9999	105	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
Brake sequence function	278	Brake opening frequency	—	0 to 30Hz	0.01Hz	—	3Hz	*108*	
	279	Brake opening current	—	0 to 220%	0.1%	—	130%	*108*	
	280	Brake opening current detection time	—	0 to 2s	0.1s	—	0.3s	*108*	
	281	Brake operation time at start	—	0 to 5s	0.1s	—	0.3s	*108*	
	282	Brake operation frequency	—	0 to 30Hz	0.01Hz	—	6Hz	*108*	
	283	Brake operation time at stop	—	0 to 5s	0.1s	—	0.3s	*108*	
	284	Deceleration detection function selection	—	0, 1	1	—	0	*108*	
	285	Overspeed detection frequency	—	0 to 30Hz, 9999	0.01Hz	—	9999	*115, 108*	
Droop control	286	Droop gain	—	0 to 100%	0.1%	—	0%	*238*	
	287	Droop filter time constant	—	0 to 1s	0.01s	—	0.3s	*238*	
—	291	Pulse train I/O selection	0, 1, 10, 11, 20, 21, 100		1	0		*142, 239*	
—	292	Automatic acceleration/deceleration	—	0, 1, 3, 7, 8, 11	1	—	0	*156, 94, 108*	
—	293	Acceleration/deceleration individual operation selection	—	0 to 2	1	—	0	*94*	
—	294	UV avoidance voltage gain	0 to 200%		0.1%	100%		*152*	
—	299	Rotation direction detection selection at restarting	0, 1, 9999		1	0		*148*	
RS-485 communication	331	RS-485 communication station number	0 to 31(0 to 247)		1	0		*201*	
	332	RS-485 communication speed	3, 6, 12, 24, 48, 96, 192, 384		1	96		*201*	
	333	RS-485 communication stop bit length	0, 1, 10, 11		1	1		*201*	
	334	RS-485 communication parity check selection	0, 1, 2		1	2		*201*	
	335	RS-485 communication retry count	0 to 10, 9999		1	1		*201*	
	336	RS-485 communication check time interval	0 to 999.8s, 9999		0.1s	0s		*201*	
	337	RS-485 communication waiting time setting	0 to 150ms, 9999		1	9999		*201*	
	338	Communication operation command source	0, 1		1	0		*191*	
	339	Communication speed command source	0, 1, 2		1	0		*191*	
	340	Communication startup mode selection	0, 1, 2, 10, 12		1	0		*190*	
	341	RS-485 communication CR/LF selection	0, 1, 2		1	1		*201*	
	342	Communication EEPROM write selection	0, 1		1	0		*202*	
	343	Communication error count	—		1	0		*214*	
Orientation control	350 *6	Stop position command selection	0, 1, 9999		1	9999		*111*	
	351 *6	Orientation speed	0 to 30Hz		0.01Hz	2Hz		*111*	
	352 *6	Creep speed	0 to 10Hz		0.01Hz	0.5Hz		*111*	
	353 *6	Creep switchover position	0 to 16383		1	511		*111*	
	354 *6	Position loop switchover position	0 to 8191		1	96		*111*	
	355 *6	DC injection brake start position	0 to 255		1	5		*111*	
	356 *6	Internal stop position command	0 to 16383		1	0		*111*	
	357 *6	Orientation in-position zone	0 to 255		1	5		*111*	
	358 *6	Servo torque selection	0 to 13		1	1		*111*	
	359 *6	Encoder rotation direction	0, 1		1	1		*111*	
	360 *6	16 bit data selection	0 to 127		1	0		*111*	
	361 *6	Position shift	0 to 16383		1	0		*111*	
	362 *6	Orientation position loop gain	0.1 to 100		0.1	1		*111*	
	363 *6	Completion signal output delay time	0 to 5s		0.1s	0.5s		*111*	
	364 *6	Encoder stop check time	0 to 5s		0.1s	0.5s		*111*	
	365 *6	Orientation limit	0 to 60s, 9999		1s	9999		*111*	
	366 *6	Recheck time	0 to 5s, 9999		0.1s	9999		*111*	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
Encoder feedback	367 *6	Speed feedback range	0 to 120Hz/ 0 to 60Hz, 9999 *1	0 to 120Hz, 9999	0.01Hz	9999		242	
	368 *6	Feedback gain	0 to 100		0.1	1		242	
	369 *6	Number of encoder pulses	0 to 4096		1	1024		111, 242	
	374	Overspeed detection level	0 to 400Hz		0.01Hz	140Hz		158	
	376 *6	Encoder signal loss detection enable/ disable selection	0, 1		1	0		158	
S-pattern acceleration/ deceleration C	380	Acceleration S-pattern 1	0 to 50%		1%	0		91	
	381	Deceleration S-pattern 1	0 to 50%		1%	0		91	
	382	Acceleration S-pattern 2	0 to 50%		1%	0		91	
	383	Deceleration S-pattern 2	0 to 50%		1%	0		91	
Pulse train input	384	Input pulse division scaling factor	0 to 250		1	0		239	
	385	Frequency for zero input pulse	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	0		239	
	386	Frequency for maximum input pulse	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		239	
Remote output	495	Remote output selection	0, 1, 10, 11		1	0		134	
	496	Remote output data 1	0 to 4095		1	0		134	
	497	Remote output data 2	0 to 4095		1	0		134	
Maintenance	503	Maintenance timer	0 (1 to 9998)		1	0		249	
	504	Maintenance timer alarm output set time	0 to 9998, 9999		1	9999		249	
—	505	Speed setting reference	1 to 120Hz/ 1 to 60Hz *1	1 to 120Hz	0.01Hz	60Hz		135	
S-pattern acceleration/ deceleration D	516	S-pattern time at a start of acceleration	0.1 to 2.5s		0.1s	0.1s		91	
	517	S-pattern time at a completion of acceleration	0.1 to 2.5s		0.1s	0.1s		91	
	518	S-pattern time at a start of deceleraiton	0.1 to 2.5s		0.1s	0.1s		91	
	519	S-pattern time at a completion of deceleraiton	0.1 to 2.5s		0.1s	0.1s		91	
—	539	Modbus-RTU communication check time interval	0 to 999.8s, 9999		0.1s	9999		214	
—	547	Parameter for manufacturer setting. Do not set.							
—	548								
Communication	549	Protocol selection	0, 1		1	0		214	
	550	NET mode operation command source selection	0, 1, 9999		1	9999		191	
	551	PU mode operation command source selection	1, 2, 3		1	2		191	
Current average value monitor	555	Current average time	0.1 to 1.0s		0.1s	1s		250	
	556	Data output mask time	0.0 to 20.0s		0.1s	0s		250	
	557	Current average value monitor signal output reference current	0 to 500/0 to 3600A *2		0.01/0.1A *2	Rated inverter current		250	
—	563	Energization time carrying-over times	(0 to 65535)		1	0		250	
—	564	Operating time carrying-over times	(0 to 65535)		1	0		250	
—	571	Holding time at a start	0.0 to 10.0s, 9999		0.1s	9999		90	

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
PID control	575	Output interruption detection time	0 to 3600s, 9999		0.1s	1s		228	
	576	Output interruption detection level	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	0Hz		228	
	577	Output interruption cancel level	900 to 1100%		0.1%	1000%		228	
—	611	Acceleration time at a restart	0 to 3600s, 9999		0.1s	5/15s *2		148	
—	665	Regeneration avoidance frequency gain	0 to 200%		0.1%	100%		244	
—	684	Tuning data unit switchover	—	0, 1	1	—	0	70	
Torque limit	811	Set resolution switchover	0, 1		1	0		98, 135	
Additional function	849	Analog input offset adjustment	0 to 200%		0.1%	100%		171	
	858	Terminal 4 function assignment	0, 4, 9999		1	0		165	
	859	Torque current	—	Reading only. Not settable.	Reading only. Not settable.	—	9999	70	
	864	Torque detection	—	0 to 400%	0.1%	—	150%	133	
	865	Low speed detection	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	1.5Hz		130	
Indication function	866	Torque monitoring reference	—	0 to 400%	0.1%	—	150%	142	
—	867	AM output filter	0 to 5s		0.01s	0.01s		142	
—	868	Terminal 1 function assignment	0 to 4, 9999		1	0		165	
Protective Functions	872	Input phase failure protection selection	0, 1		1	0		158	
	875	Fault definition	0, 1		1	0		159	
Regeneration avoidance function	882	Regeneration avoidance operation selection	0, 1, 2		1	0		244	
	883	Regeneration avoidance operation level	300 to 800V		0.1V	380/760VDC *5		244	
	884	Regeneration avoidance at deceleration detection sensitivity	0 to 5		1	0		244	
	885	Regeneration avoidance compensation frequency limit value	0 to 10Hz, 9999		0.01Hz	6Hz		244	
	886	Regeneration avoidance voltage gain	0 to 200%		0.1%	100%		244	
Free parameters	888	Free parameter 1	0 to 9999		1	9999		252	
	889	Free parameter 2	0 to 9999		1	9999		252	
Energy saving monitor	891	Cumulative power monitor digit shifted times	0 to 4, 9999		1	9999		160	
	892	Load factor	30 to 150%		0.1%	100%		160	
	893	Energy saving monitor reference (motor capacity)	0.1 to 55/0 to 3600kW *2		0.01/ 0.1kW *2	Inverter rated capacity		160	
	894	Control selection during commercial power-supply operation	0, 1, 2, 3		1	0		160	
	895	Power saving rate reference value	0, 1, 9999		1	9999		160	
	896	Power unit cost	0 to 500, 9999		0.01	9999		160	
	897	Power saving monitor average time	0, 1 to 1000h, 9999		1	9999		160	
	898	Power saving cumulative monitor clear	0, 1, 10, 9999		1	9999		160	
	899	Operation time rate (estimated value)	0 to 100%, 9999		0.1%	9999		160	

Parameter List

4

PARAMETERS

Function	Parameter	Name	Setting Range FR-B	Setting Range FR-B3	Minimum Setting Increments	Initial Value FR-B	Initial Value FR-B3	Refer to Page	Customer Setting
Calibration parameters	C0 (900)	FM terminal calibration	—		—	—		145	
	C1 (901)	AM terminal calibration	—		—	—		145	
	C2 (902)	Terminal 2 frequency setting bias frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	0Hz		172	
	C3 (902)	Terminal 2 frequency setting bias	0 to 300%		0.1%	0%		172	
	125 (903)	Terminal 2 frequency setting gain frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		172	
	C4 (903)	Terminal 2 frequency setting gain	0 to 300%		0.1%	100%		172	
	C5 (904)	Terminal 4 frequency setting bias frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	0Hz		172	
	C6 (904)	Terminal 4 frequency setting bias	0 to 300%		0.1%	20%		172	
	126 (905)	Terminal 4 frequency setting gain frequency	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	0.01Hz	60Hz		172	
	C7 (905)	Terminal 4 frequency setting gain	0 to 300%		0.1%	100%		172	
—	989	Parameter copy alarm release	10/100		1	10/100 *2		258	
PU	990	PU buzzer control	0, 1		1	1		255	
	991	PU contrast adjustment	0 to 63		1	58		255	
Clear parameters	Pr. CL	Parameter clear	0, 1		1	0		256	
	ALLC	All parameter clear	0, 1		1	0		257	
	Er.CL	Alarm history clear	0, 1		1	0		260	
	PCPY	Parameter copy	0, 1, 2, 3		1	0		258	

*1 Differ according to capacities. (22K or less/30K or more)
*2 Differ according to capacities. (55K or less/75K or more)
*3 Differ according to capacities. (7.5K or less/11K or more)
*4 Differ according to capacities. (7.5K or less/11K to 55K/75K or more)
*5 Differs according to the voltage class. (200V class/400V class)
*6 Setting can be made only when the FR-A7AP is mounted.
*7 Setting can be made only for the 75K or more

4.3 Control mode

(1) V/F Control (FR-B series only)

· It controls frequency and voltage so that the ratio of frequency (F) to voltage (V) is constant when changing frequency.

(2) Advanced magnetic flux vector control (FR-B3 series only)

· This control devides 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.

4.4 Before operating the FR-B3 series

4.4.1 Setting the FR-B3 series (advanced magnetic flux vector control) (Pr. 80, Pr. 81, Pr. 89) B3

Setting can be made only for FR-B3 series.

For explosion-proof certification, the FR-B3 series are tested with the rotation mode under the advanced magnetic flux control after the offline auto tuning has been performed. In the initial setting, the advanced magnetic flux vector control is selected. Always perform the offline auto tuning with the rotation mode before operation.

●What is advanced magnetic flux vector control?

The low speed torque can be improved by providing voltage compensation so that the motor current which meets the load torque to flow. Output frequency compensation (slip compensation) is made so that the motor actual speed approximates a speed command value. Effective when load fluctuates drastically, etc.

Parameter Number	Name	Initial Value	Setting Range	Description
1	**Maximum frequency**	120Hz/ 60Hz *1	0 to 120Hz	Set *Pr.1 Maximum frequency* to meet the permissible frequency of the pressure-resistant, explosion-proof motor.
80	**Motor capacity**	Inverter capacity	Inverter capacity	Cannot be changed.
81	**Number of motor poles**	4	4	Cannot be changed.
89	**Speed control gain (magnetic flux vector)**	9999	Reading only. (Not settable.)	Motor speed fluctuation due to load fluctuation is adjusted during advanced magnetic flux vector control. 100% is a referenced value.
				Gain matching with the motor set in *Pr. 71*.

*1 The initial value differs according to the inverter capacity. (22K or less/30K or more)

(1) Setting procedure of FR-B3 (advanced magnetic flux vector control)

Perform secure wiring.
(Refer to page 14)

↓

For the motor capacity and the number of motor poles (*Pr.80* and *Pr.81*), the advanced magnetic flux vector control is set in the initial setting.
(Change unnecessary) *(Refer to page 68)*

↓

Set offline auto tuning.
Pr.95=101 (Rotation mode)

↓

Select the start command and speed command.

(1) Start command
1. Operation panel :
   Setting by pressing FWD / REV of the operation panel
2. External command : Setting by forward rotation or reverse rotation command (terminal STF or STR)

(2) Speed command
1. Operation panel :
   Setting by of the operation panel
2. External analog command (terminal 2 or 4) :
   Give a speed command using the analog signal input to terminal 2 (or terminal 4).
3. Multi-speed command :
   The external signals (RH, RM, RL) may also be used to give speed command.

↓

Perform offline auto tuning.
(Refer to page 70)

↓

Test run

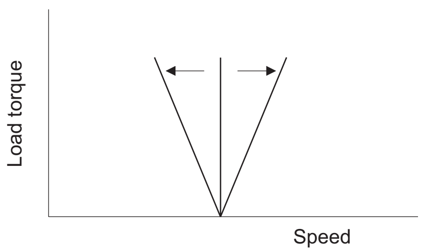
· Performing offline auto tuning. (Make sure to perform the auto tuning.)*(Pr. 96)* *(refer to page 70)*

CAUTION

· When terminal assignment is changed using *Pr. 178 to Pr. 189 (input terminal function selection)*, the other functions may be affected. Make setting after confirming the function of each terminal.

(2) Adjust the motor speed fluctuation at load fluctuation (speed control gain)

The motor speed fluctuation at load fluctuation can be adjusted using *Pr. 89*. (It is useful when the speed command does not match the motor speed after the FR-B3 (A500 specifications) series inverter is replaced with the FR-B3 (A700 specifications) series inverter, etc.)



4.4.2 Offline auto tuning (Pr. 80 to Pr. 84, Pr. 90 to Pr. 94, Pr. 96, Pr. 684, Pr. 859) B3

Setting can be made only for FR-B3 series.

- What is offline auto tuning?
  When performing FR-B3 series, the motor can be run with the optimum operating characteristics by automaticaly 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
80	**Motor capacity**	Inverter capacity	Inverter capacity	Setting cannot be changed.
81	**Number of motor poles**	4	4	The number of motor poles is always four.
82	**Motor excitation current**	9999	Reading only. (Not settable.)	Tuning data (The value measured by offline auto tuning is automatically set.)
				Use the Mitsubishi explosion-proof motor constants
83	**Motor rated voltage**	200/400V*	0 to 1000V	Set the rated motor voltage(V). * The initial value differs according to the voltage level. (200V/400V)
84	**Rated motor frequency**	60Hz	10 to 120Hz	Set the rated motor frequency (Hz).
90	**Motor constant (R1)**	9999	Reading only. (Not settable)	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Use the Mitsubishi explosion-proof motor constants
91	**Motor constant (R2)**	9999		
92	**Motor constant (L1)**	9999		
93	**Motor constant (L2)**	9999		
94	**Motor constant (X)**	9999		
96	**Auto tuning setting/ status**	0	0	Offline auto tuning is not performed
			1	Offline auto tuning is performed without motor running
			101	Offline auto tuning is performed with motor running
684	**Tuning data unit switchover**	0	0	Internal data converter value
			1	Displayed in "A, Ω, mH, %"
859	**Torque current**	9999	Reading only. (Not settable)	Tuning data (The value measured by offline auto tuning is automatically set.)
				Use the Mitsubishi explosion-proof motor constants

POINT

· Tuning is enabled even when a load is connected to the motor. (As the load is lighter, tuning accuracy is higher. Tuning accuracy does not change even if the inertia is large.)
· For the offline auto tuning, you can select either the motor non-rotation mode (*Pr.96* = "1") or rotation mode (*Pr.96* = "101"). Perform tuning in motor rotation mode in this case.
· Reading/writing/copy of motor constants tuned by offline auto tuning are enabled.
· The offline auto tuning status can be monitored with the PU (FR-DU07/FR-PU04/FR-PU07).

(1) Before performing offline auto tuning

Check the following before performing offline auto tuning.

- A motor should be connected. Note that the motor should be at a stop at a tuning start.
- When performing the offline auto tuning, always select the rotation mode (*Pr.96*="101").
- Note the following when selecting offline auto tuning performed with motor running (*Pr. 96 Auto tuning setting/status* = "101").
  Torque is not enough during tuning.
  The motor may be run at nearly its rated speed.
  The brake is open.
  No external force is applied to rotate the motor.

(2) Setting

1) Set "101" in *Pr. 96 Auto tuning setting/status* .
   · When the setting is "101" . . . . . . Tuning is performed without motor running.
   It takes approximately 40s until tuning is completed.
   The motor runs at nearly its rated frequency.
2) Set the rated motor current (initial value is rated inverter current) in *Pr. 9 Electronic thermal O/L relay* *(refer to page 96)*.
3) Set the rated voltage of motor (initial value is 200V/400V) in *Pr. 83 Motor rated voltage* and rated frequency of motor (initial value is 60Hz) in *Pr. 84 Rated motor frequency* .
   (For a Japanese standard motor, etc. which has both 50Hz and 60Hz rated values, use it with initial value (200V/60Hz or 400V/60Hz).)

(3) Execution of tuning

CAUTION

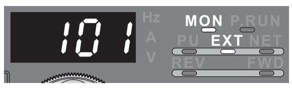
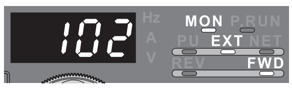
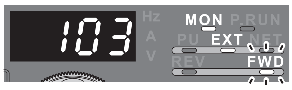
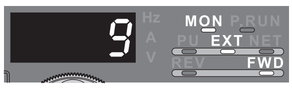
- Before performing tuning, check the monitor display of the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07) if the inverter is in the state ready for tuning. (Refer to 2 below)

1)When performing PU operation, press FWD/REV of the operation panel.
For external operation, turn on the run command (STF signal or STR signal). Tuning starts.

CAUTION

- When selecting offline auto tuning performed with motor running (*Pr. 96 Auto tuning setting/status* = "101"), caution must be taken since the motor runs.
- 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:
  · Input signals <valid signal> STOP, OH, MRS, RT, CS, RES, STF, STR
  · Output terminal RUN, OL, IPF, FM, AM, A1B1C1
  Note that the progress status of offline auto tuning is output from AM and 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 excecuted properly.

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

	Parameter Unit (FR-PU04/FR-PU07) Display	Operation Panel (FR-DU07) Display
Pr. 96 setting	101	101
(1) Setting	101 STOP PU	
(2) Tuning in progress	TUNE 102 STF FWD PU	
(3) Normal end	TUNE 103 COMPLETION STF STOP PU	 Flickering
(4) Error end (when the inverter protective function is activated)	TUNE 9 ERROR STF STOP PU	

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

Offline Auto Tuning Setting	Time
Rotation mode (*Pr. 96* = "101")	Approximately 40s (Offline auto tuning time varies with the acceleration and deceleration time settings as indicated below. Offline auto tuning time = acceleration time + deceleration time + approx. 30s)

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

REMARKS

· Do not change the *Pr. 96* setting after completion of tuning (103).
If the *Pr. 96* setting is changed, tuning data is made invalid.
If the *Pr. 96* setting is changed, tuning must be performed 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 "101" in *Pr. 96* and perform tuning again.
9	Inverter protective function operation	Make setting again.
91	Current limit (stall prevention) function was activated.	Increase acceleration/deceleration time. 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.

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

CAUTION

· The motor constants measured once in the offline auto tuning are stored as parameters and their data are held until the offline auto tuning is performed again.
· An instantaneous power failure occurring during tuning will result in a tuning error.
After power is restored, the inverter goes into the normal operation mode. Therefore, when STF (STR) signal is on, the motor runs in the forward (reverse) rotation.
· Any alarm occurring during tuning is handled as in the ordinary mode. Note that if an error retry has been set, retry is ignored.
· The set frequency monitor displayed during the offline auto tuning is 0Hz.

⚠ CAUTION

⚠ Note that the motor may start running suddenly.
⚠ When the offline auto tuning is used in vertical lift application, e.g. a lifter, it may drop due to insufficient torque.

♦ Parameters referred to ♦

Pr. 7 Acceleration time, Pr. 8 Deceleration time ☞ *Refer to page 88*
Pr. 9 Electronic thermal O/L relay ☞ *Refer to page 96*
Pr. 80 Motor capacity, Pr. 81 Number of motor poles ☞ *Refer to page 95*
Pr. 156 Stall prevention operation selection ☞ *Refer to page 74*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*

4.5 Adjust the output torque of the motor (current)

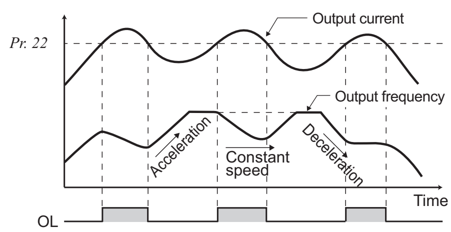
4.5.1 Stall prevention operation (Pr. 22, Pr. 23, Pr. 48, Pr. 49, Pr. 66, Pr. 114, Pr. 115, Pr. 148, Pr. 149, Pr. 154, Pr. 156, Pr. 157, Pr. 858, Pr. 868)

This function monitors the output current and automatically changes the output frequency to prevent the inverter from coming to an alarm stop 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 varied to reduce the output current.
  Also the second stall prevention function can restrict the output frequency range in which the stall prevention function is valid. *(Pr. 49)*
- 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 FR-B	Setting Range FR-B3	Description
22	**Stall prevention operation level**	150%	0		Stall prevention operation selection becomes invalid.
			0.1 to 400%		Set the current value at which stall prevention operation will be started.
23	**Stall prevention operation level compensation factor at double speed**	9999	0 to 200%		The stall operation level can be reduced when operating at a high speed above the rated frequency.
			9999		Constant according to *Pr. 22*
48	**Second stall prevention operation current**	150%	0		Second stall prevention operation invalid
			0.1 to 220%		The second stall prevention operation level can be set.
49	**Second stall prevention operation frequency**	0Hz	0		Second stall prevention operation invalid
			0.01 to 120Hz/ 0.01 to 60Hz *	0.01 to 120Hz	Set the frequency at which stall prevention operation of *Pr. 48* is started.
			9999		*Pr. 48* is valid when the RT signal is on.
66	**Stall prevention operation reduction starting frequency**	60Hz	0.01 to 120Hz/ 0.01 to 60Hz *	0.01 to 120Hz	Set the frequency at which the stall operation level is started to reduce.
114	**Third stall prevention operation current**	150%	0		Third stall prevention operation invalid
			0.1 to 220%		Stall prevention operation level can be changed with the X9 signal.
115	**Thrid stall prevention operation frequency**	0Hz	0		Third stall prevention operation invalid
			0.01 to 120Hz/ 0.01 to 60Hz *	0.01 to 120Hz	Set the frequency at which stall prevention operation when the X9 signal is on starts.
148	**Stall prevention level at 0V input**	150%	0 to 220%		Stall prevention operation level can be changed by the analog signal input to terminal 1 (terminal 4).
149	**Stall prevention level at 10V input**	200%	0 to 220%		
154	**Voltage reduction selection during stall prevention operation**	1	0		With voltage reduction — You can select whether to use output voltage reduction during stall prevention operation or not.
			1		Without voltage reduction
156	**Stall prevention operation selection**	0	0 to 31, 100, 101		You can 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		Set the output start time of the OL signal output when stall prevention is activated.
			9999		Without the OL signal output
858	**Terminal 4 function assignment**	0	0, 4, 9999		By setting "4", the stall prevention operation level can be changed with a signal to terminal 4.
868	**Terminal 1 function assignment**	0	0, 4, 9999		By setting "4", the stall prevention operation level can be changed with a signal to terminal 1.

* The setting range differs according to the inverter capacity. (22K or less/30K or more)



Stall prevention operation example

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

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

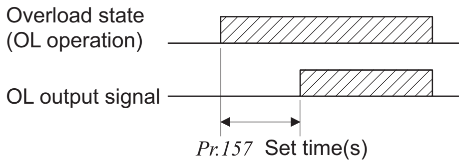
CAUTION

- If an overload status lasts long, an inverter trip (e.g. electronic thermal relay function (E.THM)) may occur.
- When *Pr. 156* has been set to activate the fast-response current limit (initial setting), the *Pr. 22* setting should not be higher than 170%. The torque will not be developed by doing so.

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

- When the output power 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 power 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 oL (overvoltage stall) is executed.

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



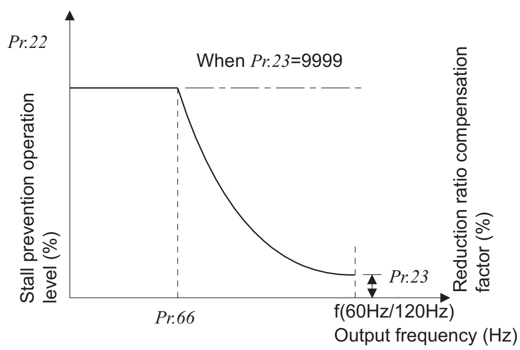
REMARKS

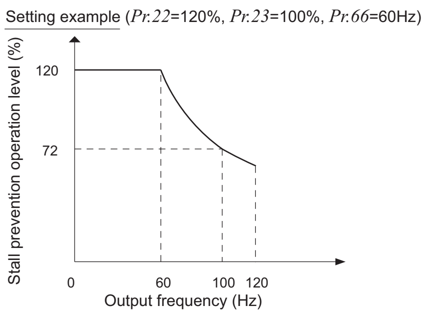
- The OL signal is assigned to the terminal OL in the initial setting. The OL signal can also be assigned to the other terminal by setting "3 (positive logic) or 103 (negative logic)" to any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

CAUTION

- If the frequency has fallen to 0.5Hz by stall prevention operation and remains for 3s, an alarm (E.OLT) appears to shutoff the inverter output.
- Changing the terminal assignment using *Pr. 190 to Pr. 196 (output terminal function selection)* may affect, the other functions. Please make setting after confirming the function of each terminal.

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





- 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 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

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

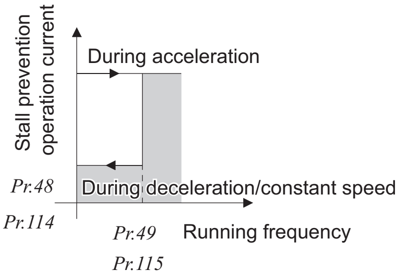
$$\text{However, } A = \frac{Pr.\,66(\text{Hz}) \times Pr.\,22(\%)}{\text{Output frequency (H)}},\quad B = \frac{Pr.\,66(\text{Hz}) \times Pr.\,22(\%)}{f}$$

f: 120Hz/60Hz (22K or less/30K or more) for FREQROL-B series and 120Hz for FREQROL-B3 series

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

(4) Set multiple stall prevention operation levels *(Pr. 48, Pr. 49, Pr. 114, Pr. 115)*

- Setting "9999" in *Pr. 49 Second stall prevention operation frequency* and turning the RT signal on make *Pr. 48 Second stall prevention operation current* valid.
- In *Pr. 48 (Pr. 114)*, you can set the stall prevention operation level at the output frequency from 0Hz to that set in *Pr. 49 (Pr. 115)*.
  During acceleration, however, the operation level is as set in *Pr. 22*.
- This function can also be used for stop-on-contact or similar operation by decreasing the *Pr. 48 (Pr. 114)* setting to weaken the deceleration torque (stopping torque).
- *Pr. 114* and *Pr. 115* are made valid when the X9 signal is on. For the terminal used for X9 signal input, set "9" in any of *Pr. 178 to Pr. 189* input terminal function selection to assign the X9 signal function.

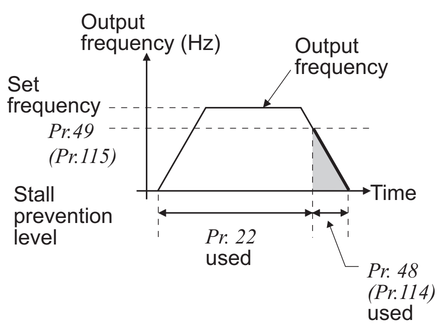


	Pr. 49 Setting	*Pr. 115* Setting	Operation
0 (initial value)			The second (third) stall prevention operation is not performed.
FR-B-22K or less FR-B3	0.01Hz to 120Hz		The second (third) stall prevention operation is performed according to the frequency.*1
FR-B-30K or more	0.01Hz to 60Hz		The second (third) stall prevention operation is performed according to the frequency.*1
	9999 *2	Setting can not be made.	The second (third) stall prevention function is performed according to the RT signal. RT signal ON ... Stall level *Pr. 48* RT signal OFF ... Stall level *Pr. 22*

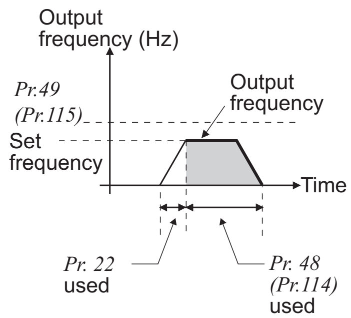
*1 The smaller setting of the stall prevention operation levels set in *Pr. 22* and *Pr. 48* has a higher priority.

*2 When *Pr. 868* = "4" (Stall prevention operation level analog input), the stall prevention operation level also switches from the analog input (terminal 1 input) to the stall prevention operation level of *Pr. 48* when the RT signal turns on.
(The second stall prevention operation level cannot be input in an analog form.)

Set frequency exceeds *Pr. 49(Pr.115)*



Set frequency is *Pr. 49 (Pr.115)*or less



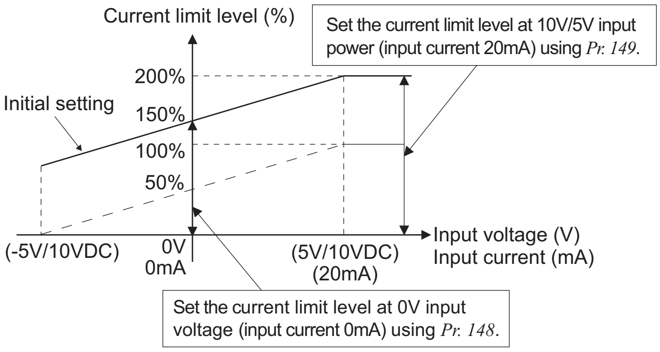
REMARKS

- When *Pr. 49* ≠ "9999" (level changed according to frequency) and *Pr. 48* = "0%", the stall prevention operation level is 0% at or higher than the frequency set in *Pr. 49*.
- In the initial setting, the RT signal is assigned to the RT terminal. By setting "3" to any of *Pr. 178 to Pr. 189 (input terminal function selection)*, you can assign the RT signal to the other terminal.

CAUTION

- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.
- The RT(X9) signal acts as the second (third) function selection signal and makes the other second (third) functions valid. *(Refer to page 122)*

(5) Stall prevention operation level setting by terminal 1 (terminal 4) (analog variable) *(Pr. 148, Pr. 149, Pr. 858, Pr. 868)*



- To set the stall prevention operation level using terminal 1 (analog input), set *Pr. 868 Terminal 1 function assignment* to "4".
  Input 0 to 5V (or 0 to 10V) to terminal 1. Select 5V or 10V using *Pr. 73 Analog input selection*. When *Pr. 73* = "1" (initial value), 0 to ±10V is input.
- To set stall prevention operation level using terminal 4 (analog current input), set "4" in *Pr. 858 Terminal 4 function assignment*.
  Input 0 to 20mA to terminal 4. The AU signal need not be turned on.
- Set the current limit level at the input voltage of 0V (0mA) in *Pr. 148 Stall prevention level at 0V input*
- Set the current limit level at the input voltage of 10V/5V (20mA) in *Pr. 149 Stall prevention level at 10V input.*

Pr. 858 Setting	*Pr. 868* Setting	V/F, Advanced Magnetic Flux Vector Control	
		Terminal 4 function	Terminal 1 function
0 (initial value)	0 (initial value)	Frequency command (AU signal-ON)	Frequency auxiliary
	4 *1		Stall prevention
	9999		—
4 *2	0 (initial value)	Stall prevention	Frequency auxiliary
	4 *1	— *3	Stall prevention
	9999	Stall prevention	—
9999	—	—	—

*1 When *Pr. 868* = "4" (analog stall prevention), other functions of terminal 1 (auxiliary input, override function, PID control) do not function.
*2 When *Pr. 858* = "4" (analog stall prevention), PID control and speed command from terminal 4 do not function even if the AU signal turns on.
*3 When "4" (stall prevention) is set in both *Pr. 858* and *Pr. 868*, function of terminal 1 has higher priority and terminal 4 has no function.

REMARKS

- The fast-response current limit level cannot be set.

(6) To further prevent an alarm stop *(Pr. 154)*

- When *Pr. 154* is set to "0", the output voltage reduces during stall prevention operation. By making setting to reduce the output voltage, an overcurrent trip can further become difficult to occur.
- Use this function where a torque decrease will not pose a problem.

Pr. 154 Setting	Description
0	Output voltage reduced
1 (initial value)	Output voltage not reduced

4

PARAMETERS

(7) 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 fast-response current limit operation will be performed or not and the operation to be performed at OL signal output.

Pr. 156 Setting	Fast-response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection ○:Activated ●:Not activated — Acceleration	Constant speed	Deceleration	OL Signal Output ○:Operation continued ●:Operation not continued *1
0 (initial value)	○	○	○	○	○
1	●	○	○	○	○
2	○	●	○	○	○
3	●	●	○	○	○
4	○	○	●	○	○
5	●	○	●	○	○
6	○	●	●	○	○
7	●	●	●	○	○
8	○	○	○	●	○
9	●	○	○	●	○
10	○	●	○	●	○
11	●	●	○	●	○
12	○	○	●	●	○
13	●	○	●	●	○
14	○	●	●	●	○
15	●	●	●	●	— *2

Pr. 156 Setting	Fast-response Current Limit ○:Activated ●: Not activated	Stall Prevention Operation Selection ○:Activated ●:Not activated — Acceleration	Constant speed	Deceleration	OL Signal Output ○:Operation continued ●:Operation not continued *1
16	○	○	○	○	●
17	●	○	○	○	●
18	○	●	○	○	●
19	●	●	○	○	●
20	○	○	●	○	●
21	●	○	●	○	●
22	○	●	●	○	●
23	●	●	●	○	●
24	○	○	○	○	●
25	●	○	○	●	●
26	○	●	○	●	●
27	●	●	○	●	●
28	○	○	●	●	●
29	●	○	●	●	●
30	○	●	●	●	●
31	●	●	●	●	— *2

100 *3	Driving	○	○	○	○	○
	Regeneration	●	●	●	●	— *2
101 *3	Driving	●	○	○	○	○
	Regeneration	●	●	●	●	— *2

*1 When "Operation not continued for OL signal output" is selected, the "E.OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.
*2 Since both fast-response current limit and stall prevention are 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.

CAUTION

· When the load is heavy, when the lift is predetermined, or when 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 drop due to gravity.

⚠ CAUTION

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

⚠ Always perform test operation.
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. 73 Analog input selection ☞ Refer to page 166*
· *Pr. 178 to Pr. 189 (Input terminal function selection) ☞ Refer to page 118*
· *Pr. 190 to Pr. 196 (output terminal function selection) ☞ Refer to page 125*
· *Pr. 858 Terminal 4 function assignment, Pr. 868 Terminal 1 function assignment ☞ Refer to page 165*

4.6 Limit the output frequency

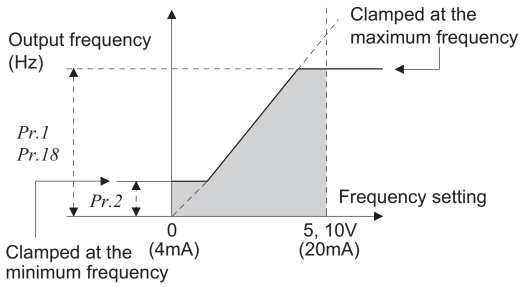
Purpose	Parameter that must be Set		Refer to Page
Set upper limit and lower limit of output frequency	**Maximum/minimum frequency**	**Pr. 1, Pr. 2**	79
Perform operation by avoiding mechanical resonance points	**Frequency jump**	**Pr. 31 to Pr. 36**	80

4.6.1 *Maximum/minimum frequency (Pr. 1, Pr. 2)*

You can limit the motor speed. Clamp the upper and lower limits of the output frequency.

Parameter Number	Name	Initial Value		Setting Range		Description
		FR-B	FR-B3	FR-B	FR-B3	
1	**Maximum frequency**	60Hz	120Hz/60Hz *1	0 to 120Hz/ 0 to 60Hz *2	0 to 120Hz	Set the upper limit of the output frequency.
2	**Minimum frequency**	0Hz		0 to 120Hz/ 0 to 60Hz *2	0 to 120Hz	Set the lower limit of the output frequency.

*1 The initial value differs according to the inverter capacity. (55K or less/75K or more)
*2 The setting range differs according to the inverter capacity. (22K or less/30K or more)



(1) Set maximum frequency

· Set the upper limit of the output frequency in *Pr. 1 Maximum frequency*. If the frequency of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.

REMARKS

· When performing operation above 60Hz using the frequency setting analog signal, change *Pr. 125 (Pr. 126) (frequency setting gain)*. If only *Pr. 1* is changed, operation above 60Hz cannot be performed.
· Set *Pr.1 Maximum frequency* to within the permissible frequency of the motor.

(2) Set minimum frequency

· Use *Pr. 2 Minimum frequency* to set the lower limit of the output frequency.
· The output frequency is clamped by the *Pr. 2* setting even if the set frequency is lower than the *Pr. 2* setting (The frequency will not decrease to the *Pr. 2* setting.)

REMARKS

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

⚠ CAUTION

⚠ Note that when *Pr. 2* is set to any value higher 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 ♦

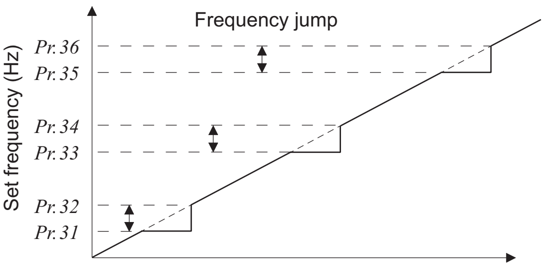
Pr. 13 Starting frequency ☞ *Refer to page 90*
Pr. 15 Jog frequency ☞ *Refer to page 83*
Pr. 125 Terminal 2 frequency setting gain frequency, Pr. 126 Terminal 4 frequency setting gain frequency ☞ *Refer to page 172*

4.6.2 Avoid mechanical resonance points (Frequency jump) (Pr. 31 to Pr. 36)

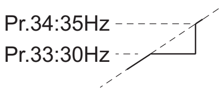
When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped.

Parameter Number	Name	Initial Value	Setting Range		Description
			FR-B	FR-B3	
31	**Frequency jump 1A**	9999	0 to 120Hz/ 0 to 60Hz, 9999	0 to 120Hz, 9999	1A to 1B, 2A to 2B, 3A to 3B is frequency jumps 9999: Function invalid
32	**Frequency jump 1B**	9999	0 to 120Hz/ 0 to 60Hz, 9999	0 to 120Hz, 9999	
33	**Frequency jump 2A**	9999	0 to 120Hz/ 0 to 60Hz, 9999	0 to 120Hz, 9999	
34	**Frequency jump 2B**	9999	0 to 120Hz/ 0 to 60Hz, 9999	0 to 120Hz, 9999	
35	**Frequency jump 3A**	9999	0 to 120Hz/ 0 to 60Hz, 9999	0 to 120Hz, 9999	
36	**Frequency jump 3B**	9999	0 to 120Hz/ 0 to 60Hz, 9999	0 to 120Hz, 9999	

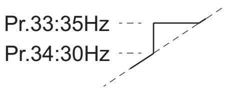
* The setting range differs according to the inverter capacity. (22K or less/30K or more)



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



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



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

CAUTION

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

4.7 Frequency setting by external terminals

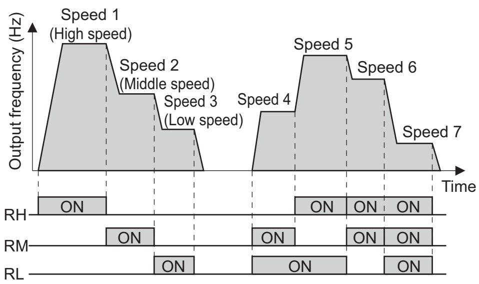
Purpose	Parameter that must be Set		Refer to Page
Make frequency setting by combination of terminals	**Multi-speed operation**	**Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239**	81
Perform jog operation	**Jog operation**	**Pr. 15, Pr. 16**	83
Added compensation for multi-speed setting and remote setting	**Multi-speed input compensation selection**	**Pr. 28**	85
Infinitely variable speed setting by terminals	**Remote setting function**	**Pr. 59**	85

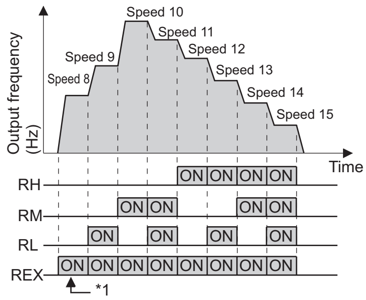
4.7.1 Multi-speed setting operation (Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)

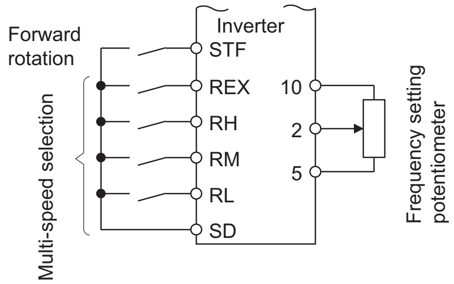
Can be used to change the preset speed in the parameter with the contact terminals.
Any speed can be selected by merely turning on-off the contact signals (RH, RM, RL, REX signals).

Parameter Number	Name	Initial Value	Setting Range		Description
			FR-B	FR-B3	
4	**Multi-speed setting (high speed)**	60Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the ferquency when RH turns on.
5	**Multi-speed setting (middle speed)**	30Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the ferquency when RM turns on.
6	**Multi-speed setting (low speed)**	10Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the ferquency when RL turns on.
24	**Multi-speed setting (speed4)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	Frequency from speed 4 to speed 15 can be set according to the combination of the RH, RM, RL and REX signals. 9999: not selected
25	**Multi-speed setting (speed 5)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
26	**Multi-speed setting (speed 6)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
27	**Multi-speed setting (speed 7)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
232	**Multi-speed setting (speed 8)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
233	**Multi-speed setting (speed 9)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
234	**Multi-speed setting (speed 10)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
235	**Multi-speed setting (speed 11)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
236	**Multi-speed setting (speed 12)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
237	**Multi-speed setting (speed 13)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
238	**Multi-speed setting (speed 14)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	
239	**Multi-speed setting (speed 15)**	9999	0 to 120Hz/ 0 to 60Hz, 9999*	0 to 120Hz, 9999	

* The setting range differs according to the inverter capacity. (22K or less/30K or more)
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*.







Multi-Speed Operation Connection Example

(1) Multi-speed setting *(Pr. 4 to Pr. 6)*

· Operation is performed at the frequency set in *Pr. 4* when the RH signal turns on, *Pr. 5* when the RM signal turns on, and *Pr. 6* when the RL signal turns on.

REMARKS

· In the initial setting, if two or three speeds are simultaneously selected, priority is given to the set frequency of the lower signal. For example, when the RH and RM signals turn on, the RM signal *(Pr. 5)* has a higher priority.
· The RH, RM, RL signals are assigned to the terminal RH, RM, RL in the initial setting.
By setting "0 (RL)", "1 (RM)", "2 (RH)" in any of *Pr.178 to Pr.189 (input terminal function assignment)*, the signals can be assigned to other terminals.

(2) Multi-speed setting higher than speed 4 *(Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)*

· Frequency from speed 4 to speed 15 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, speed 4 to speed 15 are unavailable.).
· For the terminal used for REX signal input, set "8" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.

* 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 172* for the frequency command by analog input)
· Valid in 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 a value other than “0” is set in *Pr. 59 Remote function selection*, the RH, RM and RL signals are used as the remote setting signals and the multi-speed setting becomes invalid.
· When making analog input compensation, set "1" in *Pr. 28 Multi-speed input compensation selection*.

CAUTION

· Changing the terminal assignment using *Pr. 178* to *Pr. 189 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 15 Jog frequency ☞ *Refer to page 83*
Pr. 28 Multi-speed input compensation selection ☞ *Refer to page 85*
Pr. 59 Remote function selection ☞ *Refer to page 85*
Pr. 79 Operation mode selection ☞ *Refer to page 182*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*

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

You can set the frequency and acceleration/deceleration time for jog operation. Jog operation can be performed from either the outside or PU.
Can be used for conveyor positioning, test operation, etc.

Parameter Number	Name	Initial Value	Setting Range		Description
			FR-B	FR-B3	
15	**Jog frequency**	5Hz	0 to 120Hz/ 0 to 60Hz *1	0 to 120Hz	Set the frequency for jog operation.
16	**Jog acceleration/ deceleration time**	0.5s	0 to 3600/360s*		Set the acceleration/deceleration time for jog operation. Set the time taken to reach the frequency set in *Pr. 20 Acceleration/deceleration reference frequency* for acceleration/ deceleration time. (Initial value is 60Hz) The acceleration and deceleration time cannot be set separately.

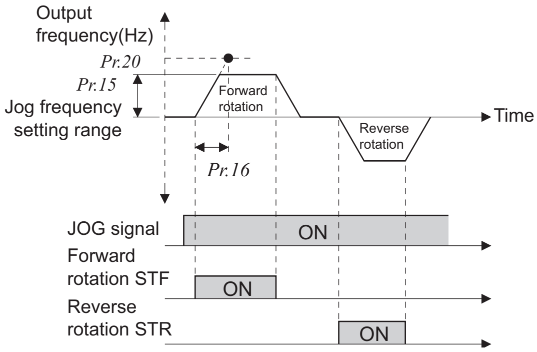
The above parameters are displayed as simple mode parameters only when the parameter unit (FR-PU04/FR-PU07) is connected. When the operation panel (FR-DU07) is connected, the above parameters can be set only when *Pr. 160 User group read selection* = "0". *(Refer to page 180)*

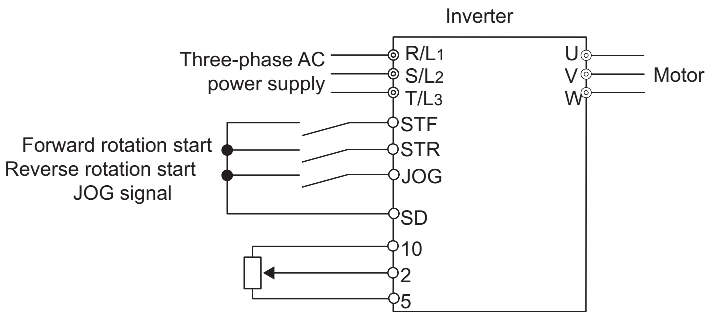
*1 The setting range differs according to the inverter capacity. (22K or less/30K or more)

*2 When the setting of *Pr. 21 Acceleration/deceleration time increments* is "0" (initial value), the setting range is "0 to 3600s" and the setting increments are "0.1s", and when the setting is "1", the setting range is "0 to 360s" and the setting increments are "0.01s"

(1) Jog operation from outside

- When the jog signal is on, a start and stop can be made by the start signal (STF, STR). (The jog signal is assigned to the terminal JOG in the initial setting)

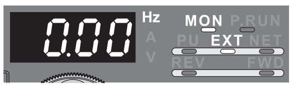




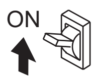
Connection diagram for external jog operation

Operation — **Indication**

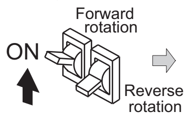
1. Screen at powering on
   - Confirm that the external operation mode is selected. ([EXT] lit)
     If not displayed, press PU/EXT to change to the external [EXT] operation mode.
     If the operation mode still does not change, set Pr. 79 to change to the external operation mode.

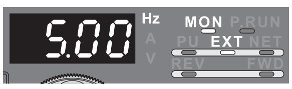


2. Turn the JOG switch on.



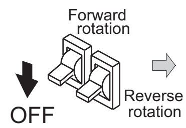
3. Turn the start switch (STF or STR) on.
   - The motor rotates while start switch (STF or STR) is ON.
   - Rotates at 5Hz. (Initial value of *Pr. 15*)

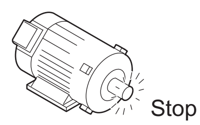




Rotates while ON

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





REMARKS

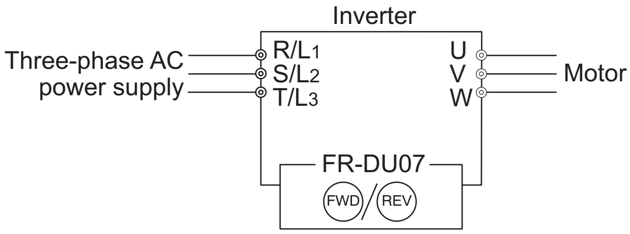
- When you want to change the running frequency, change *Pr. 15 Jog frequency* . (initial value "5Hz")
- When you want to change the acceleration/deceleration time change *Pr. 16 Jog acceleration/deceleration time* . (initial value "0.5s")

4

PARAMETERS

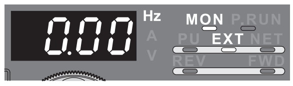
(2) Jog operation from PU

- Set the PU (FR-DU07/FR-PU07/FR-PU04) to the jog operation mode. Operation is performed only while the start button is pressed.



Operation / **Indication**

1. Confirmation of the RUN indication and operation mode indication
   - 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.
3. Press (FWD) (or (REV)).
   - While (FWD) (or (REV)) is pressed, the motor rotates.
   - Rotates at 5Hz. (initial value of Pr. 15)
4. Release (FWD) (or (REV)).

[When changing the frequency of PU JOG operation]

5. Press (MODE) to choose the parameter setting mode.
6. Turn (dial) until *Pr. 15 JOG frequency* appears.
7. Press (SET) to show the currently set value. (5Hz)
8. Turn (dial) to set the value to "10.00". (10Hz)
9. Press (SET) to set.

10. Perform the operations in steps 1 to 4. The motor rotates at 10Hz.

CAUTION

- The *Pr. 15* setting should be equal to or higher than the *Pr. 13 Starting frequency* setting.
- The JOG signal can be assigned to the input terminal using any of *Pr. 178 to Pr. 189 (input terminal function selection)*. When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.
- During jog operation, the second acceleration/deceleration via the RT signal cannot be selected. (The other second functions are valid. *(Refer to page 122)*)
- When *Pr. 79 Operation mode selection* = "4", push (FWD)/(REV) of the PU (FR-DU07/FR-PU04/FR-PU07) to make a start or push (STOP/RESET) to make a stop.
- This function is invalid when *Pr. 79* = "3" or "6".

♦ Parameters referred to ♦

- *Pr. 13 Starting frequency* ☞ *Refer to page 90*
- *Pr. 29 Acceleration/deceleration pattern selection* ☞ *Refer to page 91*
- *Pr. 20 Acceleration/deceleration reference frequency, Pr. 21 Acceleration/deceleration time increments* ☞ *Refer to page 88*
- *Pr. 79 Operation mode selection* ☞ *Refer to page 182*
- *Pr. 178 to Pr. 189 (input terminal function selection)* ☞ *Refer to page 118*

4.7.3 Input compensation of multi-speed and remote setting (Pr. 28)

By inputting the frequency setting compensation signal (terminal 1, 2), the speed (frequency) can be compensated for relative to the multi-speed setting or the speed setting by remote setting function.

Parameter Number	Name	Initial Value	Setting Range	Description
28	**Multi-speed input compensation selection**	0	0	Without compensation
			1	With compensation

REMARKS

- Select the terminal (terminal 1, 2) used for compensation input voltage (0 to ±5V, 0 to ±10) using *Pr. 73 Analog input selection*.
- When using terminal 1 for compensation input, set "0" (initial value) in *Pr. 868 Terminal 1 function assignment*.

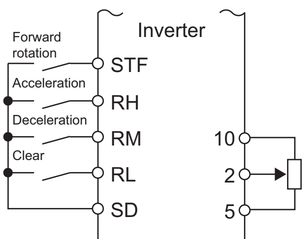
♦ Parameters referred to ♦

Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 (multi-speed operation) ☞ *Refer to page 81*
Pr. 73 Analog input selection ☞ *Refer to page 166*
Pr. 59 Remote function selection ☞ *Refer to page 85*
Pr. 868 Terminal 1 function assignment ☞ *Refer to page 165*

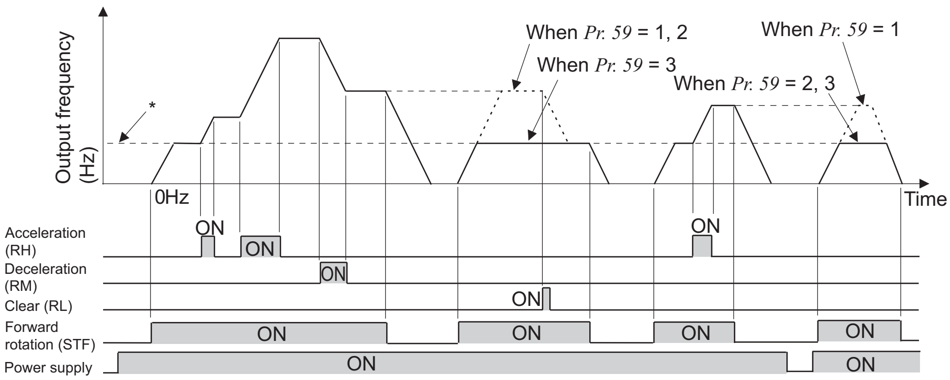
4.7.4 Remote setting function (Pr. 59)

- 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 motorized 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	Yes
			2	Remote setting	No
			3	Remote setting	No (Turning STF/STR off clears remotely- set frequency.)



Connection diagram for remote setting



* External operation 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 the remote function is used, the output frequency of the inverter can be compensated for as follows:

External operation ... Frequency set with RH and RM operation + external operation frequency other than multi-speed (*Pr.79* ="3" (PU operation frequency when *Pr.79* ="3" (external, PU combined)) and terminal 4 input.
(When making analog input compensation, set "1" in *Pr. 28 Multi-speed input compensation selection*.
When *Pr. 28* is set to "0" and acceleration/deceleration is made to reach the set frequency of the analog voltage input (terminal 2 or terminal 4) by RH/RM, the auxiliary input by terminal 1 becomes invalid.)

PU operation .... Frequency set by RH/RM operation + PU running frequency

(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)

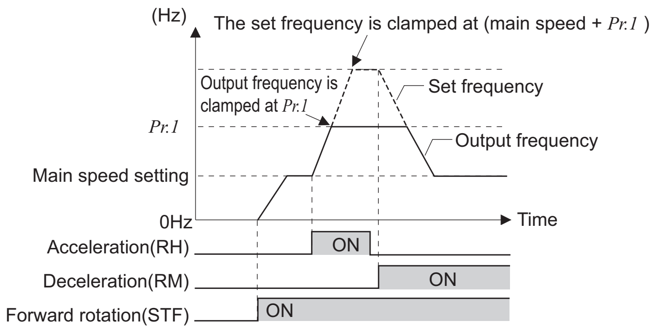
<Frequency setting storage conditions>

· Frequency at the point when the start signal (STF or STR) turns off

· The remotely-set frequency is stored every one minute after one minute has elapsed since turn off (on) of both the RH (acceleration) and RM (deceleration) signals. (The frequency is written if the present frequency setting compared with the past frequency setting every one minute is different. The state of the RL signal does not affect writing.)

CAUTION

· 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 long time has been set in *Pr. 7* or *Pr. 8*, 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 to *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 switching the start signal from ON to OFF, or changing frequency by the RH or RM signal frequently, set the frequency setting value storage function (write to EEPROM) invalid (*Pr. 59* = "2, 3"). If set valid (*Pr. 59* = "1"), frequency is written to EEPROM frequently, this will shorten the life of the EEPROM.

· The RH, RM, RL signals can be assigned to the input terminal using any *Pr. 178 to Pr. 189 (input terminal function selection)*. When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.

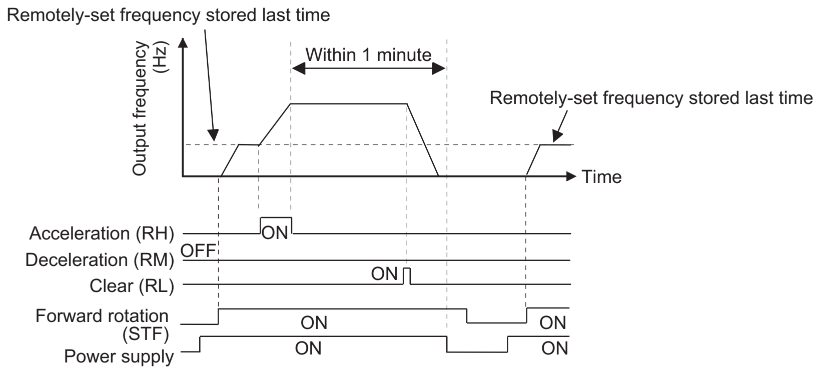
· Also available for the network operation mode.

REMARKS

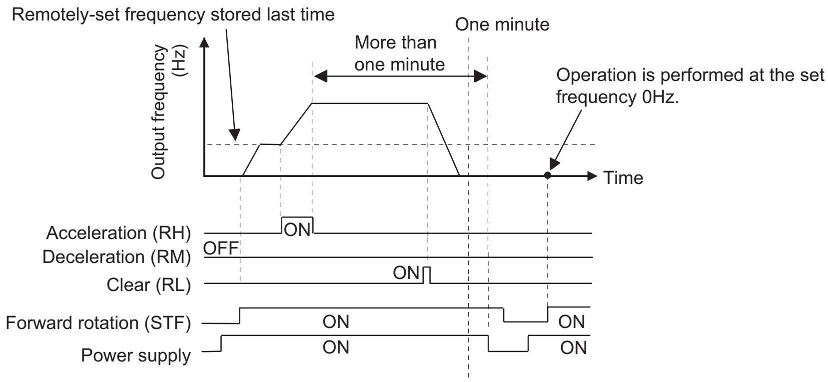
During jog operation or PID control operation, the remote setting function is invalid.

Setting frequency is "0"

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



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



⚠ CAUTION

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

♦ Parameters referred to ♦

Pr. 1 Maximum frequency ☞ *Refer to page 79*
Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 44 Second acceleration/deceleration time, Pr. 45 Second deceleration time ☞ *Refer to page 88*
Pr. 28 Multi-speed input compensation selection ☞ *Refer to page 85*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*

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

Purpose	Parameter that must be Set		Refer to Page
Motor acceleration/deceleration time setting	**Acceleration/deceleration time**	**Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45, Pr. 110, Pr. 111**	88
Starting frequency	**Starting frequency and start-time hold**	**Pr. 13, Pr. 571**	90
Set acceleration/deceleration pattern suitable for application	**Acceleration/deceleration pattern and backlash measures**	**Pr. 29, Pr. 140 to Pr. 143, Pr. 380 to Pr. 383, Pr. 516 to Pr. 519**	91
Automatically set appropriate acceleration/deceleration time	**Automatic acceleration/ deceleration ***	**Pr. 61 to Pr. 63, Pr. 292**	94

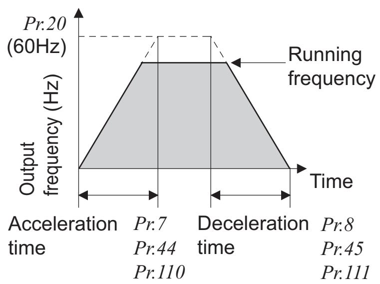
* Automatic acceleration/deceleration is supported by FR-B3 series only.

4.8.1 Setting of the acceleration and deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45, Pr. 110, Pr. 111)

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 148)*.

Parameter Number	Name	Initial Value		Setting Range FR-B	Setting Range FR-B3	Description
7	**Acceleration time**	7.5K or less	5s	0 to 3600/360s *1		Set the motor acceleration time.
		11K or more	15s			
8	**Deceleration time**	7.5K or less	5s	0 to 3600/360s *1		Set the motor deceleration time.
		11K or more	15s			
20	**Acceleration/ deceleration reference frequency**	60Hz		1 to 120Hz/ 1 to 60Hz *2	1 to 120Hz	Set the frequency that will be the basis of acceleration/deceleration time. As acceleration/deceleration time, set the frequency change time from stop to *Pr. 20*.
21	**Acceleration/ deceleration time increments**	0		0		Increments: 0.1s Range: 0 to 3600s — Increments and setting range of acceleration/ deceleration time setting can be changed.
				1		Increments: 0.01s Range: 0 to 360s
44	**Second acceleration/ deceleration time**	5s		0 to 3600/360s *1		Set the acceleration/deceleration time when the RT signal is on.
45	**Second deceleration time**	9999		0 to 3600/360s *1		Set the deceleration time when the RT signal is on.
				9999		Acceleration time = deceleration time
110	**Third acceleration/ deceleration time**	9999		0 to 3600/360s *1		Set the acceleration/deceleration time when the X9 signal is on.
				9999		Without the third acceleration/deceleration function.
111	**Third deceleration time**	9999		0 to 3600/360s *1		Set the deceleration time when the X9 signal is on.
				9999		Acceleration time = deceleration time

*1 Depends on the *Pr. 21 Acceleration/deceleration time increments* setting. The initial value for the setting range is "0 to 3600s" and the setting increments is "0.1s".
*2 The setting range differs according to the inverter capacity. (22K or less/30K or more)



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

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

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

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

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

(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.

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

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

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

(3) Change the setting range and increments of the acceleration/deceleration time *(Pr. 21)*

- Use *Pr. 21* to set the acceleration/deceleration time and minimum setting range.
  Setting "0" (initial value) .... 0 to 3600s (minimum setting increments 0.1s)
  Setting "1" .... 0 to 360s (minimum setting increments 0.01s)

CAUTION

- Changing the *Pr. 21* setting changes the acceleration/deceleration time setting *(Pr. 7, Pr. 8, Pr. 16, Pr. 44, Pr. 45, Pr. 110, Pr. 111, Pr. 264, Pr. 265)*.
  (The *Pr. 611 Acceleration time at a restart* setting is not affected.)
  <Example>
  When *Pr. 21* = "0", setting "5.0" s in *Pr. 7* and "1" in *Pr. 21* automatically changes the *Pr. 7* setting to "0.5" s.

(4) Set multiple acceleration/deceleration time (RT signal, *Pr. 44, Pr. 45, Pr. 110, Pr. 111*)

- *Pr. 44* and *Pr. 45* are valid when the RT signal is on, and *Pr. 110* and *Pr. 111* are valid when the X9 signal is on. When both the RT and X9 are on, *Pr. 110* and *Pr. 111* are valid.
- For the terminal used for X9 signal input, set "9" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.
- When "9999" is set in *Pr. 45* or *Pr. 111*, the deceleration time becomes equal to the acceleration time *(Pr. 44, Pr. 110)*.
- When *Pr. 110* = "9999", third acceleration/deceleration time is invalid.

CAUTION

- In S-shaped acceleration/deceleration pattern A *(refer to page 91)*, the set time is the period required to reach the base frequency set in *Pr. 3 Base frequency*.
- Acceleration/deceleration time formula when the set frequency is the base frequency or higher

$$t = \frac{4}{9} \times \frac{T}{(\text{Base frequency*})^2} \times f^2 + \frac{5}{9}T$$

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

The frequency for FR-B series is 60Hz and *Pr.84 Rated motor frequency* for FR-B3 series.

- Guideline for acceleration/deceleration time when Base frequency = 60Hz (0Hz to set frequency)

Acceleration/deceleration time (s) \ Frequency setting (Hz)	60	120
5	5	12
15	15	35

- The RT, X9 signal can be assigned to the input terminal using any of *Pr. 178 to Pr. 189 (input terminal function selection)*. When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.

REMARKS

- The RT (X9) signal acts as the second (third) function selection signal and makes the other second (third) function valid. *(Refer to page 122)*
- The RT signal is assigned to the RT terminal in the default setting. By setting "3" in any of *Pr. 178 to Pr. 189 (input terminal function selection)*, you can assign the RT signal to the other terminal.
- 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, Pr. 45, Pr. 110* and *Pr. 111* settings are 0.03s or less, the acceleration/deceleration time is 0.04s.
- If the acceleration/deceleration time is set, 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.

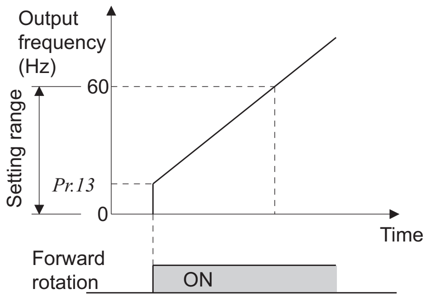
♦ Parameters referred to ♦

Pr. 10 DC injection brake operation frequency ☞ *Refer to page 100*
Pr. 29 Acceleration/deceleration pattern selection ☞ *Refer to page 91*
Pr. 125, Pr. 126 (frequency setting gain frequency) ☞ *Refer to page 172*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*

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

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

Parameter Number	Name	Initial Value	Setting Range	Description
13	Starting frequency	0.5Hz	0 to 60Hz	Frequency at start can be set in the range 0 to 60Hz. You can set the starting frequency at which the start signal is turned on.
571	Holding time at a start	9999	0.0 to 10.0s	Set the holding time of *Pr. 13 Starting frequency*.
			9999	Holding function at a start is invalid

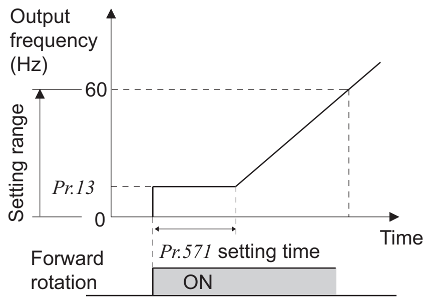


(1) Starting frequency setting *(Pr. 13)*

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

CAUTION

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 the time 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.

CAUTION

- 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 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 ♦

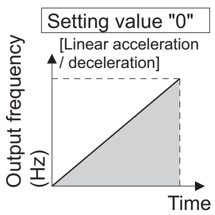
Pr. 2 Minimum frequency ☞ *Refer to page 79*

4.8.3 Acceleration/deceleration pattern (Pr. 29, Pr. 140 to Pr. 143, Pr. 380 to Pr. 383, Pr. 516 to Pr. 519)

You can set the acceleration/deceleration pattern suitable for application.
You can also set the backlash measures that stop acceleration/deceleration once at the parameter-set frequency and time during acceleration/deceleration.

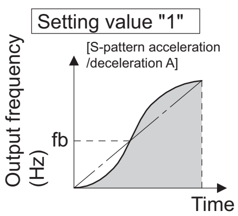
Parameter Number	Name	Initial Value	Setting Range		Description
			FR-B	FR-B3	
29	**Acceleration/deceleration pattern selection**	0	0		Linear acceleration/ deceleration
			1		S-pattern acceleration/deceleration A
			2		S-pattern acceleration/deceleration B
			3		Backlash measures
			4		S-pattern acceleration/deceleration C
			5		S-pattern acceleration/deceleration D
140	**Backlash acceleration stopping frequency**	1Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the stopping frequency and time for backlash measures. Valid when *Pr. 29* = 3
141	**Backlash acceleration stopping time**	0.5s	0 to 360s		
142	**Backlash deceleration stopping frequency**	1Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	
143	**Backlash deceleration stopping time**	0.5s	0 to 360s		
380	**Acceleration S-pattern 1**	0	0 to 50%		Valid when S-pattern acceleration/ deceleration C (*Pr. 29* = 4) is set. Set the time taken for S-pattern from starting of acceleration/deceleration to linear acceleration as % to the acceleration/deceleration time (*Pr. 7, Pr. 8* etc.). An acceleration/deceleration pattern can be changed with the X20 signal.
381	**Deceleration S-pattern 1**	0	0 to 50%		
382	**Acceleration S-pattern 2**	0	0 to 50%		
383	**Deceleration S-pattern 2**	0	0 to 50%		
516	**S-pattern time at a start of acceleration**	0.1s	0.1 to 2.5s		Valid when S-pattern acceleration/ deceleration D (*Pr. 29* = 5) is set. Set the time taken for S-pattern acceleration/deceleration (S-pattern operation).
517	**S-pattern time at a completion of acceleration**	0.1s	0.1 to 2.5s		
518	**S-pattern time at a start of deceleraiton**	0.1s	0.1 to 2.5s		
519	**S-pattern time at a completion of deceleraiton**	0.1s	0.1 to 2.5s		

* The setting range differs according to the inverter capacity. (22K or less/30K or more)



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

- When the frequency is changed for acceleration, deceleration, etc. in inverter operation, the output frequency is changed linearly (linear acceleration/ deceleration) to reach the set frequency without straining the motor and inverter. Linear acceleration/deceleration has a uniform frequency/time slope.

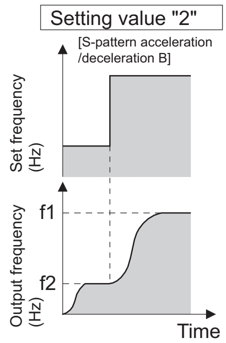


(2) S-pattern acceleration/deceleration A (*Pr. 29* = "1")

- For machine tool spindle applications, etc.
  Used when acceleration/deceleration must be made in a short time to a high-speed range of not lower than the base frequency. In this acceleration/ deceleration pattern, 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 region of *Pr. 3 Base frequency* (initial value = 60Hz) or higher.
  FR-B series: 60Hz
  FR-B3 series: 60Hz *(Pr.84 Rated motor frequency)*

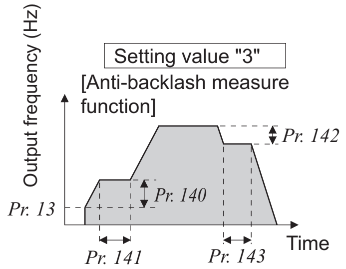
CAUTION

- As the acceleration/deceleration time of S-pattern acceleration/deceleration A, set the time taken until base frequency (60Hz) is reached, not *Pr. 20 Acceleration/deceleration reference frequency*.



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

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

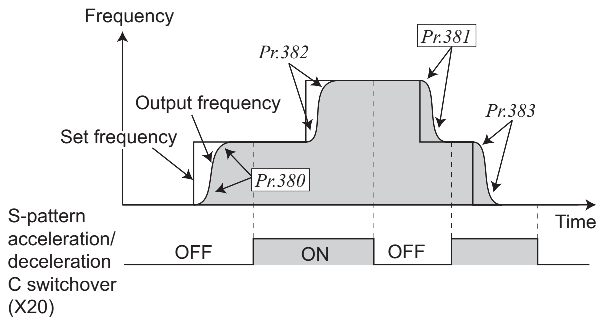


(4) Backlash measures (*Pr. 29* = "3", *Pr. 140 to Pr. 143*)

- What is backlash?
  Reduction gears have an engagement gap and have a dead zone between forward rotation and reverse rotation. This dead zone is called backlash, and this gap disables a mechanical system from following motor rotation.
  More specifically, a motor shaft develops excessive torque when the direction of rotation changes or when constant-speed operation shifts to deceleration, resulting in a sudden motor current increase or regenerative status.
- To avoid backlash, acceleration/deceleration is temporarily stopped.
  Set the acceleration/deceleration stopping frequency and time in *Pr. 140 to Pr. 143*.

CAUTION

Setting the backlash measures increases the acceleration/deceleration time by the stopping time.



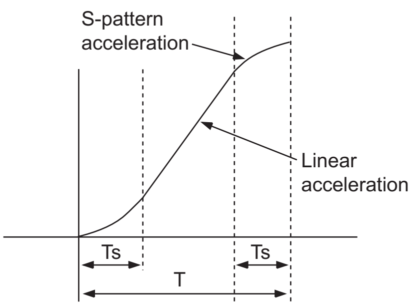
(5) S-pattern acceleration/deceleration C (*Pr. 29* = "4", *Pr. 380 to Pr. 383*)

- With the S-pattern acceleration/deceleration C switch signal (X20), an acceleration/deceleration curve S-pattern 1 or S-pattern 2 can be selected.
- For the terminal used for X20 signal input, set "20" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.

X20 signal \ Operation	During Acceleration	During Deceleration
OFF	*Pr. 380 Acceleration S-pattern 1*	*Pr. 381 Deceleration S-pattern 1*
ON	*Pr. 382 Acceleration S-pattern 2*	*Pr. 383 Deceleration S-pattern 2*

- Set % of time taken for forming an S-pattern in *Pr. 380 to Pr. 383* as acceleration time is 100%.

Parameter setting (%) Ts / T × 100%



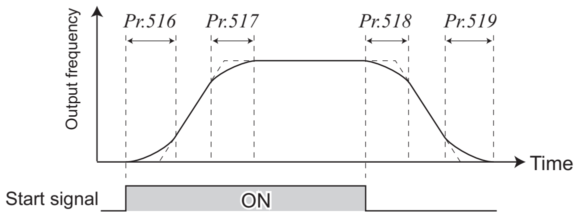
REMARKS

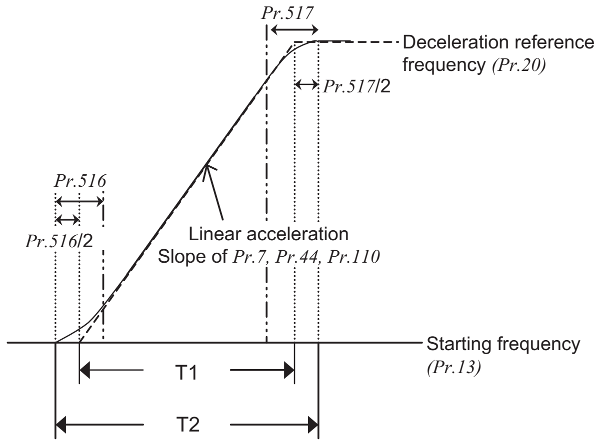
- At a start, the motor starts at *Pr. 13 Starting frequency* when the start signal turns on.
- If there is a difference between the speed command and speed at a start of deceleration due to torque limit operation etc., the speed command is matched with the speed to make deceleration.

CAUTION

- Change the S pattern acceleration/deceleration C switch (X20 signal) after the speed becomes constant.
- S pattern operation before switching continues even if the X20 signal is changed during acceleration or deceleration.
- The X20 signal can be assigned to the input terminal using any of *Pr. 178 to Pr. 189 (input terminal function selection)*. Changing the terminal assignment may affect the other functions. Make setting after confirming the function of each terminal.

(6) S-pattern acceleration/deceleration D (*Pr. 29* = "5", *Pr. 516 to Pr. 519*)





- Set the time taken for S-pattern operation of S-pattern acceleration/deceleration using *Pr. 516 to Pr. 519*.
  Set each S-pattern operation time for acceleration start *(Pr. 516)*, acceleration completion *(Pr. 517)*, deceleration start *(Pr. 518)* and deceleration completion *(Pr. 519)*.
- When S-pattern acceleration/deceleration D is set, acceleration/deceleration time will become longer as follows:

Actual acceleration time T2 = set acceleration time T1 + (S-pattern time at a start of acceleration+S-pattern time at a completion of acceleration) /2 Actual deceleration time T2 = set deceleration time T1 + (S-pattern time at a start of deceleration+S-pattern time at a completion of deceleration) /2

Set acceleration/deceleration time T1 indicates *Pr. 7, Pr. 8, Pr. 44, Pr. 45, Pr. 110* and *Pr. 111*.

CAUTION

- Even if the start signal is turned off during acceleration, the inverter will not decelerate immediately to avoid sudden frequency change. (Likewise, the inverter will not immediately accelerate when deceleration is changed to reacceleration by turning the start signal on during deceleration, etc.)

- For example, the actual acceleration time when starting the inverter with an S-pattern acceleration/deceleration pattern D selected for a stop to 60Hz in the parameter initial setting is as shown left:

Set acceleration time T1 = (*Pr. 20 - Pr. 13*) × *Pr. 7/Pr. 20* Actual acceleration time T2 = set acceleration time T1 + (*Pr. 516* + *Pr. 517*) /2

Therefore,

Set acceleration time T1 = (60Hz - 0.5Hz) × 5s/60Hz ≒ 4.96s (actual acceleration time at linear acceleration) Actual acceleration time T2 = 4.96s + (0.1s + 0.1s)/2 = 5.06s (acceleration time at S-pattern acceleration)

♦ Parameters referred to ♦

Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 20 Acceleration/deceleration reference frequency ☞ *Refer to page 88*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 118*

4.8.4 Shortest acceleraiton/deceleration and optimum acceleration/deceleration (automatic acceleration/deceleration) (Pr. 61 to Pr. 63, Pr. 292, Pr. 293) B3

Setting can be made only for FR-B3 series.

The inverter operates in the same conditions as when appropriate values are set in each parameter even if acceleration/deceleration time and V/F pattern are not set. This function is useful when you just want to operate, etc. without fine parameter setting.

Parameter Number	Name	Initial Value	Setting Range	Description
61	**Reference current**	9999	0 to 500A	Set the reference current during shortest/ optimum acceleration/deceleration.
			9999	Rated inverter output current value is reference
62	**Reference value at acceleration**	9999	0 to 220%	Set the limit value/optimum value during shortest/ optimum acceleration.
			9999	Shortest acceleration/deceleration: 150% is a limit value Optimum acceleration/deceleration: 100% is an optimum value
63	**Reference value at deceleration**	9999	0 to 220%	Set the limit value/optimum value during shortest/ optimum deceleration.
			9999	Shortest acceleration/deceleration: 150% is a limit value Optimum acceleration/deceleration: 100% is an optimum value
292	**Automatic acceleration/ deceleration**	0	0	Normal mode
			1	Shortest acceleration/deceleration (without brake)
			11	Shortest acceleration/deceleration (with brake)
			3	Optimum acceleration/deceleration
			7, 8	Brake sequence mode 1, 2 *(Refer to page 108.)*
293	**Acceleration/ deceleration individual operation selection**	0	0	Both acceleration and deceleration are made in the shortest/optimum acceleration/deceleration mode
			1	Only acceleration is made in the shortest/optimum acceleration/deceleration mode
			2	Only deceleration is made in the shortest/optimum acceleration/deceleration mode

(1) Shortest acceleration/deceleration mode (*Pr. 292* = "1, 11", *Pr. 293*)

- Set when you want to accelerate/decelerate the motor for the shortest time. It is desired to make acceleration/ deceleration in a shorter time for a machine tool etc. but the design values of machine constants are unknown.
- Acceleration/deceleration speed is automatically adjusted at a start of acceleration/deceleration so that acceleration/deceleration is made with the maximum torque the inverter can output according to the setting value of *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time*. (The setting values of *Pr. 7* and *Pr. 8* are not changed)
- Either acceleration or deceleration can be made in the shortest time using *Pr. 293 Acceleration/deceleration individual operation selection*.
  When the setting value is "0" (initial value), both acceleration and deceleration can be made in the shortest time.
- Since the 7.5K or less inverter has a built-in brake resistor, set *Pr. 292* to "11". Set "11" also when a high-duty brake resistor or brake unit is connected. Deceleration time can be further shortened.
- When the shortest acceleration/deceleration mode is selected, the stall prevention operation level during acceleration/deceleration becomes 150% (adjustable using *Pr. 61* to *Pr. 63*). The setting of *Pr. 22 Stall prevention operation level* and stall level by analog input are used only during a constant speed operation.
- It is inappropriate to use for the following applications.
  a)Machine with a large inertia such as a fan (more than 10 times). Since stall prevention operation will be activated for a long time, this type of machine may be brought to an alarm stop due to motor overloading, etc. .
  b)It is desired to always perform operation with a constant acceleration/deceleration time.
  c)It is desired to perform operation making sure the inverter and motor have enough capability.

REMARKS

- If outmatic acceleration/deceleration mode has been selected, inputting the jog signal (jog operation), RT signal (second function selection) or X9 signal (third function selection) during an inverter stop will switch to the normal operation and give priority to jog operation, second function selection or third function selection. Note that JOG and RT signal input is invalid even if JOG signal and RT signal are input during operation in automatic acceleration/deceleration mode.
- Since acceleration/deceleration is made with the stall prevention operation being activated, the acceleration/deceleration speed always varies according to the load conditions.
- Note that when proper values are set in *Pr. 7* and *Pr. 8* , acceleration/deceleration time may be shorter than selecting shortest acceleration/deceleration mode.

(2) Optimum acceleration/deceleration mode (*Pr. 292* = "3")

- The optimum operation within the rating range where the inverter can be continuously used regardless of the inverter capability is performed.
  Automatically set torque boost and acceleration/deceleration time so that the average current during acceleration/deceleration is the rated current by the self-learning of the inverter.
  It is appropriate for applications such as automatic transfer machine, etc. which is small in load change and is operated in a predetermined pattern.
- At the initial time when the optimum acceleration/deceleration mode has been selected, operation is performed at the values set in *Pr. 7 Acceleration time* and *Pr. 8 Deceleration time*. After operation, the average current and peak current are calculated from the motor current during acceleration/deceleration.These values are compared with the reference current (initial value is rated inverter current) and calculated, then more appropriate values are set in *Pr. 7* and *Pr. 8* .
  After that, operation is performed under the conditions of *Pr. 7* and *Pr. 8* set, and more appropriate values are calculated.
- Storage of parameters
  The optimum values of *Pr. 7* and *Pr. 8* are written to both the parameter RAM and EEPROM only three times of acceleration/deceleration after the optimum acceleration/deceleration mode has been selected or after the power is switched on or the inverter is reset. At of after the fourth attempt, they are not stored into EEPROM. Hence, after power-on or inverter reset, the values changed at the third time are valid. Note that the values changed at the fourth or later time are calculated to optimum and the values of *Pr. 7* and *Pr. 8* are set to RAM, the values can be stored into EEPROM by reading and writting the values with the operation panel and paramter unit.

Number of Optimum Value Changes	*Pr. 7, Pr. 8*		Optimum Conditions
	EEPROM value	RAM value	
1 to 3 times	Updated	Updated	Updated
4 or more times	Unchanged from third value	Updated	Updated

- Either acceleration or deceleration can be made in the optimum acceleration/deceleration mode using *Pr. 293 Acceleration/deceleration individual operation selection.*
  When the setting value is "0" (initial value), both acceleration and deceleration are made in the optimum acceleration/deceleration mode.
- It is inappropriate for machines which change in load and operation conditions.
  Since the stored optimum values are used for the next operation, faults, e.g. acceleration/deceleration is not made if conditons change, alarm stop is made due to overcurrent protective function, may occur.

REMARKS

- If shortest acceleration/deceleration mode has been selected, inputting the jog signal (jog operation), RT signal (second function selection) or X9 signal (third function selection) during an inverter stop will switch to the normal operation and give priority to jog operation, second function selection or third function selection. Note that JOG and RT signal input is invalid even if JOG signal and RT signal are input during operation in shortest/optimum acceleration/deceleration mode.
- Because of the learning system, this mode is not valid at the first operation after the optimum acceleration/deceleration mode is set.
- The optimum value are operated on only when acceleration is made from a stop to 30Hz or more or when deceleration is made from 30Hz or more to stop.
- When the motor is not connected or output current is less than 5% of the rated inverter current, optimum acceleration/deceleration mode will not function.

(3) Adjustment of shortest and optimum acceleration/deceleration mode *(Pr. 61 to Pr. 63)*

- By setting the adjustment parameters *Pr. 61 to Pr. 63*, the application range can be made wider.

Parameter Number	Name	Setting Range	Description
61	**Reference current**	0 to 500A	For example, when the motor and inverter are different in capacity, set the rated motor current value. Shortest acceleration/deceleration: Set reference current (A) of the stall prevention operation level during acceleration/deceleration Optimum acceleration/deceleration: Set reference current (A) of the optimum current during acceleration/deceleration
		9999 (initial value)	The rated inverter current is defined as reference.
62 63	**Reference value at acceleration** **Reference value at deceleration**	0 to 220%	Set when it is desired to change the reference level of acceleration and deceleration. Shortest acceleration/deceleration: Set the stall prevention operation level (ratio to the current value of *Pr. 61*) during acceleration/deceleration. Shortest acceleration/deceleration: Set the optimum current level (ratio to the current value of *Pr. 61*) during acceleration/deceleration.
		9999 (initial value)	Shortest acceleration/deceleration: The 150% value during shortest acceleration/deceleration is judged as the stall prevention operation level. Optimum acceleration/deceleration: 100% is the optimum value

REMARKS

- Since the *Pr. 61 to Pr. 63* settings automatically return to the initial value (9999) if the *Pr. 292* setting is changed, set *Pr. 292* first when you need to set *Pr. 61 to Pr. 63*.

♦ **Parameters referred to** ♦

Pr. 7 Acceleration time, Pr. 8 Deceleration time ☞ *Refer to page 88*
Pr. 22 Stall prevention operation level ☞ *Refer to page 74*
Pr. 22 Torque limit level ☞ *Refer to page 98*

4.9 Selection and protection of a motor

Purpose	Parameter that must be Set		Refer to Page
Motor protection from overheat	**Electronic thermal O/L relay**	**Pr. 9**	96
Use the constant torque motor	**Applied motor ***	**Pr. 71**	99
Use the constant torque motor	**Offline auto tuning**	**Pr. 82 to Pr. 84, Pr. 90 to Pr. 94, Pr. 96**	70

* Applied motor can be used only with FR-B series.

4.9.1 Motor protection from overheat (Electronic thermal relay function) (Pr. 9)

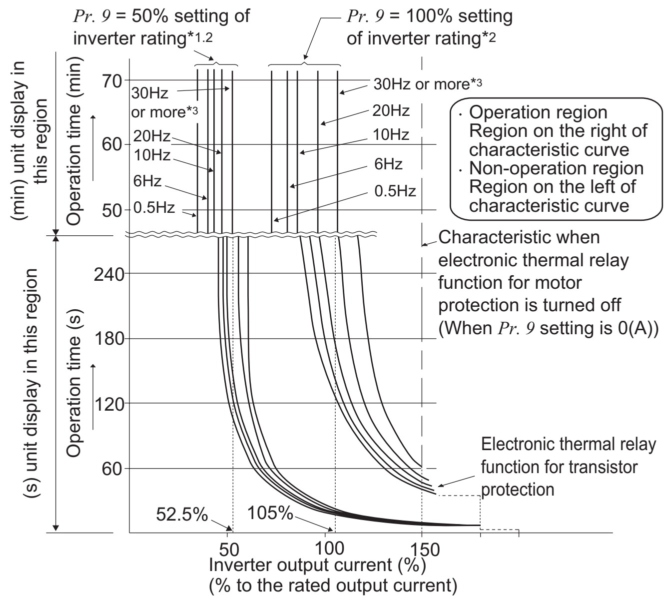
Set the current of the electronic thermal O/L relay to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

Parameter Number	Name	Initial Value	Setting Range		Description
9	**Electronic thermal O/L relay**	Rated inverter output current *1	55K or less	0 to 500A	Set the rated motor current.
			75K or more	0 to 3600A	

*1 The initial value of the FR-B-750(200V/400V), FR-B3(N)(H)400, 750 is set to 85% of the rated inverter current.

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

Electronic thermal relay function operation characteristic



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

- Set the rated current [A] of the motor in *Pr. 9*. (When the power supply specification is 200V/220V(400V/440V) 60Hz, set the 1.1 times the rated motor current.)
- Set "0" in *Pr. 9* when you do not want to activate the electronic thermal relay function, e.g. when using an external thermal relay with the motor. (Note that the output transistor protection of the inverter functions (E.THT).)
- In FR-B series, when using the Mitsubishi explosion-proof constant-torque motor
  1) Set "1" in *Pr. 71*. (This provides a 100% continuous torque characteristic in the low-speed range.)
  2) Set the rated current of the motor in *Pr. 9*.

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

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

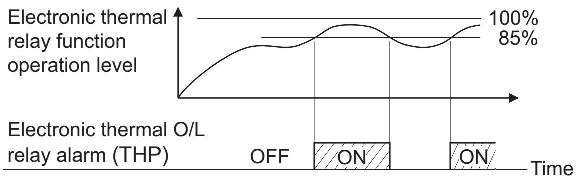
*3 When you set the electronic thermal relay function dedicated to the Mitsubishi explosion-proof constant-torque motor, this characteristic curve applies to operation at 6Hz or higher.

CAUTION

- Protective function by electronic thermal relay function is reset by inverter power reset and reset signal input. Avoid unnecessary reset and power-off.
- When multiple motors are operated by a single inverter, protection cannot be provided by the electronic thermal relay function. Install an external thermal relay to each motor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
- A special motor cannot be protected by the electronic thermal relay function. Use the external thermal relay.
- The operation time of the transistor protection thermal relay shortens when the *Pr. 72 PWM frequency selection* setting increases.

(2) Electronic thermal relay function alarm output and alarm signal (THP signal)

100%: Electronic thermal relay function alarm operation value

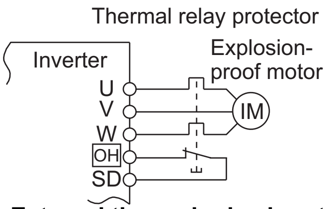


- The alarm signal (THP) is output when the electronic thermal relay function cumulative value reaches 85% of the level set in *Pr. 9* or *Pr. 51*. If it reaches 100% of the *Pr. 9 Electronic thermal O/L relay* setting, electronic thermal relay function protection (E. THM/E.THT) occurs.
- The inverter does not shut off the output if the alarm signal is output.
- For the terminal used for the THP signal output, assign the function by setting "8" (positive logic) or "108" (negative logic) in any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

CAUTION

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

(3) 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 shuts off the output and outputs the alarm signal (E.OHT).
- For the terminal used for OH signal input, assign the function by setting "7" in any of *Pr. 178 to Pr. 189 (input terminal function selection)*

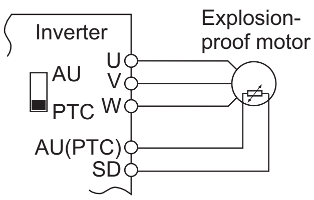
CAUTION

- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.

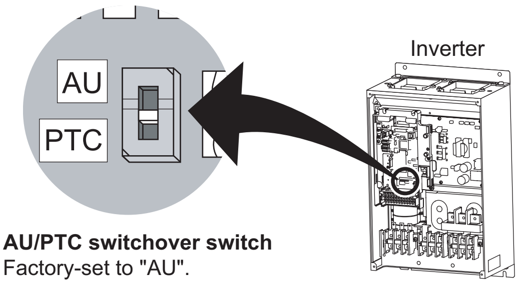
4

PARAMETERS

(4) PTC thermistor input (PTC signal)



PTC thermistor input connection example



AU/PTC switchover switch
Factory-set to "AU".
Set to the "PTC" position to validate the PTC signal input.

Built-in PTC thermistor of the motor can be input to the PTC signal (AU terminal).

· For the terminal used for PTC signal input, assign the function by setting "63" in *Pr. 184 AU terminal function selection* and also set the AU/PTC switchover switch to the PTC terminal function. (The initial setting is the AU terminal function.)

· If a motor overheat state is detected for more than 10s according to the input from the PTC thermistor, the inverter shuts off the output and outputs the PTC thermal alarm signal (E.PTC).

· The input specifications of the PTC thermistor are shown on the right.

Motor Temperature	PTC Thermistor Resistance Value (Ω)
Normal	0 to 500
Boundary	500 to 4k
Overheat	4k or higher

CAUTION

· When the PTC signal was not assigned to *Pr. 184* and the AU/PTC switchover switch was set to the PTC terminal function, the function assigned to the AU terminal is always off. Reversely, when the PTC signal was assigned to *Pr. 184* and the AU/PTC switchover switch was set to the AU terminal function, a PTC thermal error (E.PTC) occurs since the function is always in a motor overheat state.

· When you want to input a current, assign the AU signal to the other signal.

· When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of the AU terminal.

♦ Parameters referred to ♦

Pr. 71 Applied motor ☞ *Refer to page 99*
Pr. 72 PWM frequency selection ☞ *Refer to page 269*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*
Specifications of the AU terminal ☞ *Refer to page 26*

4.9.2 Applied motor (Pr. 71) B

Setting can be made only for FR-B series.

Setting of the used motor selects the thermal characteristic appropriate for the motor.
Setting is necessary when using a constant-torque motor. Thermal characteristic of the electronic thermal relay function suitable for the motor is set.

Parameter Number	Name	Initial Value	Setting Range	Description
71	**Applied motor**	0	0.1	Selecting the variable torque motor or constant-torque motor sets the corresponding motor thermal characteristic.

(1) Set the motor to be used

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

Pr. 71 Setting	Thermal Characteristic of the Electronic Thermal Relay Function	Motor (○ : used motor)	
		Variable torque	Constant torque
0	Thermal characteristics of a variable torque motor	○	
1	Thermal characteristics of the Mitsubishi constant-torque motor		○

⚠ CAUTION

⚠ Set this parameter correctly according to the motor used.
Incorrect setting may cause the motor to overheat and burn.

4

PARAMETERS

4.10 Motor brake and stop operation

<table>
<tr><th>Purpose</th><th colspan="2">Parameter that must be Set</th><th>Refer to Page</th></tr>
<tr><td>Motor braking torque adjustment</td><td>DC injection brake</td><td>Pr. 10 to Pr. 12 *1</td><td>100</td></tr>
<tr><td>Improve the motor braking torque with an option</td><td>Selection of a regenerative brake</td><td>Pr. 30, Pr. 70 *2</td><td>102</td></tr>
<tr><td>Performing operation by DC current input</td><td>DC current feeding mode</td><td>Pr. 30</td><td>102</td></tr>
<tr><td>Coast the motor to a stop</td><td>Selection of motor stopping method</td><td>Pr. 250</td><td>104</td></tr>
<tr><td>Used to stop the motor with a mechanical brake (vibration restraint at stop-on-contact)</td><td>Stop-on-contact control</td><td>Pr. 270, Pr. 275, Pr. 276</td><td>105</td></tr>
</table>

*1 Setting can be made only for FREQROL-B3 series.
*2 When the regenerative brake option is used for FREQROL-B series (55K or less) or FREQROL-B3 series, another explosion-proof test is necessary.

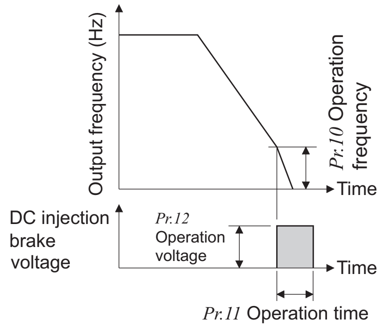
4.10.1 DC injection brake and zero speed control, servo lock (X13 signal, Pr. 10 to Pr. 12)

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

<table>
<tr><th rowspan="2">Parameter Number</th><th rowspan="2">Name</th><th colspan="3">Initial Value</th><th colspan="2">Setting Range</th><th rowspan="2">Description</th></tr>
<tr><th>FR-B</th><th colspan="2">FR-B3</th><th>FR-B</th><th>FR-B3</th></tr>
<tr><td rowspan="2">10
B3</td><td rowspan="2">DC injection brake operation frequency</td><td rowspan="2">—</td><td colspan="2" rowspan="2">3Hz</td><td rowspan="2">—</td><td>0 to 120Hz</td><td>Set the operation frequency of the DC injection brake (zero speed control, servo lock).</td></tr>
<tr><td>9999</td><td>Operated at Pr. 13 or less.</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">DC injection brake operation time</td><td rowspan="3">0.5s/
0s *</td><td colspan="2" rowspan="3">0.5s</td><td colspan="2">0</td><td>DC injection brake (zero speed control) disabled</td></tr>
<tr><td>0.5s</td><td>0.1 to 10s</td><td>Set the operation time of the DC injection brake (zero speed control, servo lock).</td></tr>
<tr><td>—</td><td>8888</td><td>Operated when X13 signal is on</td></tr>
<tr><td rowspan="2">12
B3</td><td rowspan="2">DC injection brake operation voltage</td><td>—</td><td>7.5K or less</td><td>4%</td><td rowspan="2">—</td><td rowspan="2">0 to 30%</td><td rowspan="2">Set the DC injection brake voltage (torque). When "0" is set, DC injection brake is disabled.</td></tr>
<tr><td>—</td><td>11K or more</td><td>2%</td></tr>
</table>

* The setting range differs according to the inverter capacity. (55K or less/75K or more)

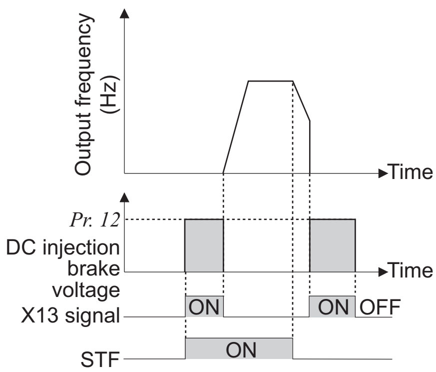
When *Pr. 11* = "0.1 to 10s"



(1) Operation frequency setting *(Pr. 10)* B3

- When the frequency at which the DC injection brake operates is set in *Pr. 10*, the DC injection brake (zero speed control, servo lock) is operated when this frequency is reached during deceleration.
- At the *Pr. 10* setting of "9999", the DC injection brake is operated when deceleration is made to the frequency set in *Pr. 13 Starting frequency*.

When *Pr. 11* = "8888"



(2) Operation time setting *(X13 signal, Pr. 11)* B3

- Use *Pr. 11* to set the duration period the DC injection brake is applied.
- When *Pr. 11* = "0s", the DC injection brake is not operated. (At a stop, the motor coasts.)
- When *Pr. 11* = "8888", the DC injection brake is applied when X13 signal is turned on.
- For the terminal used for X13 signal input, set "13" in any of *Pr. 178 to Pr. 189* to assign the function. *(Refer to page 118)*

(3) Operation voltage (torque) setting *(Pr. 12)* B3

- Use *Pr. 12* to set the percentage to the power supply voltage.
- When *Pr. 12* = "0%", the DC injection brake is not operated. (At a stop, the motor coasts.)
- When using the inverter dedicated motor (constant-torque motor), change the *Pr. 12* setting as follows.
  3.7K or less ...4%, 5.5K or more...2%

(4) DC dynamic brake in FREQROL-B series *(Pr. 11)* B

The DC dynamic brake in FREQROL-B series can be selected to operate (*Pr.11*=0.5s) or not to operate (*Pr.11*=0s) depending on the *Pr. 11 DC injection brake operation time*.
The DC injection brake operation frequency and voltage are as follows. (The setting cannot be changed.)

Capacity	Pr.11 Initial value	Operation frequency	Operation voltage
7.5K or less	0.5s	3Hz	4%
11K to 55K			2%
75K or more	0 (DC injection brake disabled)	1Hz	1%

♦ Parameters referred to ♦

Pr. 13 Starting frequency ☞ *Refer to page 90*
Pr. 71 Applied motor ☞ *Refer to page 99*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 118*
Pr. 422 Position loop gain ☞ *Refer to page 135*

4.10.2 Selection of regenerative brake (Pr. 30, Pr. 70) (75K or more) B

Setting can be made only for FR-B series.

- When making frequent starts/stops, use the brake unit (FR-BU, MT-BU5) to increase the regenerative brake duty.
- Use a power regeneration converter (MT-RC) for continuous operation in regenerative status.
  Use a high power factor converter (MT-HC) to reduce harmonics, improve the power factor, or continuously use the regenerative mode.

CAUTION

The regenerative brake option (brake unit) can be used with the 75K or more of FR-B series. Cannot be used with the 55K or less.

Parameter Number	Name	Initial Value	Setting Range		Description	
			FR-B	FR-B3	Regeneration unit	Terminal for power supply to the inverter
30	**Regenerative function selection**	0	0	—	Built-in brake resistor, without regenerative function, brake unit (FR-BU type)	R, S, T
			1	—	Brake unit (MT-BU5), power regeneration converter (MT-RC) Supports capacities of the FR-B-75K or more.	R, S, T
			2	—	High power factor converter (MT-HC) Supports capacities of the FR-B-75K or more.	P, N
70	**Special regenerative brake duty**	0%	0 to 10%*	—	Set the %ED of the built-in brake transistor operation. * Supports capacities of the FR-B-75K or more.	

Regeneration Unit	Power Supply to the Inverter	*Pr. 30* Setting	*Pr. 70* Setting
Not used	R/L1, S/L2, T/L3	0 (initial value)	—
Power regeneration converter (MT-RC)	R/L1, S/L2, T/L3	1	0% (initial value)
Brake unit (MT-BU5)	R/L1, S/L2, T/L3	1	10%
High power factor converter (FR-HC)	P/+, N/-	2	—

(1) When the built-in brake resistor, the brake unit (FR-BU) is used

· Set "0 (initial value)" in *Pr. 30*. The *Pr. 70* setting is made invalid.
At this time, the regenerative brake duty is as follows. (The built-in brake resistor is provided for the 7.5K or less.)
- · FR-B-750 to 3700(200V)........................ 3%
- · FR-B-5.5K, 7.5K(200V).......................... 2%
- · FR-B-750 to 7.5K(400V) 2%
- · FR-B-75K or more (200V/400V)............. 0% (without built-in brake resistor)

(2) When using a brake unit (MT-BU5) and power regeneration converter (MT-RC) (FR-B-75K or more)

· Set "1" in *Pr. 30*.
· Set "10%" in *Pr. 70* when using a brake unit (MT-BU5).
· Set "0%" in *Pr. 70* when using a power regeneration converter (MT-RC).

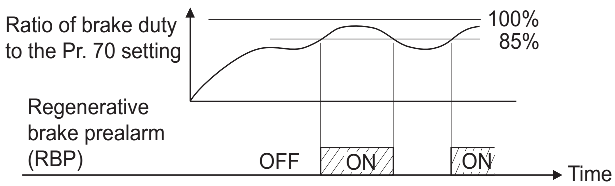
(3) When using the high power factor converter (MT-HC) (FR-B-75K or more)

When using the high power factor converter (MT-HC), another explosion-proof test is necessary.
Note, however, that the test is not necessary when using the high power factor converter for power factor improvement.

· Set "2" in *Pr. 30*. The *Pr. 70* setting is made invalid.
· Use any of *Pr. 178 to Pr. 189 (input terminal function assignment)* to assign the following signals to the contact input terminals.
  (a)X10 signal: MT-HC connection
    To make protective coordination with the MT-HC, use the inverter operation enable signal to shut off the inverter output. Input the RDY signal of the MT-HC.
  (b)X11 signal: MT-HC connection (instantaneous power failure detection signal)
    When the setting has been made to hold the mode at occurrence of an instantaneous power failure for RS-485 communication operation, use this signal to hold the mode. Input the Y1 or Y2 signal (instantaneous power failure detection signal) of the MT-HC.
· For the terminal used for X10 or X11 signal input, assign its function by setting "10" (X10) or "11" (X11) in any of *Pr. 178 to Pr. 189*.

(4) 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.
· The inverter does not shut off the output when the alarm 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 any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

REMARKS

· The MRS signal can also be used instead of the X10 signal. *(Refer to page 121.)*
· Refer to *pages 34 to 37* for the connection of brake unit, high power factor converter (MT-HC).

CAUTION

· Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* or *Pr. 190 to Pr. 196 (output terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal. *(Refer to page 118)*

⚠ CAUTION

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

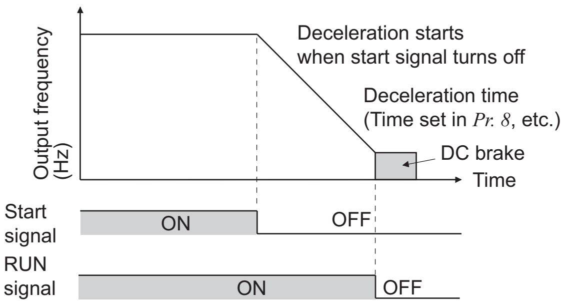
♦ Parameters referred to ♦

Pr. 57 Restart coasting time ☞ *Refer to page 148*
Pr. 178 to Pr.189 (input terminal function selection) ☞ *Refer to page 118*
Pr. 190 to Pr.196 (output terminal function selection) ☞ *Refer to page 125*
Pr. 261 Power failure stop selection ☞ *Refer to page 152*

4.10.3 Stop selection (Pr. 250)

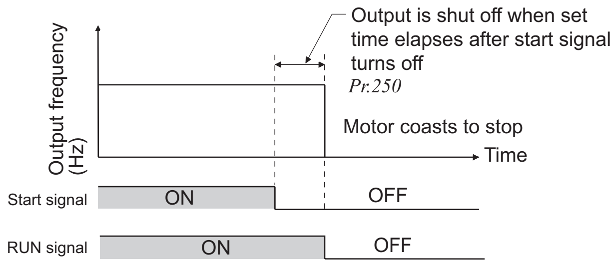
Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns off. Used to stop the motor with a mechanical brake, etc. together with switching off of the start signal.
You can also select the operations of the start signals (STF/STR). (Refer to *page 123* for start signal selection)

Parameter Number	Name	Initial Value	Setting Range	Description: Start signal (STF/STR) *(Refer to page 123)*	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.The motor is coasted to a stop (*Pr. 250* - 1000)s after the start signal is turned off.
			1000s to 1100s	STF signal: Start signal STR signal: Forward/ reverse signal	
			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	



(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 after (*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 fault definition *(Pr. 875)*
- Deceleration stop because of communication error *(Pr. 502)*
- Offline auto tuning (with motor running)
- Emergency stop by LonWorks communication

CAUTION

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

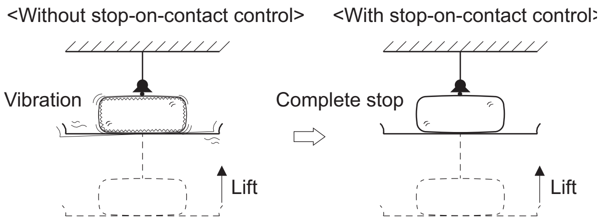
♦ Parameters referred to ♦

Pr. 7 Acceleration time , Pr. 8 Deceleration time ☞ *Refer to page 88*
Pr. 13 Starting frequency ☞ *Refer to page 90*

4.10.4 Stop-on contact control function (Pr. 6, Pr. 48, Pr. 270, Pr. 275) B3

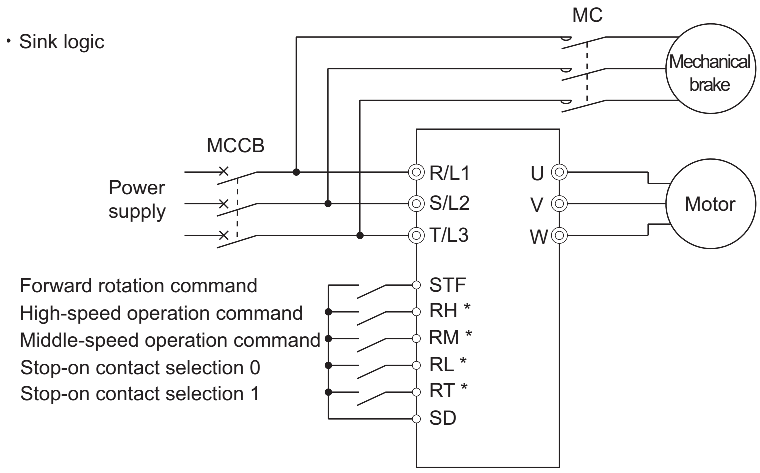
Setting can be made only for FR-B3 series.

To ensure accurate positioning at the upper limit etc. of a lift, stop-on-contact control causes a mechanical brake to be closed while the motor is developing a holding torque to keep the load in contact with a mechanical stopper etc.
This function suppresses vibration which is liable to occur when the load is stopped upon contact in vertical motion applications, ensuring steady precise positioning.

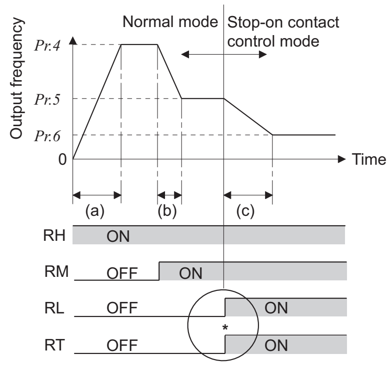


Parameter Number	Name	Initial Value	Setting Range	Description
6	**Multi-speed setting (low speed)**	10Hz	0 to 120Hz	Set the output frequency for stop-on-contact control.
22	**Stall prevention operation level**	150%	0 to 400%	Set the stall prevention operation level for stop-on-contact control. The smaller value set in either *Pr. 22* or *Pr. 48* has a priority.
48	**Second stall prevention operation current**	150%	0 to 220%	
270	**Stop-on contact/ load torque high-speed frequency control selection**	0	0	Normal operation
			1	Stop-on-contact control
			2	Load torque high speed frequency control *(Refer to page 236)*
			3	Stop-on-contact+load torque high speed frequency control *(Refer to page 236)*
275	**Stop-on contact excitation current low-speed multiplying factor**	9999	0 to 1000%	Set the force (holding torque) for stop-on-contact control. Normally set 130% to 180%. Valid only during advanced magnetic flux vector control
			9999	No compensation.

<Connection and operation example>



* The input terminal used differs according to the *Pr.180 to Pr.189* settings.



Goes into stop-on-contact control mode when both RL and RT switch on.
*RL and RT may be switched on in any order with any time difference
(a):Acceleration time (*Pr.7*)
(b):Deceleration time (*Pr.8*)
(c):Second deceleration time (*Pr.44*)

(1) Set stop-on-contact control

- Make sure that the inverter is in external operation mode. *(Refer to page 182)*
- Set"1 or 3" in *Pr. 270 Stop-on contact/load torque high-speed frequency control selection* .
- Set output frequency during stop-on-contact control in *Pr. 6 Multi-speed setting (low speed)*.
  The frequency should be as low as possible (about 2Hz). If it is set to more than 30Hz, the operating frequency will be 30Hz.
- When both the RT and RL signals are switched on, the inverter enters the stop-on-contact mode, in which operation is performed at the frequency set in *Pr. 6* independently of the preceding speed.

CAUTION

- By increasing the *Pr. 275* setting, the low-speed (stop-on-contact) torque increases, but overcurrent alarm (E.OCT) may occur or the machine may oscillate in a stop-on-contact state.
- The stop-on-contact function is diferent from servo-lock function, and if used to stop or hold a load for an extended period, this function can cause the motor to overheat.
  After a stop, immediately reset this function and use a mechanical brake to hold the load.
- Under the following operating conditions, the stop-on-contact function is made invalid:
  PU operation *(Pr. 79)* · JOG operation (JOG signal) · PU+external operation *(Pr. 79)* · PID control function operation *(Pr. 128)*
  · Remote setting function operation *(Pr. 59)* · Orientation control function operation
- When performing stop-on-contact control during encoder feedback control, encoder feedback control is made invalid due to a mode shift to the stop-on-contact control mode.

(2) Function switching of stop-on-contact control selection

<table>
<tr><th>Useful Functions</th><th>Normal Operation
(either RL or RT is off or both are off)</th><th colspan="2">With Stop-on-Contact Control
(both RL and RT are on)</th></tr>
<tr><td>Output frequency</td><td>Multi-speed
0 to 5V, 0 to 10V
4 to 20mA etc.</td><td colspan="2">Pr. 6 setting</td></tr>
<tr><td>Stall prevention operation level</td><td>Pr. 22 setting</td><td colspan="2">The smaller value set in either Pr. 22 or Pr. 48. *</td></tr>
<tr><td>Torque limit level</td><td>—</td><td colspan="2">—</td></tr>
<tr><td>Excitation current low speed scaling factor</td><td>—</td><td>—</td><td>The current is compensated for by Pr. 275 (0 to 1000%) settings before RL and RT are switched on.</td></tr>
<tr><td>Fast-response current limit</td><td>Valid</td><td colspan="2">Invalid</td></tr>
</table>

* When RL and RT are on, *Pr. 49 Second stall prevention operation frequency* is invalid. The smaller setting between *Pr.22* and *Pr.48* is valid.

(3) Set frequency when stop-on-contact control (*Pr. 270* = 1, 3) is selected

- The following table lists the frequencies set when the input terminals (RH, RM, RL, RT, JOG) are selected together. Bold frame indicates stop-on-contact control is valid.
- Stop-on-contact control is disabled when remote setting function is selected (*Pr. 59* = 1 to 3).

Input Signal (○ = on)					Set Frequency
RH	RM	RL	RT	JOG	
○					*Pr. 4 Multi-speed setting (high speed)*
	○				*Pr. 5 Multi-speed setting (middle speed)*
		○			*Pr. 6 Multi-speed setting (low speed)*
			○		By 0 to 5V(0 to 10V), 4 to 20mA input
				○	*Pr. 15 Jog frequency*
○	○				*Pr. 26 Multi-speed setting (speed 6)*
○		○			*Pr. 25 Multi-speed setting (speed 5)*
○			○		*Pr. 4 Multi-speed setting (high speed)*
○				○	*Pr. 15 Jog frequency*
	○	○			*Pr. 24 Multi-speed setting (speed4)*
	○		○		*Pr. 5 Multi-speed setting (middle speed)*
	○			○	*Pr. 15 Jog frequency*
		○	○		*Pr. 6 Multi-speed setting (low speed)*
		○		○	*Pr. 15 Jog frequency*
			○	○	*Pr. 15 Jog frequency*
		○	○	○	*Pr. 15 Jog frequency*
	○		○	○	*Pr. 15 Jog frequency*
	○	○		○	*Pr. 15 Jog frequency*
	○	○	○		*Pr. 6 Multi-speed setting (low speed)*
○			○	○	*Pr. 15 Jog frequency*
○		○		○	*Pr. 15 Jog frequency*
○		○	○		*Pr. 6 Multi-speed setting (low speed)*
○	○			○	*Pr. 15 Jog frequency*
○	○		○		*Pr. 26 Multi-speed setting (speed 6)*
○	○	○			*Pr. 27 Multi-speed setting (speed 7)*
	○	○	○	○	*Pr. 15 Jog frequency*
○		○	○	○	*Pr. 15 Jog frequency*
○	○		○	○	*Pr. 15 Jog frequency*
○	○	○		○	*Pr. 15 Jog frequency*
○	○	○	○		*Pr. 6 Multi-speed setting (low speed)*
○	○	○	○	○	*Pr. 15 Jog frequency*
					By 0 to 5V(0 to 10V), 4 to 20mA input

CAUTION

- Changing the terminal function using any of *Pr. 178 to Pr. 189* may affect the other functions. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 4 to Pr. 6, Pr. 24 to Pr. 27 (multi-speed setting) ☞ *Refer to page 81*
Pr. 15 Jog frequency ☞ *Refer to page 83*
Pr. 22 Stall prevention operation level, Pr. 48 Second stall prevention operation current ☞ *Refer to page 74*
Pr. 59 Remote function selection ☞ *Refer to page 85*
Pr. 79 Operation mode selection ☞ *Refer to page 182*
Pr. 128 PID action selection ☞ *Refer to page 228*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*
Pr. 270 = 2, 3 (load torque high speed frequency control) ☞ *Refer to page 236*

4.10.5 Brake sequence function (Pr. 278 to Pr. 285, Pr. 292) B3

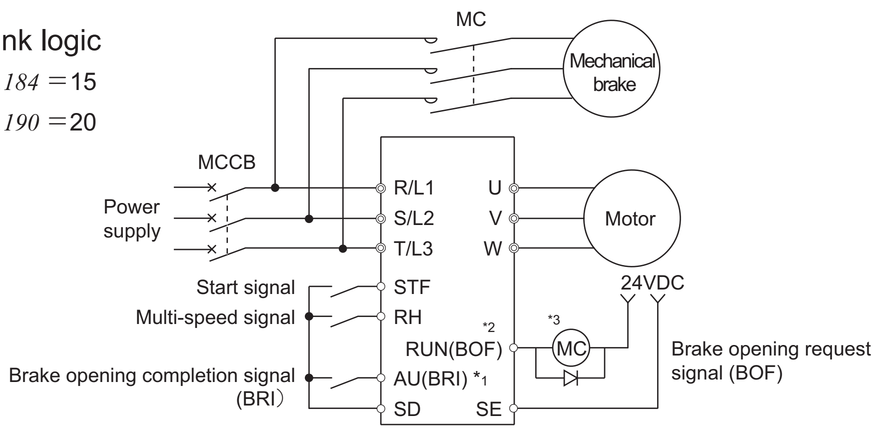
Setting can be made only for FR-B3 series.

This function is used to output from the inverter the mechanical brake operation timing signal in vertical lift and other applications.
This function prevents the load from dropping with gravity at a start due to the operation timing error of the mechanical brake or an overcurrent alarm from occurring at a stop, ensuring secure operation.

Parameter Number	Name	Initial Value	Setting Range	Description
278	**Brake opening frequency**	3Hz	0 to 30Hz	Set to the rated slip frequency of the motor + about 1.0Hz. This parameter may be only set if *Pr. 278* ≤ *Pr. 282*.
279	**Brake opening current**	130%	0 to 220%	Generally, set this parameter to about 50 to 90%. If the setting is too low, the load is liable to drop due to gravity at start. Suppose that the rated inverter current is 100%.
280	**Brake opening current detection time**	0.3s	0 to 2s	Generally, set this parameter to about 0.1 to 0.3s.
281	**Brake operation time at start**	0.3s	0 to 5s	Set the mechanical delay time until the brake is loosened. Set the mechanical delay time until the brake is loosened + about 0.1 to 0.2s when *Pr. 292* = "8".
282	**Brake operation frequency**	6Hz	0 to 30Hz	Set the frequency to activate the mechanical brake by turning off the brake opening request signal (BOF). Generally, set this parameter to the *Pr. 278* setting + 3 to 4Hz. Setting is enabled only when *Pr. 282* ≥ *Pr. 278*.
283	**Brake operation time at stop**	0.3s	0 to 5s	Set the mechanical delay time until the brake is closed + 0.1s when *Pr. 292*=7. Set the mechanical delay time until the brake is closed + 0.2 to 0.3s when *Pr. 292* = 8.
284	**Deceleration detection function selection**	0	0	Deceleration is not detected.
			1	If deceleration is not normal during deceleration operation, the inverter alarm is provided.
285	**Overspeed detection frequency**	9999	0 to 30Hz	If (detected frequency) - (output frequency) ≥ *Pr. 285* during encoder feedback control, the inverter alarm (E.MB1) is provided.
			9999	Overspeed is not detected.
292	**Automatic acceleration/ deceleration**	0	0	Normal operation mode
			1, 11	Shortest acceleration/deceleration mode *(Refer to page 94)*
			3	Optimum acceleration/deceleration mode *(Refer to page 95)*
			7	Brake sequence mode 1
			8	Brake sequence mode 2

<Connection diagram>

· Sink logic
· *Pr.184* = 15
· *Pr.190* = 20



*1 The input signal terminal used differs according to the *Pr. 178 to Pr. 189* settings.
*2 The output signal terminal used differs according to the *Pr. 190 to Pr. 196* settings.
*3 The current should be within the permissible current of transistor in the inverter. (24V 0.1ADC)

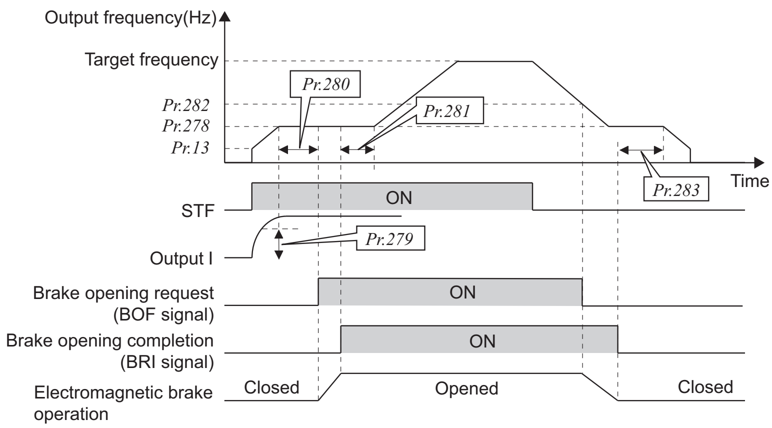
CAUTION

- When brake sequence mode is selected, automatic restart after instantaneous power failure is invalid.
- When using this function, set the acceleration time to 1s or longer.
- Changing the terminal function using any of *Pr. 178 to Pr. 189*, *Pr. 190 to Pr. 196* may affect the other functions. Please make setting after confirming the function of each terminal.

(1) Set the brake sequence mode

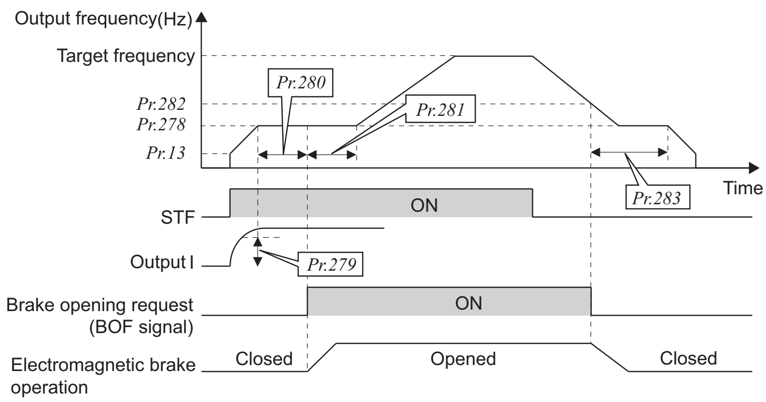
- The brake sequence function is valid only when the external operation mode, external/PU combined operation mode 1 or network operation mode is selected.
- Set "7 or 8" (brake sequence mode) in *Pr. 292* .
  To ensure more complete sequence control, it is recommended to set "7" (brake opening completion signal input) in *Pr. 292* .
- Set "15" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* and assign the brake opening completion signal (BRI) to the input terminal.
- Set "20 (positive logic)" or 120 (negative logic) in any of *Pr. 190 to Pr. 196 (output terminal function selection)* and assign the brake opening request signal (BOF) to the output terminal.

(2) With brake opening completion signal input (*Pr. 292* = "7")



- When the start signal is input to the inverter, the inverter starts running. When the internal speed command reaches the value set in *Pr. 278* and the output current is not less than the value set in *Pr. 279* , the inverter outputs the brake opening request signal (BOF) after the time set in *Pr. 280* has elapsed.
  When the time set in *Pr. 281* elapses after the brake opening completion signal (BRI) was activated, the inverter increases the output frequency to the set speed.
- When the speed has decreased to the frequency set in *Pr. 282* during deceleration, the BOF signal is turned off. When the time set in *Pr. 283* elapses after the electromagnetic brake operation was completed and the BRI signal was turned off, the inverter output is switched off.

(3) Without brake opening completion signal input (*Pr. 292* = "8")



- When the start signal is input to the inverter, the inverter starts running. When the internal speed command reaches the value set in *Pr. 278* and the output current is not less than the value set in *Pr. 279* , the inverter outputs the brake opening request signal (BOF) after the time set in *Pr. 280* has elapsed.
  When the time set in *Pr. 281* elapses after the BOF signal is output, the inverter increases the output frequency to the set speed.
- When the speed has decreased to the frequency set in *Pr. 282* during deceleration, the brake opening request signal (BOF) is turned off. When the time set in *Pr. 283* has elapsed after the BOF signal is turned off, the inverter output is switched off.

REMARKS

- Even if automatic acceleration/deceleration has been selected, inputting the jog signal (jog operation), RT signal (second function selection) or X9 signal (third function selection) during an inverter stop will switch to the normal operation and give priority to jog operation or second and third function selection. Note that JOG and RT signal input is invalid even if JOG signal and RT signal are input during automatic acceleration/deceleration operation.

(4) Protective functions

If any of the following errors occurs in the brake sequence mode, the inverter results in an alarm, shuts off the output, and turns off the brake opening request signal (BOF).

Error Display	Description
E.MB1	(Detection frequency) - (output frequency) > *Pr. 285* during encoder feedback control When *Pr. 285 Overspeed detection frequency* = 9999, overspeed is not detected.
E.MB2	Deceleration is not normal during deceleration operation from the set frequency to the frequency set in *Pr. 282*. (when *Pr. 284* =1) (except stall prevention operation)
E.MB3	Brake opening request signal (BOF) turned on though the motor is at a stop. (gravity drop prevention function)
E.MB4	Although more than 2s have elapsed after the start command (forward or reverse rotation) is input, the brake opening request signal (BOF) does not turn on.
E.MB5	Although more than 2s have elapsed after the brake opening request signal (BOF) turned on, the brake opening completion signal (BRI) does not turn on.
E.MB6	Though the inverter had turned on the brake opening request signal (BOF), the brake opening completion signal (BRI) turned off midway.
E.MB7	Although more than 2s have elapsed after the brake opening request signal (BOF) turned off at a stop, the brake opening completion signal (BRI) does not turn off.

CAUTION

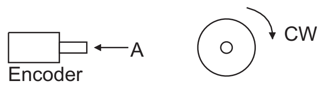
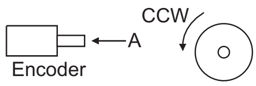
· Overspeed detection *(Pr. 285)* is valid under encoder feedback control (used with the FR-A7AP option) even if a value other than "7 or 8" is set in *Pr. 292*.
· A too large setting of *Pr. 278 Brake opening frequency* activates stall prevention operation and may cause E.MB4.

♦ Parameters referred to ♦

Pr. 180 to Pr. 186 (input terminal function selection) ☞ *Refer to page 118*
Pr. 190 to Pr. 195 (output terminal function selection) ☞ *Refer to page 125*
Encoder feedback control ☞ *Refer to page 242*

4.10.6 Orientation control (Pr. 350 to Pr. 366, Pr. 369)

This function is used with a position detector (encoder) installed to the spindle of a machine tool, etc. to allow a rotation shaft to be stopped at the specified position (oriented).
Option FR-A7AP is necessary.
Pr. 350 Stop position command selection is initially set to "9999", orientation control function is invalid.

Parameter Number	Name	Initial Value	Setting Range	Description	
350	**Stop position command selection**	9999	0	Internal stop position command *(Pr. 356)*	
			1	External stop position command (FR-A7AX 16-bit data)	
			9999	Orientation control invalid	
351	**Orientation speed**	2Hz	0 to 30Hz	Decrease the motor speed to the set value when the orientation command (X22) is given.	
352	**Creep speed**	0.5Hz	0 to 10Hz	After the speed reaches the orientation speed, the speed decreases to the creep speed set in *Pr. 352* as soon as the current position pulse reaches the creep switchover position set in *Pr. 353*.	
353	**Creep switchover position**	511	0 to 16383*		
354	**Position loop switchover position**	96	0 to 8191	As soon as the current position pulse reaches the set position loop switchover position, control is changed to position loop.	
355	**DC injection brake start position**	5	0 to 255	After changed to position loop, DC injection brake is applied and the motor stops as soon as the current position pulse reaches the set DC injection brake start position.	
356	**Internal stop position command**	0	0 to 16383*	When "0" is set in *Pr. 350*, the internal position command is activated and the setting value of *Pr. 356* becomes a stop position.	
357	**Orientation in-position zone**	5	0 to 255	Set the in-position zone at a stop of the orientation.	
358	**Servo torque selection**	1	0 to 13	Functions at orientation completion can be selected.	
359	**Encoder rotation direction**	1	0	 Clockwise direction as viewed from A is forward rotation	
			1	 Counter clockwise direction as viewed from A is forward rotation	
360	**16 bit data selection**	0	0	Speed command	When 1 is set in *Pr. 350* and the FR-A7AX is mounted, set a stop position using 16-bit data. Stop position command is input as binary regardless of the *Pr. 304* setting.
			1	16 bit data is used as external position command as is.	
			2 to 127	Set the stop position dividing up to 128 stop positions at regular intervals.	
361	**Position shift**	0	0 to 16383*	Shift the origin using a compensation value without changing the origin of the encoder. The stop position is a position obtained by adding the setting value of *Pr. 361* to the position command.	
362	**Orientation position loop gain**	1	0.1 to 100	When servo torque function is selected using *Pr. 358*, output frequency for generating servo torque increases to the creep speed of *Pr. 352* gradually according to the slope set in *Pr. 362*. Although the operation becomes faster when the value is increased, a machine may hunt, etc.	
363	**Completion signal output delay time**	0.5s	0 to 5.0s	The orientation complete signal is output delaying the set time after in-position zone is entered. Also, the signal turns off delaying the set time after in-position zone is out.	
364	**Encoder stop check time**	0.5s	0 to 5.0s	Orientation fault signal (ORM) is output when the encoder remains stopped for the set time without orientation completion in the state where no orientation complete signal (ORA) is output. ORM signal is output when orientation is not completed again in the set time in the state where ORA signal is output.	

Parameter Number	Name	Initial Value	Setting Range	Description
365	**Orientation limit**	9999	0 to 60.0s	Measure the time taken after passing the creep switchover position and output the orientation fault signal (ORM) if orientation is not completed within the set time.
			9999	Set to 120s.
366	**Recheck time**	9999	0 to 5.0s	Turning off the start signal with orientation command (X22) on after stopping the motor by orientation control, the present position is checked again after the set time elapses and the orientation complete signal (ORA) or orientation fault signal (ORM) is output.
			9999	Not checked.
369	**Number of encoder pulses**	1024	0 to 4096	Set the number of pulses of the encoder. Set the number of pulses before multiplied by four.

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

* When the operation panel (FR-DU07) is used, the maximum setting is 9999. When a parameter unit is used, up to the maximum value within the setting range can be set.

(1) Setting

If the orientation command signal (X22) is turned on during operation after the various parameters have been set, the speed will decelerate to the "orientation switchover speed". After the "orientation stop distance" is calculated, the speed will further decelerate, and the "orientation state" (servo lock) will be entered. The "orientation complete signal" (ORA) will be output when the "orientation complete width" is entered.

(2) Setting I/O singals

Terminal	Terminal Name	Application Explanation
X22*1	Orientation command input	Used to enter an orientation signal for orientation. For the terminal used for X22 signal input, set "22" in any of *Pr. 178 to Pr. 189* to assign the function.
SD	Contact input common	Common terminal for the orientation signal.
ORA*2	Orientaiton complete signal output	Switched low if the orientation has stopped within the in-position zone while the start and orientation signals are input. For the terminal used for the ORA signal output, assign the function by setting "27 (positive logic) or 127 (negative logic)" in any of *Pr. 190 to Pr. 196*.
ORM*2	Orientation fault signal output	Switched low if the orientation has not stopped within the in-position zone while the start and orientation signals are input. For the terminal used for the ORM signal output, assign the function by setting "28 (positive logic) or 128 (negative logic)" in any of *Pr. 190 to Pr. 196*.
SE	Open collector output common	Common terminal for the ORA and ORM open collector output terminals.

*1 For X22 signals, assign functions to any of terminal using *Pr. 178 to Pr. 189 (ouput terminal function selection). (Refer to page 118)*

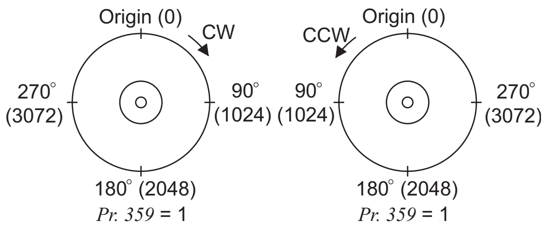
*2 For ORA and ORM signals, assign functions to any of terminal using *Pr. 190 to Pr. 196 (ouput terminal function selection). (Refer to page 125)*

(3) Selecting stop position command (*Pr. 350 Stop position command selection*)

· Select either the internal stop position command *(Pr. 356)* or the external stop position command (16-bit data using the FR-A7AX).

Pr.350 Setting	Stop Position Command Source
0	Internal stop position command (*Pr. 356*: 0 to 16383)
1	External stop position command (FR-A7AX) 16-bit data

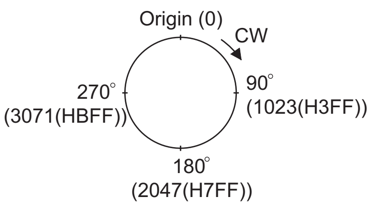
1) Internal stop position command (*Pr. 350* = "0")
The value set in *Pr. 356* is the stop position.
When the number of encoder pulses is 1024p/r, one revolution of the encoder is divided into 4096 positions, i.e. 360°/4096 pulses = 0.0879°/pulses per address, as shown on the right. The stop positions (addresses) are indicated in parentheses.



2) External stop position command (*Pr. 350* = "1")
Mount the option FR-A7AX and set a stop position using 16-bit data (binary input).
· The value set in *Pr. 360 16 bit data selection* should be the number of stop positions less 1.

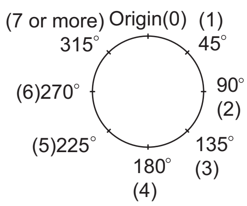
Pr. 360 Setting	Description
0	External position command is made invalid (speed command or torque command with the FR-A7AX)
1	Position command direct input The 16-bit digital signal from the FR-A7AX is directly serves as stop position command. <Example> When the *Pr. 369 Number of encoder pulses* setting is 1024, stop position command from 0 to 4095 can be directly input using the FR-A7AX and input digital signal of 2047 (H7FF) to stop the motor at 180° position. The command more than 4096 is considered as 4095.
2 to 127	Set the stop position command dividing up to 128 stop positions at regular intervals. If the external stop command entered is greater than the setting, the stop positions are the same as those in the maximum external stop command value. <Example> When the number of stop positions is 90 (divided at intervals of 4°), 90 - 1 = 89. Hence, set "89".

[Example] When *Pr. 369* = "1024"



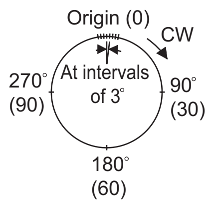
When *Pr. 360* = "1"

[Example 2] 8 stop positions



When *Pr. 360* = "7"

[Example 3] 120 stop positions



When *Pr. 360* = "119"

CAUTION

· Values in parentheses indicate binary data entered from the terminals. Even if the position pulse monitor (*Pr. 52 DU/PU main display data selection* = 19) is selected, the data monitored is not the number of stop positions but is 0 to 65535 pulses.
· FR-A7AX parameters *(Pr. 300 to Pr. 305)* are invalid. (Valid when *Pr. 360* = "0")
· When the option is not fitted or *Pr. 360* = "0", the stop position is 0 even if the external stop position command is selected with the *Pr. 350* setting.

- Relationship between stop position command and 16-bit data

Pr. 350 Stop position command selection	*Pr. 360 16 bit data selection*	Operation		
		Stop position command	**16 bit data (FR-A7AX)**	**Speed command**
0:internal	0: speed command	Internal *(Pr. 356)*	Speed command	16 bit data
	1, 2 to 127: position command	Internal *(Pr. 356)*	Invalid	External command (or PU)
1: external	0: speed command	Internal *(Pr. 356)*	Speed command	16 bit data
	1, 2 to 127: position command	External (Internal when the FR-A7AX is not mounted *(Pr. 356)*)	Position command	External command (or PU)

3) *Pr. 361 Position shift* (initial value "0")

The stop position is a position obtained by adding the setting value of *Pr. 361* to the position command.

<Position shift function>

Shift the origin using a compensation value without changing the origin of the poisition detector (encoder).

REMARKS

- When orientation control is made valid using *Pr. 350 Stop position command selection* with the FR-A7AP mounted, the rotation direction of encoder is displayed on the rotation direction display of the PU (FR-DU07/FR-PU04/FR-PU07).
  Set the parameter so that turning on the STF signal displays FWD or turning on the STR signal displays REV.

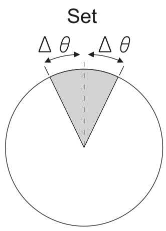
(4) Monitor display change

Monitor	REMARKS
Position pulse monitor	When "19" is set in *Pr. 52* , position pulse monitor is displayed instead of output voltage monitor of the PU. (Displayed only when the FR-A7AP is mounted.)
Orientation status	When "22" is set in *Pr. 52* , orientation status is displayed instead of output voltage monitor of the PU. (Displayed only when the FR-A7AP is mounted.) 0-Other than orientation operation or orientation speed is not reached 1-Orientation speed is reached 2-Creep speed is reached 3-Position loop is reached 4-Orientation complete 5-Orientatino fault (pulse stop) 6-Orientatino fault (orientation limit) 7-Orientation fault (recheck) 8-Continuous multi-point orientation

(5) *Pr. 357 Orientation in-position zone* (initial value "5")

- The positioning width for orientation stop can be set. The initial setting of *Pr. 357* is "5". To change the $\Delta\theta$ value, finely adjust with ± 10 increments, and make fine adjustment.
- If the position detection value from the encoder enters $\pm\Delta\theta$ during orientation stop, the orientation complete signal (ORA) will be output.

Example of operation



$$\Delta\theta = \frac{360^\circ}{\underset{\text{Number of encoder pulses}}{Pr.369} \times \text{four times}} \times Pr.\ 357$$

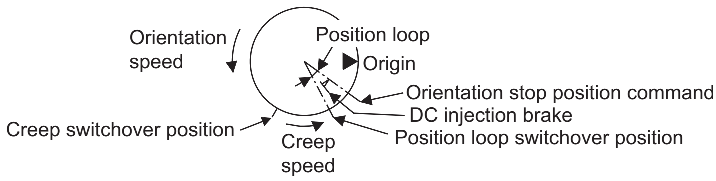
(6) Orientation operation (under V/F control, advanced magnetic flux vector control)

● Orientation during running

1) When the orientation command (X22) is input, the motor speed decreases to the orientation speed set in *Pr. 351 Orientation speed* . (*Pr. 351* initial value: 2Hz)
2) After the speed reaches the orientation speed, the speed decreases to the creep speed set in *Pr. 352 Creep speed* as soon as the current position pulse reaches the creep switchover position set in *Pr. 353 Creep switchover position* (*Pr. 352* initial value:0.5Hz, *Pr. 353* initial value: 511)
3) Moreover, as soon as the current position pulse reaches the set position loop switchover position in *Pr. 354 Position loop switchover position* , control is changed to position loop. (*Pr. 354* initial value: 96)
4) After switching to position loop, the inverter decelerates and stops with DC injection brake as soon as the current position pulse has rached the DC injection brake start position set in *Pr. 355 DC injection brake start position*. (*Pr. 355* initial value: 5)
5) When the position pulse has stopped within the in-position zone set in *Pr. 357 Orientation in-position zone* , the orientation completion signal (ORA) is output after the comletion signal output delay time set in *Pr. 363 Completion signal output delay time* has elapsed. If the motor does not stop within the in-position zone due to external force, etc., the orientation completion signal is turned off after the time set in *Pr. 363 Completion signal output delay time* has elapsed. (*Pr. 357* initial value: 5)
6) If the orientation is not completed continusouly for the time set in *Pr. 365 Orientation limit* after passing the creep switchover position, the orientation fault signal (ORM) is output.
7) When the motor stops before the position pulse reaching the in-position zone due to external force after orientation start and orientation completion signal (ORA) is not output, orientation fault signal (ORM) is output after the time set in encoder stop check time set in *Pr. 364 Encoder stop check time* has elapsed. Moreover, the orientation complete signal (ORA) is turned off after the time set in *Pr. 363 Completion signal output delay time* has elapsed if the position pulse is outside the in-position zone due to external force, etc. after outputting the orientation complete signal (ORA), and the orientation fault signal (ORM) is output if the orientation has not completed within the time set in *Pr. 364 Encoder stop check time* .
8) When the start signal (STF or STR) is turned off with the orientation command on after outputting the orientation completion signal (ORA) and orientation fault signal (ORM), the orientation complete signal (ORM) or orientation fault signal (ORM) is output again after recheck time set in *Pr. 366 Recheck time* has elapsed.
9) The orientation completion signal (ORA) and orientation fault signal (ORM) are not output when the orientation command is off.

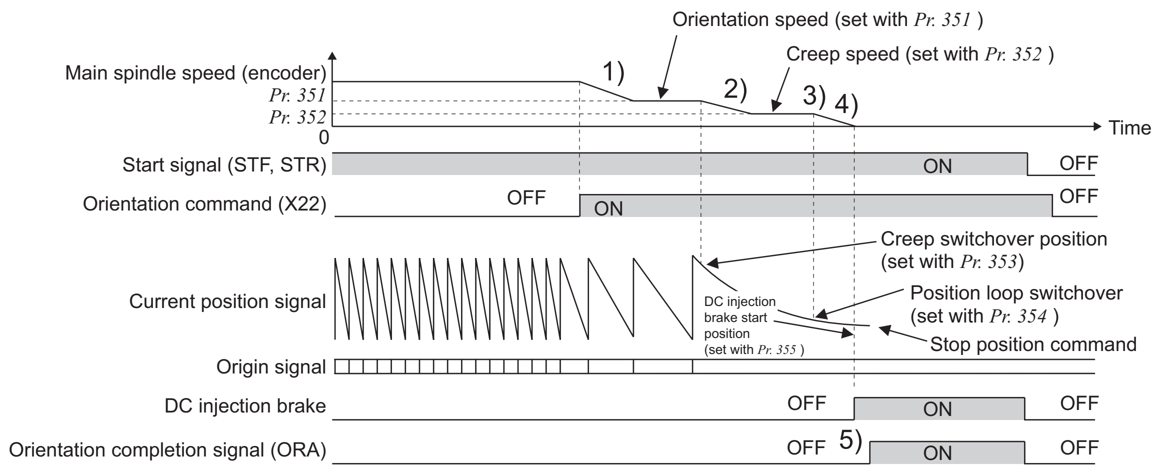
REMARKS

- When the orientation command is off with the start signal on, the speed accelerates to the command speed.



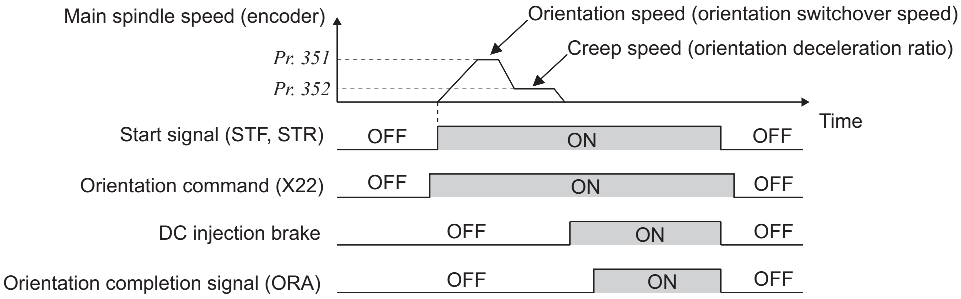
- If the motor shaft hants, set a larger value in *Pr. 354 Position loop switchover position* or a smaller value in *Pr. 352 Creep speed* to prevent it.

• Action time chart



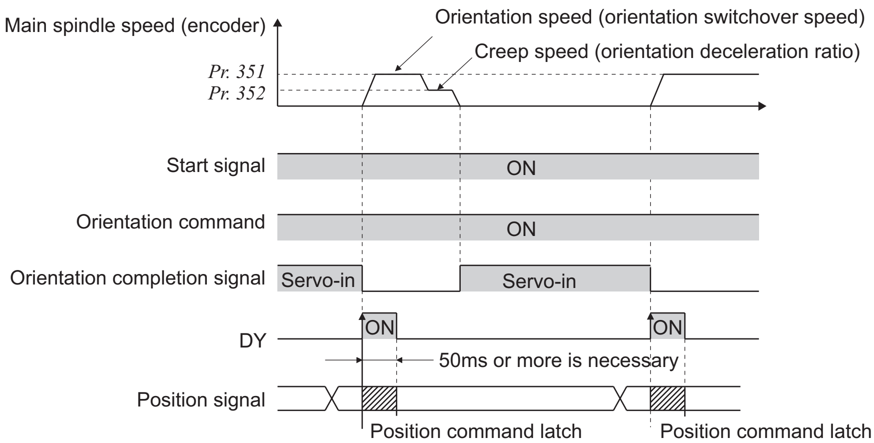
● Orientation from stop

After turning on the orientation command (X22), turning on the start signal will increase the motor speed to the orientation speed set in *Pr. 351 Orientation speed*, then orientation operation same as when "orientation during running" is performed.
Note that, DC injection brake is operated if the position signal is within the DC injection brake start position.
• Action time chart



● Continuous multi-point orientation

Orientation command and orientation with STF/STR on
(Orientation in servo in status)



- Read the position data at starting up of DY (refer to *the FR-A7AX instruction manual*).
- When the position signal is within the creep switchover position, the speed starts up to the creep speed not to the orientation speed.
- When the position signal is not within the creep switchover position, the speed starts up tp the orientation speed.
- The DC injection brake is operated if the position signal is within the DC injection brake start position.
- 16-bit data with the FR-A7AX is valid only when the DY signal is on.

CAUTION

- The encoder should be coupled with the motor shaft or main spindle oriented with a speed ratio of 1 to 1 without any mechanical looseness.
- DC injection brake operates when orientation stop is made. Release the DC injection brake in a time as short as possible (within several seconds) since continuous operation of the DC injection brake will cause the motor to overheat, leading to burnout.
- Since no servo lock function is available after orientation stop, provide a holding mechanism such as mechanical brake or knock pin when secure holding of a main spindle is required.
- To ensure correct positioning, the encoder must be set in the proper rotation direction and the A and B phases connected correctly.
- When the pulse signal from the encoder stops due to the encoder signal loss, etc. during orientation, the orientation fault signal (ORM) may be output.
- When the DC injection brake is set to disabled using parameter for DC injection brake adjustment (voltage, frequency, speed, time) when performing orientation control, orientation operation can not be completed. Always set the DC injection brake enabled.
- To terminate orientation, the start signal (STF or STR) must be first switched off and the orientation signal (X22) must be switched off. As soon as this orientation signal is switched off, orientation control ends.(Depending on the *Pr. 358 Servo torque selection* setting, orientation status continues if the orientation signal remains on even if DC injection brake is released at turning off of the start signal. Therefore, the orientation status of the monitor function is not 0.)
- When retry function of *Pr. 358 Servo torque selection* is selected, this retry function is performed three times including the first orientation.
- When performing orientation control, make proper setting of *Pr. 350 Stop position command selection* and *Pr. 360 16 bit data selection (external position command selection)*. If the values set are incorrect, proper orientation control will not be performed.
- When *Pr. 11 DC injection brake operation time* = "8888" (DC injection brake external selection), DC injection brake does not operate if the X13 signal is not turned on. Note that the DC injection brake is applied under orientation control regardless of the X13 signal status.
- When orientation control is exercised, PID control is invalid.

● Servo torque selection (*Pr. 358*)

Function \ *Pr. 358* Setting	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Remarks
1) Servo torque function selection until output of the orientation completion signal (ORA)	×	○	○	○	○	×	○	×	○	×	○	×	×	○	○: With servo torque function ×: Without servo torque function
2) Retry function selection	×	×	×	×	×	×	×	○	×	×	×	○	×	×	○: With retry function ×: Without retry function
3) Output frequency is compensated when the motor stops outside the in-position zone	×	×	○	○	×	○	○	×	×	×	×	×	○	○	○: With frequency compensation ×: Without frequency compensation
4) DC injection brake and servo torque selection when the position pulse comes off the in-position zone after output of the orientation completion signal (ORA)	○	×	×	×	×	○	○	○	○	○	○	○	○	○	○: With DC injection brake ×: With servo torque
5) End switch selection of the DC injection brake and orientation completion signal (ORA)	○	○	○	×	×	○	○	○	○	×	×	×	×	×	○: When the start signal (STF, STR) or orientation command is turned off ×: When the orientation command is turned off
6) Completion signal off selection when the position pulse comes off the in-position zone after output of the orientation completion signal (ORA)	○	○	○	○	○	×	×	×	×	×	×	×	×	×	○: Turnes off the completion signal when the motor stops outside of the in-position zone ×: Completion signal remains on even if the position pulse comes off the completion zone (orientation fault singal (ORM) is not output)

REMARKS

- When the orientation command is off with the start signal on, the speed accelerates to the command speed.
- When the motor shaft stops outside of the set setting range of stop position, the motor shaft is returned to the stop position by servo torque function (if enough torque is generated).

1) Servo torque function selection until output of the orientation completion signal
Whether servo torque is available or not is selected using *Pr. 358 Servo torque selection*. Servo torque is not generated if the current position pulse is in between the orientation stop position and DC injection brake start position. Although, the shaft is retained by the DC injection brake, servo torque is generated to return the shaft within the width if the shaft moves out of the width by external force, etc. Once the orientation completion signal (ORA) is output, the motor runs according to the setting made in 4).

2) Retry function selection
Select retry function using *Pr. 358 Servo torque selection* . Note that servo torque function can not be used together. When the motor shaft is not stopped within the in-position zone when the motor stop is checked, orientation operation is performed again by retry function.
With this retry function, three orientations including the first one are performed. More than three times retry operations are not made. (The orientation fault signal (ORM) is not output during retry operation)

3) Frequency compensation function when the motor stops outside the orinetation in-position zone
When the motor stops before entering the in-position zone due to external force, etc., output frequency is increased to move the shaft to the orientation stop position. The output frequency is gradually increased to the creep speed of *Pr. 352 Creep speed* .
Note that retry function can not be used together.

4) DC injection brake and servo torque selection when the position pulse comes off the in-position zone after output of the orientation completion signal (ORA)
If the position pulse comes off the orientation in-position width, you can select a setting either fixing a shaft with the DC injection brake or returning the motor to the orientation stop position with servo torque.

5) Orientation operation end switch operation selection between DC injection brake or servo torque
When ending the orientation operation, turn off the start signal (STF or STR), then turn off the orientation command (X22). At this time, you can select when to turn off the orientation completion signal (ORA) from between at turning off of the start signal or turning off of the orientation command signal.

6) Selection of completion signal off or on when the motor stops outside of the in-position zone after output of the orientation completion signal (ORA)
You can select the mode to turn off the completion signal or keep the completion signal on (orientation fault signal (ORM) is not output) when the motor stops outside of the in-position zone.

● Position loop gain (*Pr. 362*)

When servo torque function is selected using *Pr. 358 Servo torque selection* , output frequency for generating servo torque increases to the creep speed of *Pr. 352 Creep speed* gradually according to the slope set in *Pr. 362 Orientation position loop gain* .
Although the operation becomes faster when the value is increased, a machine may hunt, etc.

4.11 Function assignment of external terminal and control

Purpose	Parameter that must be Set		Refer to Page
Assign function to input terminal	**Input terminal function selection**	**Pr. 178 to Pr. 189**	118
Set MRS signal (output shutoff) to normally closed contact specification	**MRS input selection**	**Pr. 17**	121
Make the second (third) function valid only during constant speed operation	**RT reflection time selection**	**Pr. 155**	122
Assign start signal and forward/ reverse command to other signals	**Start signal (STF/STR) operation selection**	**Pr. 250**	123
Assign function to output terminal	**Output terminal function assignment**	**Pr. 190 to Pr. 196**	125
Detect output frequency	**Up-to-frequency sensitivity Output frequency detection Low speed detection**	**Pr. 41 to Pr. 43, Pr. 50, Pr. 116, Pr. 865**	130
Detect output current	**Output current detection Zero current detection**	**Pr. 150 to Pr. 153, Pr. 166, Pr. 167**	132
Remote output function	**Remote output**	**Pr. 495 to Pr. 497**	134
Detect output torque	**Output torque detection**	**Pr. 864**	133

4.11.1 Input terminal function selection (Pr. 178 to Pr. 189)

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

Parameter Number	Name	Initial Value	Initial Signal	Setting Range	
				FR-B	FR-B3
178	**STF terminal function selection**	60	STF (forward rotation command)	0 to 12, 14, 16, 19, 20, 22, 24, 25, 60, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 60, 62, 64 to 67, 9999
179	**STR terminal function selection**	61	STR (reverse rotation command)	0 to 12, 14, 16, 19, 20, 22, 24, 25, 61, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 22, 24, 25, 61, 62, 64 to 67, 9999
180	**RL terminal function selection**	0	RL (low-speed operation command)	0 to 12, 14, 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999
181	**RM terminal function selection**	1	RM (middle-speed operation command)		
182	**RH terminal function selection**	2	RH (high speed operation command)		
183	**RT terminal function selection**	3	RT (second function selection)		
184	**AU terminal function selection**	4	AU (terminal 4 input selection)	0 to 12, 14, 16, 19, 20, 22, 24, 25, 62 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 62 to 67, 9999
185	**AM terminal function selection**	5	JOG (Jog operation selection)	0 to 12, 14, 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999	0 to 9, 12 to 16, 19, 20, 22, 24, 25, 62, 64 to 67, 9999
186	**CS terminal function selection**	6	CS (selection of automatic restart after instantaneous power failure)		
187	**MRS terminal function selection**	24	MRS (output stop)		
188	**STOP terminal function selection**	25	STOP (start self-holding selection)		
189	**RES terminal function selection**	62	RES (inverter reset)		

(1) Input terminal function assignment

· Use *Pr. 178 to Pr. 189* to set the functions of the input terminals.
· Refer to the following table and set the parameters:

Setting	Signal Name	Function		Application ○:Corres-pondence ×:Non-corres-pondence FR-B	FR-B3	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	81
0	RL	*Pr. 59* = 1, 2 *1	Remote setting (setting clear)	○	○	Pr. 59	85
0	RL	*Pr. 270* = 1, 3 *2	Stop-on-contact selection 0	×	○	Pr. 270, Pr. 275	105
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	81
1	RM	*Pr. 59* = 1, 2 *1	Remote setting (deceleration)	○	○	Pr. 59	85
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	81
2	RH	*Pr. 59* = 1, 2 *1	Remote setting (acceleration)	○	○	Pr. 59	85
3	RT	Second function selection		○	○	Pr. 44, Pr.45, Pr.48 to Pr.50	122
3	RT	*Pr. 270* = 1, 3 *2	Stop-on-contact selection 1	×	○	Pr. 270, Pr. 275	105
4	AU	Terminal 4 input selection		○	○	Pr. 267	166
5	JOG	Jog operation selection		○	○	Pr. 15, Pr. 16	83
6	CS	Selection of automatic restart after instantaneous power failure, flying start		○	○	Pr. 57, Pr. 58, Pr.162 to Pr.165, Pr. 299, Pr. 611	148
7	OH	External thermal relay input *3		○	○	Pr. 9	96
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	81
9	X9	Third function selection		○	○	Pr. 110, Pr. 111, Pr. 114 to Pr.116	122
10	X10	Inverter operation enable signal (MT-HC connection)		○	×	Pr. 30, Pr. 70	102
11	X11	MT-HC connection, instantaneous power failure detection		○	×	Pr. 30, Pr. 70	102
12	X12	PU operation external interlock		○	○	Pr. 79	182
13	X13	External DC injection brake operation start		×	○	Pr. 10 to Pr. 12	100
14	X14	PID control valid terminal		○	○	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	228
15	BRI	Brake opening completion signal		×	○	Pr. 278 to Pr. 285	108
16	X16	PU-external operation switchover		○	○	Pr. 79, Pr. 340	188
19	X19	Load torque high-speed frequency		○	○	Pr. 270 to Pr. 274	236
20	X20	S-shaped acceleration/deceleration C switching terminal		○	○	Pr. 380 to Pr. 383	91
22	X22	Orientation command *4, *6		○	○	Pr. 350 to Pr. 369	111
24	MRS	Output stop		○	○	Pr. 17	121
25	STOP	Start self-holding selection		○	○	—	123
60	STF	Forward rotation command (assigned to STF terminal *(Pr. 178)* only)		○	○	—	123
61	STR	Reverse rotation command (assigned to STR terminal *(Pr. 179)* only)		○	○	—	123
62	RES	Inverter reset		○	○	—	—
63	PTC	PTC thermistor input (assigned to AU terminal *(Pr. 184)* only)		○	○	Pr. 9	96
64	X64	PID forward/reverse action switchover		○	○	Pr. 127 to Pr. 134	228
65	X65	PU-NET operation switchover		○	○	Pr. 79, Pr. 340	189
66	X66	External-NET operation switchover		○	○	Pr. 79, Pr. 340	189
67	X67	Command source switchover		○	○	Pr. 338, Pr. 339	195
9999	—	No function		○	○	—	—

*1 When *Pr. 59 Remote function selection* = "1 or 2", the functions of the RL, RM and RH signals change as listed above.
*2 When *Pr. 270 Stop-on contact/load torque high-speed frequency control selection* = "1 or 3", the functions of the RL and RM signals change as listed above.
*3 The OH signal turns on when the relay contact "opens".
*4 The FR-A7AX (16-bit digital input) is needed to externally input a stop position under orientation control.
*5 Available only when used with the FR-A7AP (option).

CAUTION

- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.
- One function can be assigned to two or more terminals. In this case, the terminal inputs are ORed.
- The priorities of the speed commands are in order of jog, multi-speed setting (RH, RM, RL, REX) and PID (X14).
- When the X10 signal (MT-HC connection - inverter operation enable signal) is not set or when the PU operation external interlock (X12) signal is not assigned at the *Pr. 79 Operation mode selection* setting of "7", the MRS signal shares this function.
- Use common terminals to assign multi-speeds (speed 7) and remote setting. They cannot be set individually. (Common terminals are used since these functions are designed for speed setting and need not be set at the same time.)

(2) Response time of each signal

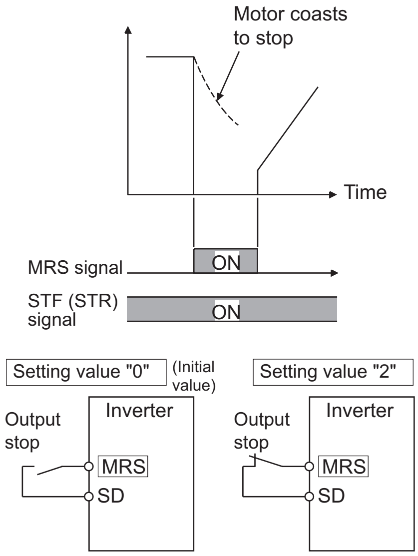
- The response time of the X10 signal is within 2ms. However, when the X10 signal is not assigned at the *Pr. 30 Regenerative function selection* setting of "2" (MT-HC connection), the response time of the MRS signal is within 2ms. *Pr. 17 MRS input selection* is made invalid.

Pr. 30 Setting	MRS Assignment	X10 Assignment	Response Time		*Pr. 17*
			MRS	X10	
2	○	×	Within 2ms	—	Invalid
	×	○	—	Within 2ms	—
	○	○	Within 20ms	Within 2ms	Valid
Other than 2	○	×	Within 20ms	—	Valid
	×	○	—	—	—
	○	○	Within 20ms	—	Valid

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

The inverter output can be shut off from the MRS signal. The logic of the MRS signal can also 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)



(1) Output shutoff signal (MRS signal)

- Turning on the output shutoff signal (MRS) during inverter running shuts off the output immediately.
- Terminal MRS 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* = "2")

- 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.

REMARKS

- The MRS signal is assigned to the terminal MRS in the initial setting. By setting "24" in any of *Pr. 178 to Pr. 189 (input terminal function selection)*, the MRS signal can be assigned to the other terminal.
- The MRS signal can shut off the output, independently of the PU, external or network operation mode.

CAUTION

- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 118*

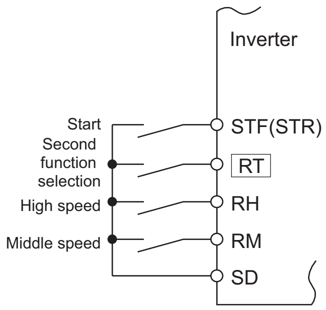
4.11.3 Condition selection of function validity by the second function selection signal (RT) and third function selection signal (X9) (RT signal, X9 signal, Pr. 155)

You can select the second (third) function using the RT(X9) signal.
You can also set the condition (reflection conditon) where the second function and third function become valid.

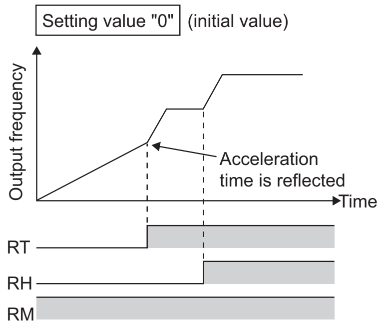
Parameter Number	Name	Initial Value	Setting Range	Description
155	**RT signal function validity condition selection**	0	0	Second (third) function is immediately made valid with on of the RT(X9) signal.
			10	Second (third) function is valid only during the RT (X9) signal is on and constant speed operation. (invalid during acceleration/deceleration)

- When the RT signal turns on, the second function becomes valid.
- When the X9 signal turns on, the third function becomes valid.
  For the X9 signal, set "9" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.
- The second (third) 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 main motor and sub motor

Second function connection diagram



Second acceleration/deceleration time example



- Functions that can be set as second and third functions

Function	First Function Parameter Number	Second Function Parameter Number	Third Function Parameter Number	Refer to Page
Acceleration time	Pr. 7	Pr. 44	Pr. 110	88
Deceleration time	Pr. 8	Pr. 44, Pr. 45	Pr. 110, Pr. 111	88
Stall prevention	Pr. 22	Pr. 48, Pr. 49	Pr. 114, Pr. 115	74

REMARKS

- The RT signal is assigned to the RT terminal in the initial setting. By setting "3" in any of *Pr. 178 to Pr. 189 (input terminal function selection)*, the RT signal can be assigned to the other terminal.

CAUTION

- When the RT (X9) signal is on, the other functions such as the second (third) are also selected.
- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 178 to Pr.189 (input terminal function selection) ☞ *Refer to page 118*

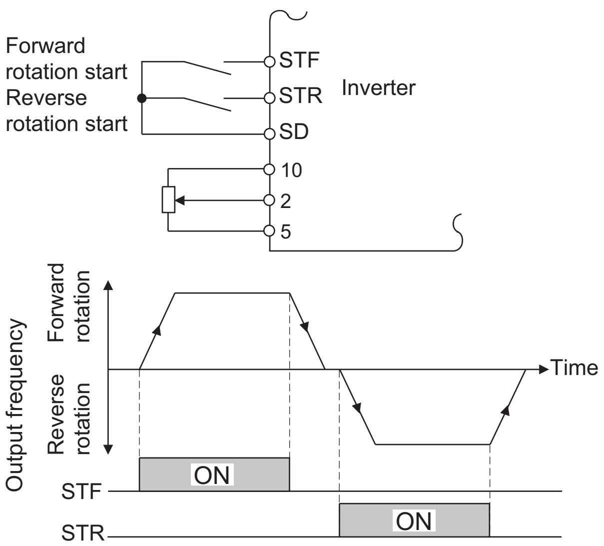
4.11.4 Start signal selection (STF, STR, STOP signal, Pr. 250)

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 104* for stop selection)

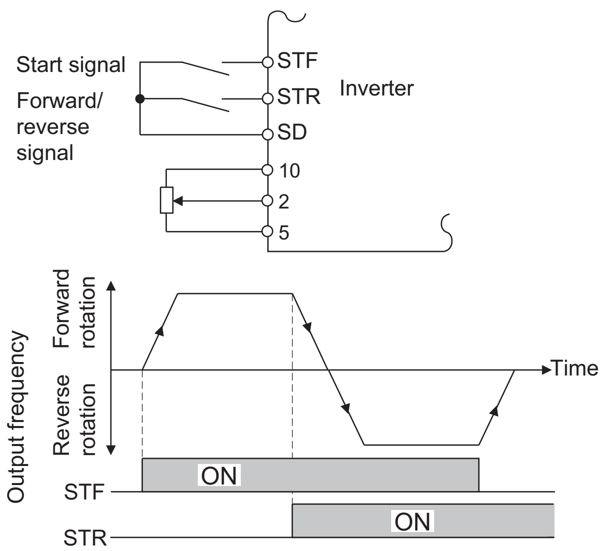
Parameter Number	Name	Initial Value	Setting Range	Description	
				Start signal (STF/STR)	Stop operation *(Refer to page 104)*
250	Stop selection	9999	0 to 100s	STF signal: Forward rotation start STR signal: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after the start signal is turned off. When the setting is any of 1000s to 1100s, the inverter coasts to a stop in (*Pr. 250* - 1000)s.
			1000s to 1100s	STF signal: Start signal STR signal: Forward/reverse rotation signal	
			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 rotation signal	

(1) 2-wire type (STF, STR signal)

- A two-wire type 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. If both are turned off (or on) during operation, the inverter decelerates to a stop.
- The speed setting signal may either be given by entering 0 to 10VDC across the speed setting input terminal 2-5, 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 81*)
- 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", the motor coasts to a stop if the start command is turned off. *(Refer to page 104)*
- The STF and STR signals are assigned to the STF and STR terminals in the initial setting. The STF signal can be assigned to *Pr. 178 STF terminal function selection* and the STR signal to *Pr. 179 STR terminal function selection* only.

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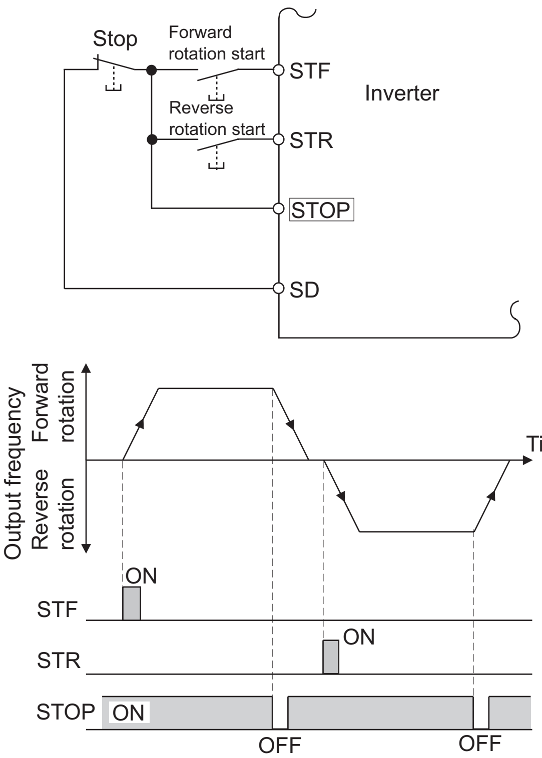
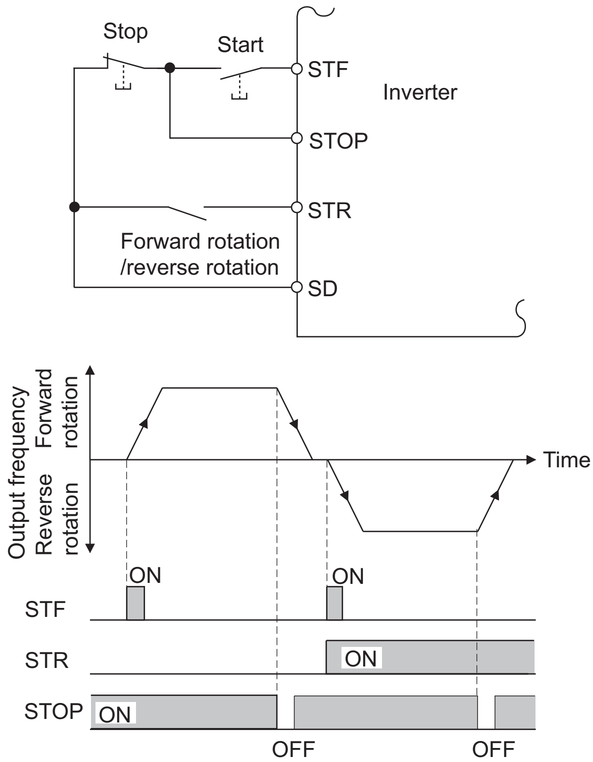
(2) 3-wire type (STF, STR, STOP signal)

- A three-wire type connection is shown below.
- The start self-holding selection becomes valid when the STOP signal is turned on. 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.



Three-Wire Type Connection Example (*Pr. 250* = "9999")



Three-Wire Type Connection Example (*Pr. 250* = "8888")

REMARKS

- The STOP signal is assigned to the terminal STOP in the initial setting. By setting "25" in *Pr. 178 to Pr. 189*, the STOP signal can also be assigned to the other terminal.
- 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 81*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 118*

4.11.5 Output terminal function selection (Pr. 190 to Pr. 196)

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

Parameter Number	Name	Initial Value		Initial Signal	Setting Range	
					FR-B	FR-B3
190	**RUN terminal function selection**	**Open collector output terminal**	0	RUN (inverter running)	0 to 8, 10 to 16, 25 to 28, 34, 45 to 47, 64, 70, 90 to 99, 100 to 108, 110 to 116, 125 to 128, 134, 145 to 147, 164, 170, 190 to 199, 9999	0 to 6, 8, 10 to 16, 20, 25 to 28, 34, 35, 45 to 47, 64, 70, 90 to 99, 100 to 106, 108, 110 to 116, 120, 125 to 128, 134, 135, 145 to 147, 164, 170, 190 to 199, 9999
191	**SU terminal function selection**		1	SU (up to frequency)		
192	**IPF terminal function selection**		2	IPF (instantaneous power failure, undervoltage)		
193	**OL terminal function selection**		3	OL (overload alarm)		
194	**FU terminal function selection**		4	FU (output frequency detection)		
195	**ABC1 terminal function selection**	**Relay output terminal**	99	ALM (alarm output)	0 to 8, 10 to 16, 25 to 28, 34, 45 to 47, 64, 70, 90, 91, 94 to 99, 100 to 108, 110 to 116, 125 to 128, 134, 145 to 147, 164, 170, 190, 191, 194 to 199, 9999	0 to 6, 8, 10 to 16, 20, 25 to 28, 34, 35, 45 to 47, 64, 70, 90, 91, 94 to 99, 100 to 106, 108, 110 to 116, 120, 125 to 128, 134, 135, 145 to 147, 164, 170, 190, 191, 194 to 199, 9999
196	**ABC2 terminal function selection**		9999	No function		

(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 Name	Function	Operation	Application ○:Correspondence ×:Non-correspondence		Related Parameters	Refer to Page
Positive Logic	Negative Logic				FR-B	FR-B3		
0	100	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above *Pr. 13 Starting frequency*.	○	○	—	128
1	101	SU	Up to frequency *1	Output when the output frequency is reached to the set frequency. *3	○	○	Pr. 41	130
2	102	IPF	Instantaneous power failure/ undervoltage	Output at occurrence of an instantaneous power failure or when undervoltage protection is activated.	○	○	Pr. 57	148
3	103	OL	Overload alarm	Output while stall prevention function is activated.	○	○	Pr. 22, Pr. 23, Pr. 66, Pr. 148, Pr. 149, Pr. 154	74
4	104	FU	Output frequency detection	Output when the output frequency reaches the frequency set in *Pr. 42* (*Pr. 43* for reverse rotation). *3	○	○	Pr. 42, Pr. 43	130
5	105	FU2	Second output frequency detection	Output when the output frequency reaches the frequency set in *Pr. 50*. *3	○	○	Pr. 50	130
6	106	FU3	Third output frequency detection	Output when the output frequency reaches the frequency set in *Pr. 116*. *3	○	○	Pr. 116	130
7	107	RBP	Regenerative brake prealarm	Output when 85% of the regenerative brake duty set in *Pr. 70* is reached. (75K or more)	○	×	Pr. 70	102
8	108	THP	Electronic thermal relay function prealarm	Output when the electronic thermal relay function cumulative value reaches 85%. (Electronic thermal relay function protection (E.THT/E.THM) activates, when the value reached 100%.)	○	○	Pr. 9	97
10	110	PU	PU operation mode	Output when the PU operation mode is selected.	○	○	Pr. 79	182

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Setting		Signal Name	Function	Operation	Application ○:Corres-pondence ×:Non-corres-pondence		Related Parameters	Refer to Page
Positive Logic	Negative Logic				FR-B	FR-B3		
11	111	RY	Inverter operation ready	Output when the inverter power is turned on, then output after reset process is completed (when the inverter can be started by switching the start signal on or while it is running).	○	○	—	128
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	132
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	132
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	228
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.	○	○		
20	120	BOF	Brake opening request	Output to open the brake when the brake sequence function is selected.	×	○	Pr. 278 to Pr. 285, Pr. 292	108
25	125	FAN	Fan fault output	Output at the time of a fan fault.	○	○	Pr. 244	246
26	126	FIN	Heatsink overheat pre-alarm	Output when the heatsink temperature reaches about 85% of the heatsink overheat protection providing temperature.	○	○	—	271
27	127	ORA	Orientation in-position	When orientation is valid *4	○	○	Pr. 350 to Pr. 366, Pr. 369	111
28	128	ORM	Orientation error		○	○		
34	134	LS	Low speed output	Output when the output frequency reduces below the *Pr. 865* setting.	○	○	Pr. 865	130
35	135	TU	Torque detection	Output when the motor torque rises above the *Pr. 864* value.	×	○	Pr. 864	133
45	145	RUN3	Inverter running and start command is on	Output when the inverter running and start commands are on.	○	○	—	128
46	146	Y46	During deceleration at occurrence of power failure (retained until release)	Output when the power failure-time deceleration function is executed.	○	○	Pr. 261 to Pr. 266	152
47	147	PID	During PID control activated	Output during PID control.	○	○	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	228
64	164	Y64	During retry	Output during retry processing.	○	○	Pr. 65 to Pr. 69	155
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	228
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	247
91	191	Y91	Alarm output 3 (power-off signal)	Output when an error occurs due to the circuit failure or connection alarm of the inverter.	○	○	—	129
92	192	Y92	Energy saving average value updated timing	Turned on and off alternately every time the power saving average value is updated when the power saving monitor is used. Cannot be set to *Pr. 195* and *Pr. 196* (relay output terminal).	○	○	Pr. 52, Pr. 54, Pr. 158, Pr. 891 to Pr. 899	160

Setting		Signal Name	Function	Operation	Application ○:Correspondence ×:Non-correspondence		Related Parameters	Refer to Page
Positive Logic	Negative Logic				FR-B	FR-B3		
93	193	Y93	Current average value monitor signal	Average current value and maintenance timer value are output as pulses. Cannot be set to *Pr. 195* and *Pr. 196* (relay output terminal).	○	○	Pr. 555 to Pr. 557	250
94	194	ALM2	Alarm output 2	Output when the inverter protective function is activated to stop the output (major fault). Continue outputting the signal during inverter reset and stop outputting after reset is cancelled. *2	○	○	—	129
95	195	Y95	Maintenance timer signal	Output when *Pr. 503* rises to or above the *Pr. 504* setting.	○	○	Pr. 503, Pr. 504	249
96	196	REM	Remote output	Output to the terminal when a value is set to the parameter.	○	○	Pr. 495 to Pr. 497	134
97	197	ER	Minor fault output 2	Output when the inverter protective function is activated to stop the output (major fault)	○	○	Pr. 875	159
98	198	LF	Minor fault output	Output when a minor fault (fan failure or communication error warning) occurs.	○	○	Pr. 121, Pr. 244	201, 246
99	199	ALM	Alarm output	Output when the inverter protective function is activated to stop the output (major fault). The signal output is stopped when a reset turns on.	○	○	—	129
9999		—	No function	—	○	○	—	—

*1 Note that when the frequency setting is varied using an analog signal or  of the operation panel (FR-DU07), 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".)

*2 When a power supply reset is performed, the alarm output 2 signal (ALM2) turns off as soon as the power supply switches off.

*3 Up to frequency SU, frequency detection FU, FU2, FU3 under encoder feed back control signals are as below.
SU, FU: Output when the actual speed (frequency) by the encoder feedback signal exceeds detected specification frequency.
FU2, FU3: Output when the inverter output frequency exceeds detected specification frequency.

*4 This parameter is valid when the FR-A7AP (option) is mounted.

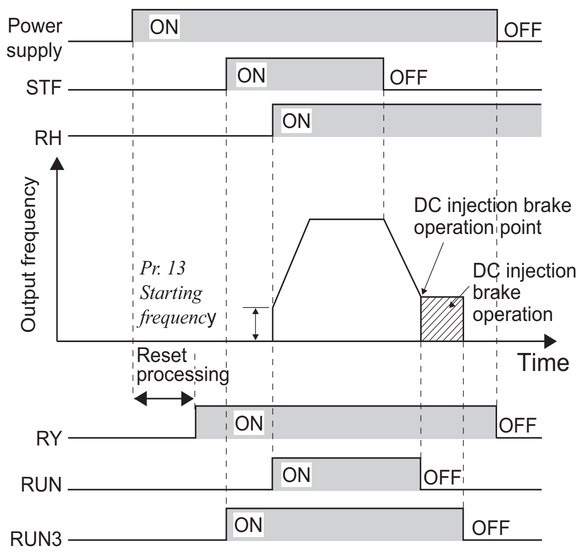
REMARKS

- 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".
- The signal will not function if a value other than the above is set to any of *Pr. 190 to Pr. 196*.
- When *Pr. 76 Alarm code output selection* = "1", the output signals of the terminals SU, IPF, OL and FU are switched as set in *Pr. 76*. (When an inverter alarm occurs, the signal output is switched to the alarm output.)
- The output assignment of the terminal RUN and alarm output relay are as set above regardless of *Pr. 76*.

CAUTION

- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.
- Do not assign signals which repeat frequent ON/OFF to A1, B1, C1, A2, B2, C2. Otherwise, the life of the relay contact decreases.

(2) Inverter operation ready signal (RY signal) and inverter running signal (RUN, RUN3 signal)



- When the inverter is ready to operate, the output of the operation ready signal (RY) is on. (It is also on during inverter running.)
- When the output frequency of the inverter rises to or above *Pr. 13 Starting frequency*, the output of the inverter running signals (RUN) is turned on. During an inverter stop or DC injection brake operation, the output is off.
- For the RUN3 signal, output is on while the inverter running and the start signal is on.
  (For the RUN3 signal, output is on if the starting command is on even when the inverter protective function is activated or the MRS signal is on.)
- The output is on during DC injection brake operation and off during an inverter stop.

Inverter Status / Output Signal	Start Signal is OFF (during stop)	Start Signal is ON (during stop)	Start Signal is ON (during running)	Under DC Injection Brake	At Alarm Occurrence or MRS Signal is on (output shutoff)		Automatic Restart after Instantaneous Power Failure		
							Coasting		Restarting
					Start signal is ON	Start signal is OFF	Start signal is ON	Start signal is OFF	
RY	ON	ON	ON	ON	OFF		ON *1		ON
RUN	OFF	OFF	ON	OFF	OFF		OFF		ON
RUN3	OFF	ON	ON	ON	ON	OFF	ON	OFF	ON

*1 This signal turns off during power failure or undervoltage.

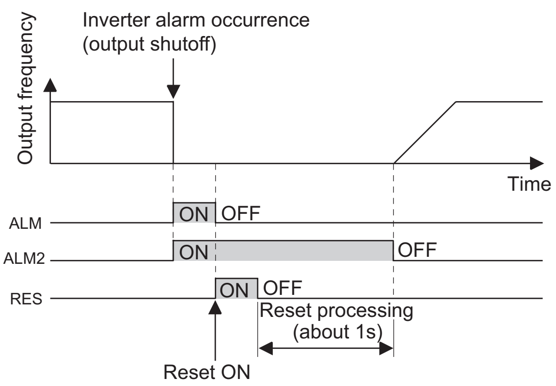
Output Signal	*Pr. 190 to Pr. 196* Setting	
	Positive logic	Negative logic
RY	11	111
RUN	0	100
RUN3	45	145

- When using the RY, RY2, RUN, RUN2 and RUN3 signals, assign functions to *Pr. 190 to Pr. 196 (output terminal selection function)* referring to the table on the left.

REMARKS

- The RUN signal is assigned to the terminal RUN in the initial setting.

(3) Alarm output signal (ALM, ALM2 signal)



- If the inverter comes to an alarm stop, the ALM and ALM2 signals are output.
- The ALM2 signal remains on during a reset period after alarm occurrence.
- When using the ALM2 signal, set "94 (positive logic)" or "194 (negative logic)" to any of *Pr. 190 to Pr. 196 (output terminal function selection)* to assign the function to the output terminal.
- The ALM signal is assigned to the A1B1C1 contact in the initial setting.

REMARKS

Refer to *page 266* for the inverter alarm description.

(4) Input MC shutoff signal (Y91 signal)

- The Y91 signal is output at occurrence of an alarm attributable to the failure of the inverter circuit or an alarm caused by a wiring mistake.
- When using the Y91 signal, set "91 (positive logic)" or "191 (negative logic)" to any of *Pr. 190 to Pr. 196 (output terminal function selection)* to assign the function to the output terminal.
- The following table indicates the alarms that will output the Y91 signal. (Refer to *page 266* for the alarm description.)

No.	Alarm Description
1	Inrush current limit circuit alarm (E.IOH)
2	CPU error (E.CPU)
3	CPU error (E.6)
4	CPU error (E.7)
5	Parameter storage device alarm (E.PE)
6	Parameter storage device alarm (E.PE2)
7	24VDC power output short circuit (E.P24)
8	Operation panel power supply short circuit, RS-485 terminal power supply short circuit(E.CTE)
9	Output side earth(ground) fault overcurrent protection(E.GF)
10	Output phase failure (E.LF)
11	Brake transistor alarm detection (E.BE)

♦ Parameters referred to ♦

Pr. 13 Starting frequency ☞ *Refer to page 90 .*
Pr. 76 Alarm code output selection ☞ *Refer to page 157*

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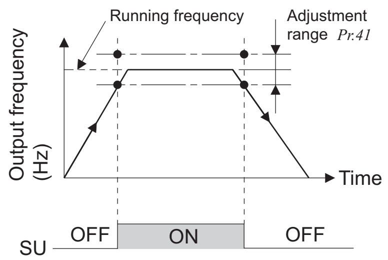
4.11.6 Detection of output frequency (SU, FU, FU2 , FU3, LS signal, Pr. 41 to Pr. 43, Pr. 50, Pr. 116, Pr. 865)

The inverter output frequency is detected and output to the output signal.

Parameter Number	Name	Initial Value	Setting Range		Description
			FR-B	FR-B3	
41	**Up-to-frequency sensitivity**	10%	0 to 100%		Set the level where the SU signal turns on.
42	**Output frequency detection**	6Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the frequency where the FU (FB) signal turns on.
43	**Output frequency detection for reverse rotation**	9999	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the frequency where the FU (FB) signal turns on in reverse rotation.
			9999		Same as *Pr. 42* setting
50	**Second output frequency detection**	30Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the frequency where the FU2 (FB2) signal turns on.
116	**Third output frequency detection**	60Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the frequency where the FU3 (FB3) signal turns on.
865	**Low speed detection**	1.5Hz	0 to 120Hz/ 0 to 60Hz*	0 to 120Hz	Set the frequency where the LS signal turns on.

* The setting range differs according to the inverter capacity. (22K or less/30K or more)

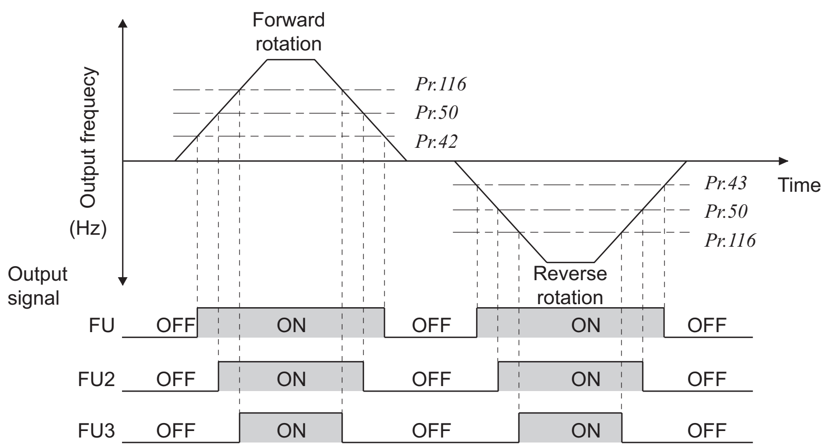


(1) Up-to-frequency sensitivity (SU signal, *Pr. 41*)

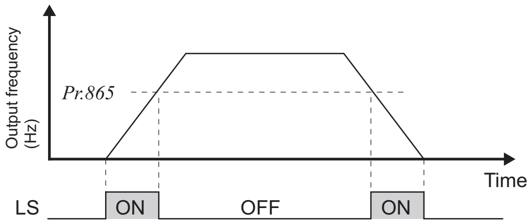
- When the output frequency reaches the running frequency, the up-to-frequency signal (SU) is output.
- The *Pr. 41* value can be adjusted within the range ±1% to ±100% on the assumption that the set frequency is 100%.
- This parameter can be used to ensure that the running frequency has been reached to provide the operation start signal etc. for related equipment.

(2) Output frequency detection (FU signal, FU2 signal, FU3 signal, *Pr. 42, Pr. 43, Pr. 50, Pr. 116*)

- When the output frequency rises to or above the *Pr. 42* setting, the output frequency detection signal (FU) is output.
- This function can be used for electromagnetic brake operation, open signal, etc.
- The FU (FU2, FU3) signal is output when the output frequency reaches the set frequency.
- When the detection frequency is set in *Pr. 43*, frequency detection used exclusively for reverse rotation can also be set. This function is effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during elevator operation, etc.
- When *Pr. 43* ≠ "9999", the *Pr. 42* setting applies to forward rotation and the *Pr. 43* setting applies to reverse rotation.
- When outputting a frequency detection signal besides the FU signal, set the detection frequency in *Pr. 50 or Pr. 116*. The FU2 signal (FU3 signal if *Pr. 116* or more) is output when the output frequency reaches or exceeds the *Pr. 50* setting.
- For each signal, assign functions to *Pr. 190 to Pr. 196 (output terminal function selection)* referring to the table below.



Parameter Number	Output Signal	*Pr. 190 to Pr. 196* Setting	
		Positive logic	Negative logic
42, 43	FU	4	104
50	FU2	5	105
116	FU3	6	106



(3) Low speed detection (LS signal, *Pr. 865*)

· The low speed detection signal (LS) is output when the output frequency reduces below the *Pr. 865 Low speed detection* setting.
· For the LS signal, set "34 (positive logic) or 134 (negative logic)" in *Pr. 190 to Pr. 196 (output terminal function selection)* and assign functions to the output terminal.

REMARKS

· The FU signal is assigned to the terminal FU and the SU signal is assigned to the terminal SU in the initial setting.
· All signals are OFF during DC injection brake.

CAUTION

· When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*

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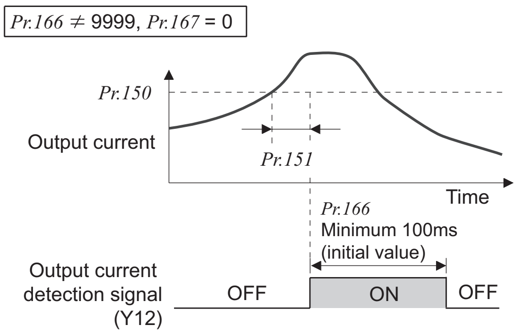
4.11.7 Output current detection function (Y12 signal, Y13 signal, Pr. 150 to Pr. 153, Pr. 166, Pr. 167)

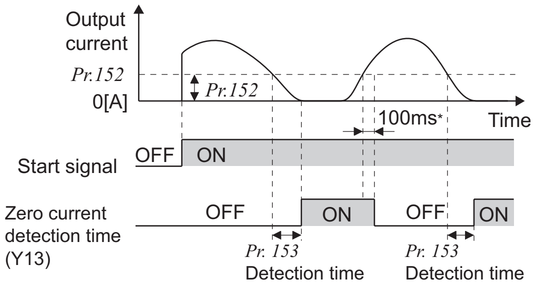
The output power during inverter running can be detected and output to the output terminal.

Parameter Number	Name	Initial Value	Setting Range	Description
150	**Output current detection level**	150%	0 to 220%	Set the output current detection level. 100% is the rated inverter current.
151	**Output current detection signal delay time**	0s	0 to 10s	Set the output current detection period. Set the time from when the output current has risen above the setting until the output current detection signal (Y12) is output.
152	**Zero current detection level**	5%	0 to 220%	Set the zero current detection level. The rated inverter current is assumed to be 100%.
153	**Zero current detection time**	0.5s	0 to 1s	Set this parameter to define the period from when the output current drops below the *Pr. 152* value until the zero current detection signal (Y13) is output.
166	**Output current detection signal retention time**	0.1s	0 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 an alarm stop when the Y12 signal is on. (E.CDO)



(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 output is stopped and the output current detection alarm (E.CDO) is displayed when the Y12 signal turns on. When an alarm stop 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 made valid after Y12 turns OFF.
- Set "12 (positive logic)" or "112 (negative logic)" to any of *Pr. 190 to Pr. 196 (output terminal function selection)* to assign the function of the Y12 signal to the output terminal.



* Once turned on, the zero current detection time signal (Y13) is held on for at least 100ms.

(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".
- Set "13 (positive logic)" or "113 (negative logic)" in any of *Pr. 190 to Pr. 196 (output terminal function selection)* to assign the function of the Y13 signal to the output terminal.

CAUTION

- This function is also valid during execution of the offline auto tuning.
- The response time of Y12 and Y13 signals is approximately 350ms.
- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.

⚠ CAUTION

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

⚠ To prevent the machine and equipment from resulting in hazardous conditions by use of the zero current detection signal, install a safety backup such as an emergency brake.

♦ Parameters referred to ♦

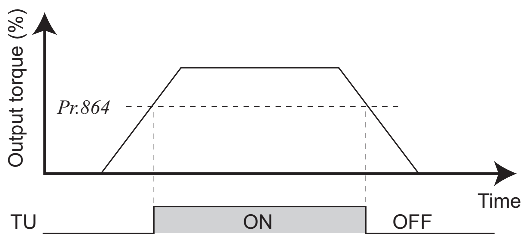
Offline auto tuning ☞ *Refer to page 70*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*

4.11.8 Detection of output torque (TU signal, Pr. 864) B3

Setting can be made only for FR-B3 series.

Output the signal when the motor torque rises above the setting value.
This function can be used for electromagnetic brake operation, open signal, etc.

Parameter Number	Name	Initial Value	Setting Range	Description
864	**Torque detection**	150%	0 to 400%	Set the torque value where the TU signal turns on.



- When the output torque reaches or exceeds the detected torque value set in *Pr. 864* the torque detection signal (TU) turns on.
  It turns off when the torque falls below the detection torque value.
- For the TU signal, set "35 (positive logic) or 135 (negative logic)" in *Pr. 190 to Pr. 196 (output terminal function selection)* and assign functions to the output terminal.

CAUTION

- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions maybe affected. Please make setteing after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*

4.11.9 Remote output function (REM signal, Pr. 495 to Pr. 497)

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 clear at inverter reset
			1	Remote output data held at powering off	
			10	Remote output data clear at powering off	Remote output data held at inverter reset
			11	Remote output data held at powering off	
496 *	Remote output data 1	0	0 to 4095	Refer to the following diagram.	
497 *	Remote output data 2	0	0 to 4095		

* 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

*1	*1	*1	*1	*1	ABC2	ABC1	FU	OL	IPF	SU	RUN

Pr. 497

b11 ... b0

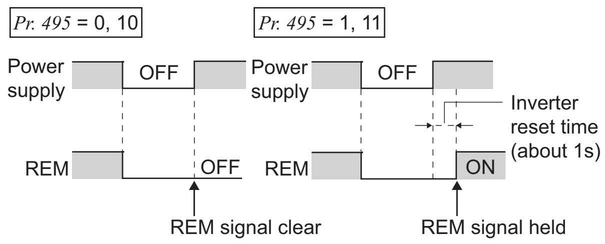
*1	*1	RA3 *3	RA2 *3	RA1 *3	Y6 *2	Y5 *2	Y4 *2	Y3 *2	Y2 *2	Y1 *2	Y0 *2

*1 As desired
*2 Y0 to Y6 are available only when the extension output option (FR-A7AY) is fitted
*3 RA1 to RA3 are available only when the relay output option (FR-A7AR) is fitted

- The output terminal can be turned on/off depending on the *Pr. 496* or *Pr. 497* setting. The remote output selection can be controlled on/off by computer link communication from the PU connector or RS-485 port or by communication from the communication option.
- Set "96" (positive logic) or "196" (negative logic) to any of *Pr. 190 to Pr. 196 (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* or *Pr. 497*, 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



- When *Pr. 495* = "0 (initial value), 10", performing a power supply reset (including a power failure) clears the REM signal output. (The ON/OFF status of the terminals are as set in *Pr. 190 to Pr. 196*.) The *Pr. 496* and *Pr. 497* settings are also "0".
  When *Pr. 495* = "1, 11", the remote output data before power supply-off is stored into the EEPROM, so the signal output at power recovery is the same as before power supply-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, 11", the signal before reset is held even an inverter reset is made.

REMARKS

- The output terminal where the REM signal is not assigned using any of *Pr. 190 to Pr. 196* does not turn on/off if 0/1 is set to the terminal bit of *Pr. 496* or *Pr. 497* . (It turns on/off with the assigned function.)
- When the inverter is reset (terminal reset, reset request through communication), *Pr. 496* and *Pr. 497* values turn to "0". When *Pr. 495* = "1, 11", however, they are the settings at power supply-off. (The settings are stored at power supply-off.)
  When *Pr. 495* = "10, 11", they are the same as before an inverter reset is made.

CAUTION

- When *Pr. 495* = "1" (remote output data retention even at powering off), take such a step as to connect R1/L11, S1/L21 and P/+, N/- to ensure that control power will be retained to some degree. If you do not take such a step, the output signals provided after power-on are not guaranteed.

♦ Parameters referred to ♦

- *Pr. 190 to Pr. 196 (output terminal function selection)* Refer to page 125

4.12 Monitor display and monitor output signal

Purpose	Parameter that must be Set		Refer to Page
Display motor speed Set speed	**Speed display and speed setting**	**Pr. 37, Pr. 144, Pr. 505, Pr. 811**	135
Change PU monitor display data	**DU/PU main display data selection Cumulative monitor clear**	**Pr. 52, Pr. 170, Pr. 171, Pr. 268, Pr. 891**	137
Change of the monitor output from terminal FM and AM	**Terminal FM, AM function selection**	**Pr. 54, Pr. 158, Pr. 291, Pr. 866, Pr. 867**	137
Set the reference of the monitor output from terminal FM and AM	**Setting of reference of terminal FM and AM**	**Pr. 55, Pr. 56, Pr. 291, Pr. 866, Pr. 867**	142
Adjust terminal FM, AM outputs	**Terminal FM, AM calibration**	**Pr. 900, Pr. 901**	145

Speed display and speed setting (Pr. 37, Pr. 144, Pr. 505, Pr. 811)

You can change the PU (FR-DU07/FR-PU04/FR-PU07) monitor display or frequency setting to motor speed or machine speed.

Parameter Number	Name	Initial Value	Setting Range	Description	
37	**Speed display**	0	0	Frequency display, setting	
			1 to 9998 *	Set the machine speed at *Pr. 505*.	
144	**Speed setting switchover**	4	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	1 to 120Hz	Set the reference speed for *Pr. 37*.	
811	**Set resolution switchover**	0		Speed setting and running speed monitor increments from the PU, RS-485 communication or communication option.	
			0	1r/min	
			1	0.1r/min	

* The maximum value of the setting range differs according to the *Pr.1 Maximum frequency* and it can be calculated from the following formula.

$$Pr.37\text{ (set maximum value)} < \frac{65535 \times Pr.\ 505\text{ (Hz)}}{Pr.1\text{(Hz)}}$$

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

- To display the machine speed, set in *Pr. 37* the machine speed for operation with frequency set in *Pr. 505*.
  For example, when *Pr. 505* = "60Hz" and *Pr. 37* = "1000", "1000" is displayed on the running speed monitor when the running frequency is 60Hz. When running frequency is 30Hz, "500" is displayed.
- When displaying the motor speed, set the number of motor poles (2, 4, 6, 8, 10) or number of motor poles + 100 (102, 104, 106, 108, 110) in *Pr. 144*.
  When the number of motor poles are set by *Pr.81 Number of motor poles*, the *Pr.144* setting is automatically changed.If the *Pr.144* setting is changed, the *Pr.81* setting is not automatically changed.
  Example 1) When Pr.81 is set to "2" or "12" from the initial value, Pr.144 changes from "4" to "2".
  Example 2) If Pr.81 is set to "2" when Pr.144 is "104", Pr.144 changes from "104" to "102".
- When "1" is set in *Pr. 811*, the setting increments of speed setting from the PU, speed setting from RS-485 communication or communication options (other than FR-A7ND, FR-A7NL) and running speed monitor is 0.1r/min.
- 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
- When the running speed monitor is selected, each monitor and setting are determined by the combination of *Pr. 37* and *Pr. 144* as listed below. (The units within the thick frame are the initial values.)

Pr. 37 Setting	*Pr. 144* Setting	Output Frequency Monitor	Set Frequency Monitor	Running Speed Monitor	Frequency Setting Parameter Setting
0 (initial value)	0	Hz	Hz	r/min *1	Hz
	2 to 10	Hz	Hz	r/min *1	Hz
	102 to 110	r/min *1	r/min *1	r/min *1	r/min *1
1 to 9998	0	Hz	Hz	Machine speed *1	Hz
	2 to 10	Machine speed *1	Machine speed *1	Machine speed *1	Machine speed *1
	102 to 110	Hz	Hz	r/min *1	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*
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.
*2 The increments for Hz are 0.01Hz, machine speed are 1m/min, and r/min are 1r/min.
*3 *Pr. 505* is always set as frequency (Hz).

CAUTION

- In the FR-B series, the output frequency of the inverter is displayed in terms of synchronous speed, and therefore, it is unequal to the actual speed by motor slip. Since the FREQROL-B3 series are operated by the advanced magnetic flux vector control, this display changes to the actual speed (estimated value calculated based on the motor slip) and actual speed from the encoder when encoder feed back control is performed. When performing the encoder feed back control, however, another explosion-proof test is necessary.
- When the running speed display is selected at the setting of *Pr. 37* = "0" and *Pr. 144* = "0", the monitor display is provided on the assumption that the number of motor poles is 4. (1800r/min is displayed at 60Hz)
- Refer to *Pr. 52* when you want to change the PU main monitor (PU main display).
- Since the panel display of the operation panel (FR-DU07) is 4 digits in length, the monitor value of more than "9999" is displayed "----".
- After setting the running speed in 0.1r/min increments (*Pr. 811* = "0"), changing the setting increments to 1r/min increments (*Pr. 811* = "1") changes the speed resolution from 0.1r/min to 0.3r/min (four poles), which may round down 0.1r/min increments.
- 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.

⚠ CAUTION

⚠ Make sure that the settings of the running speed and number of motor poles are correct. Otherwise, the motor might run at extremely high speed, damaging the machine.

♦ Parameters referred to ♦

Pr. 52 DU/PU main display data selection ☞ *Refer to page 137*
Pr. 80 Motor capacity, Pr. 81 Number of motor poles ☞ *Refer to page 68*

4.12.1 DU/PU, FM, AM terminal monitor display selection (Pr. 52, Pr. 54, Pr. 158, 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 (FR-DU07)/parameter unit (FR-PU04/FR-PU07) can be selected.
In addition, signals to be output from the terminal FM (pulse train output) and AM (analog voltage output) can be selected.

Parameter Number	Name	Initial Value	Setting Range		Description
			FR-B	FR-B3	
52*	DU/PU main display data selection	0 (output frequency)	0, 5, 6, 8 to 14, 17 to 20, 22 to 25, 50 to 57, 100	0, 5 to 14, 17 to 20, 22 to 25, 34, 50 to 57, 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, 6, 8 to 14, 17, 18, 21, 24, 50, 52, 53	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52, 53	Select the monitor output to terminal FM.
158*	AM terminal function selection				Select the monitor output to terminal AM.
170	Watt-hour meter clear	9999	0		Set "0" to clear the watt-hour meter monitor.
			10		Set the maximum value when monitoring from communication to 0 to 9999kWh.
			9999		Set the maximum value when monitoring from communication to 0 to 65535kWh.
171	Operation hour meter clear	9999	0, 9999		Set "0" in the parameter to clear the watt-hour monitor. Setting "9999" has no effect.
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 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 (FR-DU07) 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*.
- Set the monitor to be output to the terminal AM (analog voltage output (0 to 10VDC voltage output)) in *Pr. 158 AM terminal function selection*.
- Refer to the following table and set the monitor to be displayed. (The signals marked × cannot be selected for monitoring)

Types of Monitor	Increments	*Pr. 52* Setting		*Pr. 54* (FM) *Pr. 158* (AM) Setting	Full-scale Value of the Terminal FM and AM	Description
		DU LED	PU main monitor			
Output frequency	0.01Hz	0/100		1	*Pr. 55*	Displays the inverter output frequency.
Output current	0.01A/0.1A *7	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.

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Types of Monitor	Increments	*Pr. 52* Setting		*Pr. 54* (FM) *Pr. 158* (AM) Setting	Full-scale Value of the Terminal FM and AM	Description
		DU LED	PU main monitor			
Alarm display	—	0/100		×	—	Displays 8 past alarms individually.
Frequency setting	0.01Hz	5	*1	5	*Pr. 55*	Displays the set frequency.
Running speed	1(r/min)	6	*1	6	The value converted with the *Pr. 37* value from *Pr. 55*	Displays the motor speed (depending on *Pr. 37* and *Pr. 144* settings, for details, refer to *page 135*)
Motor torque *3	0.1%	7	*1	7	*Pr. 866*	Displays the motor torque in percentage on the assumption that the rated motor torque is 100%
Converter output voltage	0.1V	8	*1	8	200V class: 400V 400V class: 800V	Displays the DC bus voltage value.
Regenerative brake duty	0.1%	9	*1	9	*Pr. 70*	Brake duty set in *Pr. 30* and *Pr. 70*
Electronic thermal relay function load factor	0.1%	10	*1	10	100%	Displays the motor thermal cumulative value on the assumption that the thermal operation level is 100%.
Output current peak value	0.01A/0.1A *7	11	*1	11	*Pr. 56*	Retains the peak value of the output current monitor and displays (clears at every start)
Converter output voltage peak value	0.1V	12	*1	12	200V class: 400V 400V class: 800V	Retains the peak value of the DC bus voltage value and displays (clears at every start)
Input power	0.01kW/ 0.1kW *7	13	*1	13	Rated inverter power × 2	Displays power on the inverter input side
Output power	0.01kW/ 0.1kW *7	14	*1	14	Rated inverter power × 2	Displays power on the inverter output side
Load meter	0.1%	17		17	100%	Torque current is displayed in % on the assumption that the *Pr. 866* setting is 100%
Motor excitation current	0.01A/0.1A *7	18		18	*Pr. 56*	Displays the excitation current of the motor
Position pulse *2	—	19		×	—	Displays the number of pulses per rotation of the motor when orientation control is valid
Cumulative energization time *4, *8	1h	20		×	—	Cumulative energization time since the inverter shipment is displayed. You can check the numbers of the monitor value exceeded 65535h with *Pr. 563*.
Reference voltage output	—	—		21	—	Terminal FM: 1440 pulse/s is output when *Pr. 291* = 0, 1. 50k pulse/s is output when *Pr. 291* ≠ 0, 1. Terminal AM: 10V is output
Orientation status *2	1	22		×	—	Displays only when orientation control is valid *(Refer to page 111)*
Actual operation time *4, *5, *8	1h	23		×	—	Cumulative inverter running time is displayed. You can check the numbers of the monitor value exceeded 65535h with *Pr. 564*. Use *Pr. 171* to clear the value. *(Refer to page 141)*
Motor load factor	0.1%	24		24	200%	On the assumption that the rated inverter current value is 100%, the output current value is displayed in %. Monitor value = output current monitor value/ rated inverter current × 100 [%]
Cumulative power *8	0.01kWh/ 0.1kWh *6 *7	25		×	—	Cumulative power amount is displayed according to the output power monitor. Use *Pr. 170* to clear the value. *(Refer to page 141)*
Motor output *3	0.01kW/ 0.1kW *7	34		34	Rated motor capacity	Multiplys the motor speed by the then output torque and displays the machine output of the motor shaft end
Power saving effect	Variable according to parameters	50		50	Inverter capacity	Displays energy saving effect monitor You can change the monitor to power saving, power saving average value, charge display and % display using parameters. (For details, refer to *page 161*)
Cumulative saving power *8		51		×	—	

Types of Monitor	Increments	*Pr. 52* Setting		*Pr. 54* (FM) *Pr. 158* (AM) Setting	Full-scale Value of the Terminal FM and AM	Description
		DU LED	PU main monitor			
PID set point	0.1%	52		52	100%	Displays the set point, measured value and deviation during PID control (For details, refer to *page 233*)
PID measured value	0.1%	53		53	100%	
PID deviation	0.1%	54		×	—	
Input terminal status	—	55	*1	×	—	Displays the input terminal ON/OFF status on the PU (refer to *page 140* for DU display)
Output terminal status	—		*1	×	—	Displays the output terminal ON/OFF status on the PU (refer to *page 140* for DU display)
Option input terminal status	—	56	×	×	—	Displays the input terminal ON/OFF status of the digital input option (FR-A7AX) on the DU (refer to *page 140* for details)
Option output terminal status	—	57	×	×	—	Displays the output terminal ON/OFF states of the digital output option (FR-A7AY) or relay output option (FR-A7AR) on the DU (refer to *page 140* for details)

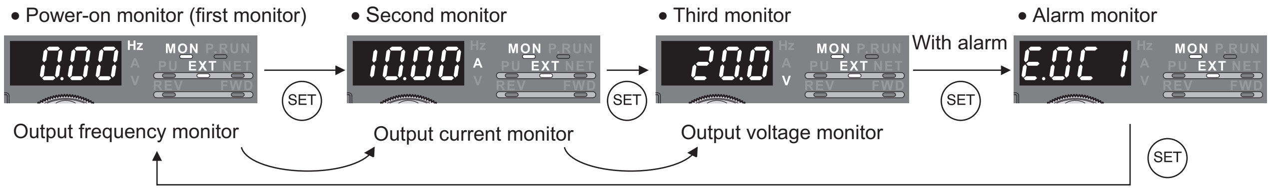
*1 Frequency setting to output terminal status on the PU main monitor are selected by "other monitor selection" of the parameter unit (FR-PU04, FR-PU07).
*2 Position pulse and orientation status function when used with an option (FR-A7AP). When orientation control is invalid, "0" remains displayed and these functions are invalid. When performing the orient control, another explosion-proof test is necessary.
*3 Valid only for FR-B3 series.
*4 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When the operation panel (FR-DU07) is used, the time is displayed up to 65.53 (65530h) on the assumption that 1h = 0.001, and thereafter, it is added up from 0.
*5 The actual operation time is not added up if the cumulative operation time before power supply-off is less than 1h.
*6 When using the parameter unit (FR-PU04/FR-PU07), "kW" is displayed.
*7 The setting depends on the inverter capacity. (55K or less / 75K or more)
*8 Since the panel display of the operation panel (FR-DU07) is 4 digits in length, the monitor value of more than "9999" is displayed "----".

REMARKS

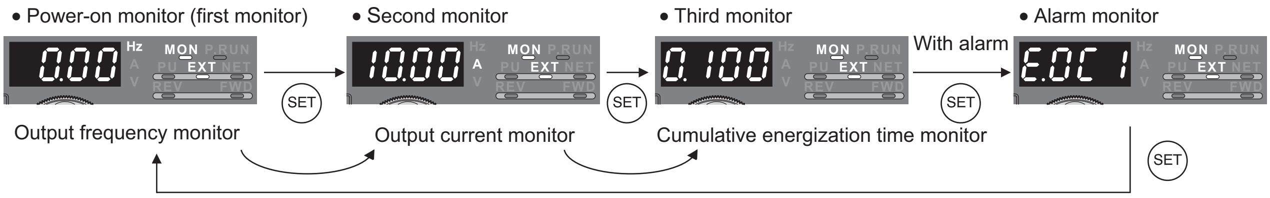
- By setting "0" in *Pr. 52*, the monitoring of output frequency to alarm display can be selected in sequence by SET.
- When the operation panel (FR-DU07) is used, the displayed units are Hz, V and A only and the others are not displayed.
- The monitor set in *Pr. 52* is displayed in the third monitor position. (The output voltage monitor is changed.)

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.



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

· When *Pr. 52* is set to "100", the set frequency monitor is displayed during a stop and the output frequency monitor is displayed during operation. (LED of Hz flickers during stop and is lit during running.)

Type of Monitor	*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		
Alarm display	Alarm display		

REMARKS

· During an error, the output frequency at error occurrence appears.
· During MRS, the values displayed are the same as during a stop.
· In FR-B3 series, the tuning status monitor has priority.

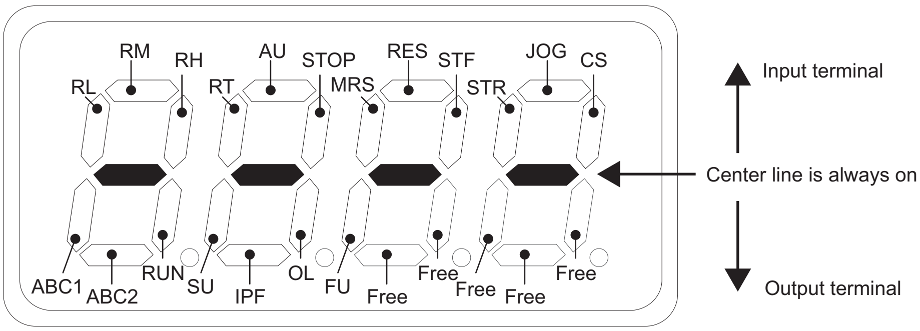
(3) Operation panel (FR-DU07) I/O terminal monitor *(Pr. 52)*

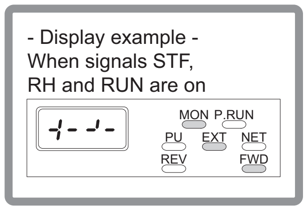
· When *Pr. 52* is set to any of "55 to 57", the I/O terminal states can be monitored on the operation panel (FR-DU07).
· The I/O terminal monitor is displayed on the third monitor.
· The LED is on when the terminal is on, and the LED is off when the terminal is off. The center line of LED is always on.

Pr. 52 Setting	Monitor Description
55	Display the I/O and output terminal ON/OFF status of the inverter unit.
56 *	Display the input terminal ON/OFF status of the digital input option (FR-A7AX).
57 *	Display the output terminal ON/OFF status of the digital output option (FR-A7AY) or relay output option (FR-A7AR).

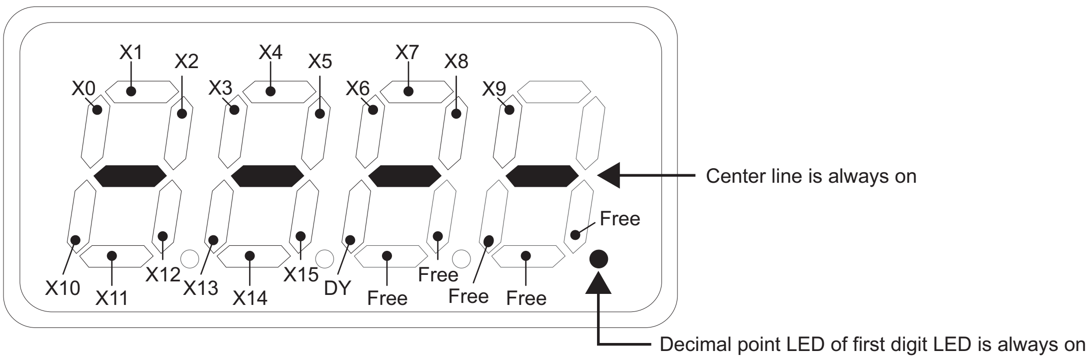
* You can set "56" or "57" even if the option is not fitted. When the option is not fitted, the monitor displays are all off.

· On the unit I/O terminal monitor (*Pr. 52* = "55"), the upper LEDs denote the input terminal status and the lower the output terminal status.

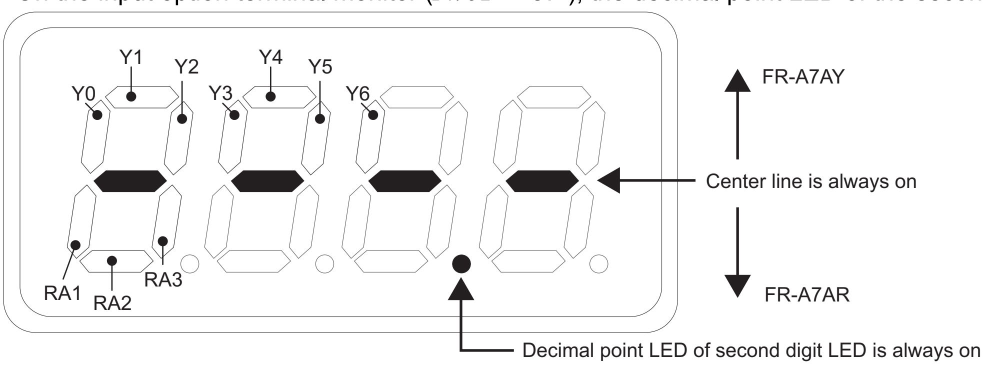




· On the input option terminal monitor (*Pr. 52* = "56"), the decimal point LED of the first digit LED is on.



· On the input option terminal monitor (*Pr. 52* = "57"), the decimal point LED of the second digit LED is on.



(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 1h increments.
- The operation panel (FR-DU07), parameter unit (FR-PU04, FR-PU07) and communication (RS-485 communication, communication option) display increments and display ranges are as indicated below.

Operation Panel *1		Parameter Unit *2		Communication		
Range	Increments	Range	Increments	Range		Increments
				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
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 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 0 to 99999.99.99kWh, 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.

- 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 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 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 in *Pr. 170* and *Pr. 170* is read again, "9999" or "10" is displayed.

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

- On the cumulative energization time monitor (*Pr. 52* = "20"), the inverter running time is added up every 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 numbers of monitor 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" in *Pr. 171* clears the actual operation time monitor. (Energization time monitor can not be cleared.)

REMARKS

- The actual operation time is not added up unless the inverter is operated one or more hours continuously.
- If "0" is written in *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 (FR-DU07) 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	When 1 or 2 decimal places (0.1 increments or 0.01 increments) are monitored, the decimal places are dropped and the monitor displays an integer value (1 increments). The monitor value of 0.99 or less 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). When the monitor display digit is originally in 1 increments, it is displayed unchanged in 1 increments.

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") or cumulative saving power monitor (*Pr. 52* = "51") does not change.

♦ Parameters referred to ♦

Pr. 37 Speed display, Pr. 144 Speed setting switchover ☞ *Refer to page 135*
Pr. 55 Frequency monitoring reference, Pr. 56 Current monitoring reference, Pr. 866 Torque monitoring reference ☞ *Refer to page 142*
Pr. 291 Pulse train I/O selection ☞ *Refer to page 142*

4

PARAMETERS

4.12.2 Reference of the terminal FM (pulse train output) and AM (analog voltage output) (Pr. 55, Pr. 56, Pr. 291, Pr. 866, Pr. 867)

Two types of monitor output, pulse train output from the terminal FM and analog voltage output from the terminal AM, are available. In addition, pulse train output by voltage output and by open collector output can be selected for terminal FM.
Set the reference of the signal output from terminal FM and AM.

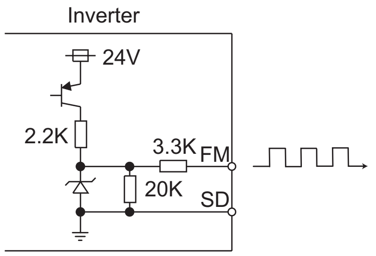
<table>
<tr><th rowspan="2">Parameter Number</th><th rowspan="2">Name</th><th colspan="2">Initial Value</th><th colspan="2">Setting Range</th><th colspan="2" rowspan="2">Description</th></tr>
<tr><th>FR-B</th><th>FR-B3</th><th>FR-B</th><th>FR-B3</th></tr>
<tr><td>55</td><td>Frequency monitoring reference</td><td colspan="2">60Hz</td><td>0 to 120Hz/0 to 60Hz *2</td><td>0 to 120Hz</td><td colspan="2">Set the full-scale value to output the output frequency monitor value to terminal FM and AM.</td></tr>
<tr><td>56</td><td>Current monitoring reference</td><td colspan="2">Rated inverter output current</td><td>0 to 500A/0 to 3600A *3</td><td>0 to 500A</td><td colspan="2">Set the full-scale value to output the output current monitor value to terminal FM and AM.</td></tr>
<tr><td rowspan="8">291</td><td rowspan="8">Pulse train I/O selection</td><td colspan="2" rowspan="8">0</td><td colspan="2"></td><td>Pulse train input</td><td>Pulse train output</td></tr>
<tr><td colspan="2">0</td><td>Terminal JOG</td><td>FM output</td></tr>
<tr><td colspan="2">1</td><td>Pulse train input</td><td>FM output</td></tr>
<tr><td colspan="2">10</td><td>Terminal JOG</td><td>High speed pulse train output (50%Duty)</td></tr>
<tr><td colspan="2">11</td><td>Pulse train input</td><td>High speed pulse train output (50%Duty)</td></tr>
<tr><td colspan="2">20</td><td>Terminal JOG</td><td>High speed pulse train output (ON width is always same)</td></tr>
<tr><td colspan="2">21</td><td>Pulse train input</td><td>High speed pulse train output (ON width is always same)</td></tr>
<tr><td colspan="2">100</td><td>Pulse train input</td><td>High speed pulse train output (ON width is always same)
The inverter outputs the signal input as pulse train as is</td></tr>
<tr><td>866 *1</td><td>Torque monitoring reference</td><td>-</td><td>150%</td><td>-</td><td>0 to 400%</td><td colspan="2">Set the full-scale value to output the torque monitor value to terminal FM and AM.</td></tr>
<tr><td>867</td><td>AM output filter</td><td colspan="2">0.01s</td><td colspan="2">0 to 5s</td><td colspan="2">Set the output filter of terminal AM.</td></tr>
</table>

*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*. setting can be made only for FR-B3 series.
*2 The setting range differs according to the inverter capacity. (22K or less/30K or more)
*3 The setting range differs according to the inverter capacity. (55K or less/75K or more)

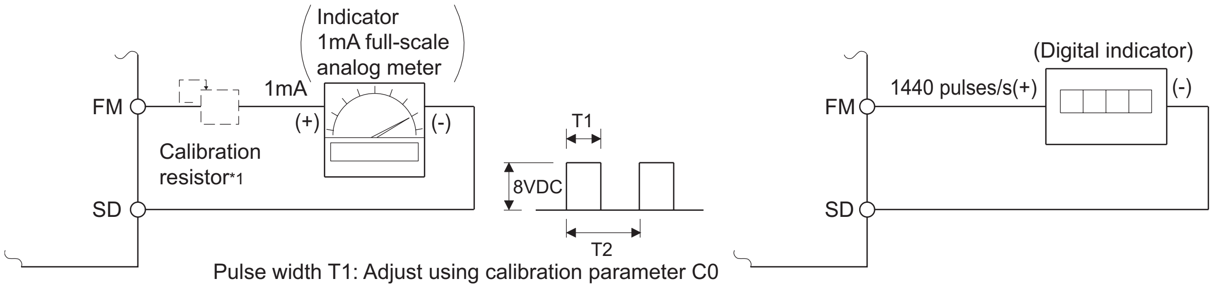
(1) Pulse train output of the terminal FM *(Pr. 291)*

- Two types of pulse train can be output to the terminal FM.

FM output circuit



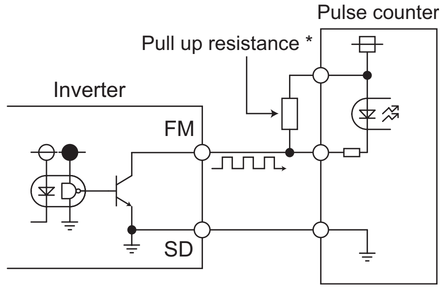
- When *Pr. 291 Pulse train I/O selection* = "0 (initial value) or 1", FM output is selected and pulse train with maximum of 8VDC 2400pulses/s is output.
  The pulse width can be adjusted by calibration *parameter C0 (Pr. 900) FM terminal calibration* using the operation panel and parameter unit.
- Output frequency, etc. of the inverter can be indicated by connecting a DC ammeter of full-scale 1mA, digital indicator, etc.



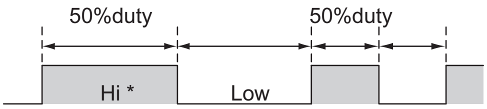
Pulse width T1: Adjust using calibration parameter C0
Pulse cycle T2: Set with *Pr. 55* (frequency monitor)
Set with *Pr.56* (current monitor)

*1 Not needed when the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07) is used for calibration.
This resistor is used when calibration must be made near the frequency meter for such a reason as a remote frequency meter.
Note that the needle of the frequency meter may not deflect to full-scale when the calibration resistor is connected. In this case, use this resistor and operation panel or parameter unit together.
*2 The initial setting is 1mA full-scale and 1440 pulse/s teminal FM frequency at 60Hz.

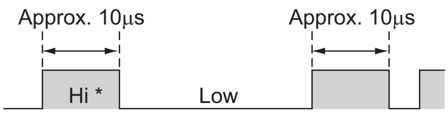
High speed pulse train output circuit (connection example with a pulse counter)



Pulse when *Pr. 291* = "10, 11"



Pulse when *Pr. 291* = "20, 21, 100"



- When *Pr. 291 Pulse train I/O selection* = "10, 11, 20, 21, 100", high speed pulse train is output by open collector output. Pulse train of maximum of 55k pulses/s is output.
Two types of pulse width, 50% Duty and fixed ON width, are available. Adjustment by calibration *parameter C0 (Pr. 900) FM terminal calibration* can not be performed.

* When the output wiring length is long, a pulse shape is deformed due to the stray capacitances of the wiring and output pulse can not be recognized. If the wiring length is long, connect the open collector output signal and the power supply using an external pull up resistance.
Check specifications of a pulse counter for a resistance value to pull up. Select an appropriate resistance value so that the load current is 80mA or less.

- When *Pr. 291* = "10, 11", the pulse cycle is 50% Duty (ON width and OFF width are the same).
- When *Pr. 291* = "20, 21, 100", fixed ON width of pulse is output (approx. 10μs).
- When the setting value is "100", the pulse train from the pulse train input (terminal JOG) is output as is. Use this value for synchronous speed operation of multiple inverters. (Refer to *page 239*)

* Hi indicates that the open collector output transistor is on.

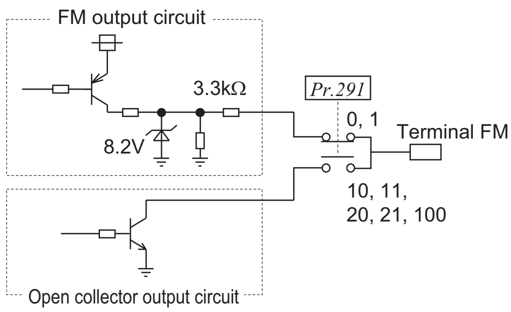
● High speed pulse train output specifications

Item	Specifications
Output method	NPN open collector output
Voltage between a collector and emitter	30V (max)
Maximum permissible load current	80mA
Output pulse rate	0 to 55kpps *
Output resolution	3pps (excluding a jitter)

* The output pulse rate is 50kpps when a monitor output value is 100%.

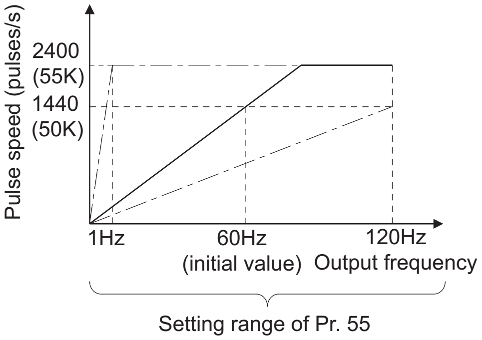
CAUTION

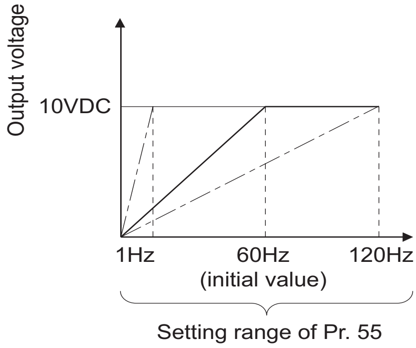
· Input specifications of terminal JOG (pulse train input or contact input) can be selected with *Pr. 291*.
Change the setting value using care not to change input specifications of terminal JOG. (Refer to *page 239* for pulse train input.)
· After changing a setting value of *Pr. 291*, connect a meter between terminal FM and SD. Take care that a voltage should not be applied to terminal FM when FM output (voltage output) pulse train is selected.
· The FM output of the inverter can not be connected to devices which have source logic type pulse input.
· When high speed pulse train output (*Pr. 291* = "10, 11, 20, 21, 100") is selected, performing parameter all clear returns the *Pr. 291* setting to the initial value of "0", changing the terminal FM output from high speed pulse train output to FM output (voltage output).



(2) Frequency monitoring reference *(Pr. 55)*

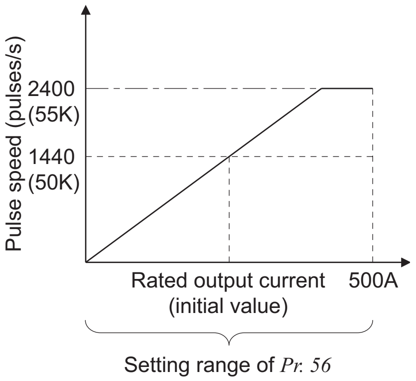
- Set the frequency to be based when the frequency is selected as the output of the terminal FM and terminal AM.
- Set the inverter output frequency (set frequency) at which the pulse speed of the terminal FM is 1440 pulses/s (50K pulses/s). The pulse speed and inverter output frequency are proportional to each other. Note that the maximum pulse train output is 2400 pulses/s (55K pulses/s).
- Set the reference value of the frequency at which the output voltage of the terminal AM is 10VDC.
- The output voltage and frequency are proportional to each other. (The maximum output voltage is 10VDC.)

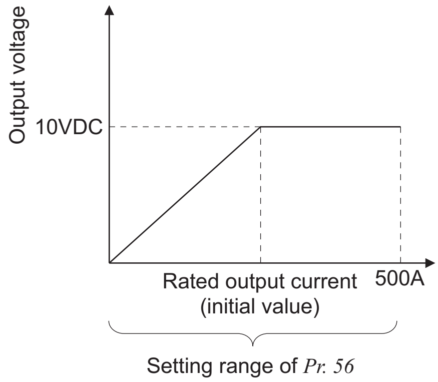




(3) Current monitoring reference *(Pr. 56)*

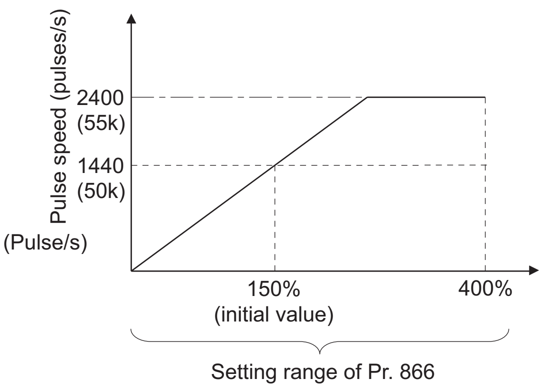
- Set the current at which the pulse speed of the terminal FM is 1440 pulses/s (50K pulses/s).
- The pulse speed and current value are proportional to each other. (The maximum pulse train output is 2400 pulses/s (55K pulses/s).)
- Set the reference value of the current at which the output voltage of the terminal AM is 10VDC.
- The output voltage and current value are proportional to each other. (The maximum output voltage is 10VDC.)

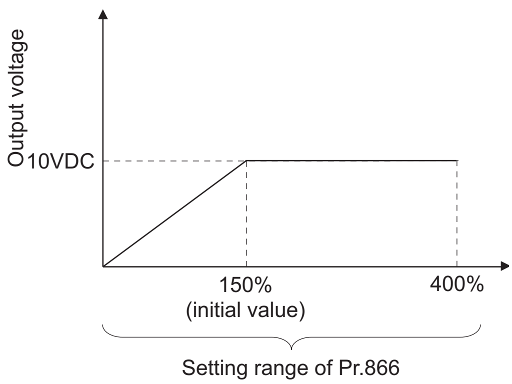




(4) Reference of torque monitor (*Pr. 866*) B3

- Set the torque at which the pulse speed of the terminal FM is 1440 pulses/s (50k pulses/s).
- Pulse speed and torque monitor value are proportional. (The maximum pulse train output is 2400 pulses/s (55k pulses/s).
- Set the torque reference value at which the output voltage of the terminal AM is 10VDC.
- Output voltage and torque monitor value are proportional. (The maximum output voltage is 10VDC.)





(5) Terminal AM response adjustment *(Pr. 867)*

- Using *Pr. 867*, the output voltage response of the terminal AM can be adjusted within the range 0 to 5s.
- Increasing the setting stabilizes the terminal AM output more but reduces the response level. (Setting "0" sets the response level to 4ms)

4.12.3 Terminal FM, AM calibration (Calibration parameter C0 (Pr. 900), C1 (Pr. 901))

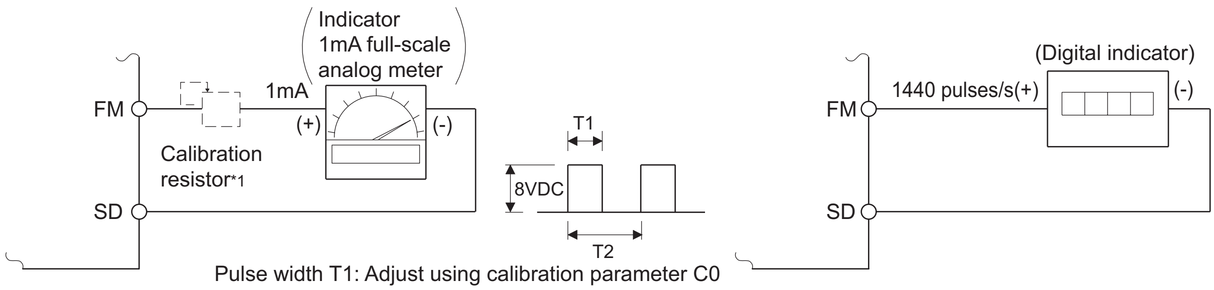
By using the operation panel or parameter unit, you can calibrate terminal FM and terminal AM to full scale deflection.

Parameter Number	Name	Initial Value	Setting Range	Description
C0(900)	FM terminal calibration	—	—	Calibrate the scale of the meter connected to terminal FM.
C1(901)	AM terminal calibration	—	—	Calibrate the scale of the analog meter connected to terminal AM.

*1 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).
*2 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) FM terminal calibration *(C0(Pr. 900))*

- The terminal FM is preset to output pulses. By setting the *Calibration parameter 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 by a digital counter. The monitor value is 1440 pulses/s output at the full-scale value of the table on the previous page *(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 (FR-DU07) or parameter unit (FR-PU04/FR-PU07) is used for calibration.
This resistor is used when calibration must be made near the frequency meter for such a reason as a remote frequency meter.
Note that the needle of the frequency meter may not deflect to full-scale when the calibration resistor is connected. In this case, use this resistor and operation panel or parameter unit together.
*2 The initial settings are 1mA full-scale and 1440 pulses/s terminal FM frequency at 60Hz.

- Calibrate the terminal FM in the following procedure.
  1) Connect an indicator (frequency meter) across the 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 output signal list *(page 137)* and set *Pr. 54*. When you selected the running frequency or inverter output current as the output signal, 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.

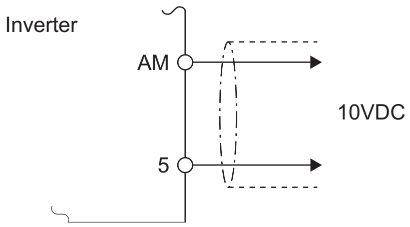
REMARKS

- When outputting such an item as the output current, which cannot reach a 100% value easily by operation, set *Pr. 54* to "21" (reference voltage output) and make calibration. 1440 pulses/s are output from the terminal FM.
- The wiring length of the terminal FM should be 200m maximum.

CAUTION

- The initial value of *the calibration parameter C0 (Pr. 900)* is set to 1mA full-scale and 1440 pulses/s FM output frequency at 60Hz. The maximum pulse train output of terminal FM is 2400 pulses/s.
- When a frequency meter is connected to across terminals FM-SD to monitor the running frequency, the FM terminal output is filled to capacity at the initial setting if the maximum output frequency reaches or exceeds 100Hz. In this case, the *Pr. 55* setting must be changed to the maximum frequency.
- When *Pr. 291 Pulse train I/O selection* = "10, 11, 20, 21, 100" (high speed pulse train output), calibration using *calibration parameter C0 (Pr. 900)* can not be made.

(2) AM terminal calibration *(C1 (Pr. 901))*



· Terminal AM is factory-set to provide a 10VDC output in the full-scale status of the corresponding monitor item. *Calibration parameter C1 (Pr. 901)* allows the output voltage ratios (gains) to be adjusted according to the meter scale. Note that the maximum output voltage is 10VDC.

· Calibrate the AM terminal in the following procedure.

1) Connect a 0-10VDC meter (frequency meter) to across inverter terminals AM-5. (Note the polarity. The terminal AM is positive.)
2) Refer to the monitor description list *(page 137)* and set *Pr. 158*.
   When you selected the running frequency, inverter output current, etc. as monitor, preset in *Pr. 55* or *Pr. 56* the running frequency or current value at which the output signal will be 10V.
3) When outputting the item that cannot achieve a 100% value easily by operation, e.g. output current, set "21" (reference voltage output) in *Pr. 158* and perform the following operation. After that, set "2" (output current, for example) in *Pr. 158*.

REMARKS

· When outputting such an item as the output current, which cannot reach a 100% value easily by operation, set *Pr. 54* to "21" (reference voltage output) and make calibration. 10VDC is output from the terminal AM.

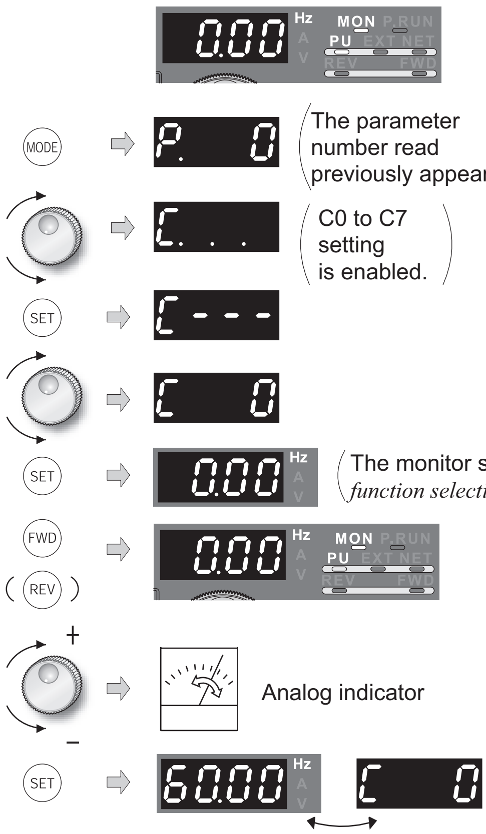
(3) How to calibrate the terminal FM when using the operation panel (FR-DU07)

Operation

1. Confirmation of the RUN indication and operation mode indication
2. Press (MODE) to choose the parameter setting mode.
3. Turn (dial) until C. . . appears.
4. Press (SET) to display C - - - .
5. Turn (dial) until C 0 appears.
   Set to *C0 FM terminal calibration*.
6. Press (SET) to enable setting.
7. If the inverter is at a stop, (press (FWD) or (REV)) to start the inverter.
   (Motor needs not be connected.)
8. Turn (dial) to adjust the indicator needle to the desired position.
9. Press (SET). Setting is complete.

Display

(When Pr. 54=1)



(The parameter number read previously appears.)

(C0 to C7 setting is enabled.)

(The monitor set to *Pr. 54 FM terminal function selection* is displayed.)

Analog indicator

Flicker...Parameter setting complete!!

- By turning (dial), you can 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

- Calibration can also be made for external operation. Set the frequency in external operation mode, and make calibration in the above procedure.
- Calibration can be made even during operation.
- For the operating procedure using the parameter unit (FR-PU04/FR-PU07), refer to the parameter unit instruction manual.

♦ **Parameters referred to** ♦

Pr. 54 FM terminal function selection ☞ *Refer to page 137*
Pr. 55 Frequency monitoring reference ☞ *Refer to page 142*
Pr. 56 Current monitoring reference ☞ *Refer to page 142*
Pr. 158 AM terminal function selection ☞ *Refer to page 137*
Pr. 291 Pulse train I/O selection ☞ *Refer to page 239*

4.13 Operation selection at power failure and instantaneous power failure

Purpose	Parameter that must be Set		Refer to Page
At instantaneous power failure occurrence, restart inverter without stopping motor	**Automatic restart operation after instantaneous power failure/flying start**	**Pr. 57, Pr. 58, Pr. 162 to Pr. 165, Pr. 299, Pr. 611**	148
When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.	**Power failure-time deceleration-to-stop function**	**Pr. 261 to Pr. 266, Pr. 294**	152

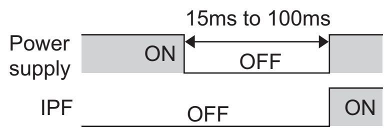
4.13.1 Automatic restart after instantaneous power failure/flying start (Pr. 57, Pr. 58, Pr. 162 to Pr. 165, Pr. 299, Pr. 611)

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
				FR-B	FR-B3	
57	**Restart coasting time**	9999		0		· 1.5K or less .... 0.5s, · 2.2K to 7.5K .... 1s, · 11K to 55K .... 3.0s, · 75K or more .... 5.0s, The above times are coasting time.
				0.1 to 5s/ 0.1 to 30s *	0.1 to 5s	Set the waiting time for inverter-triggered restart after an instantaneous power failure.
				9999		No restart
58	**Restart cushion time**	1s		0 to 60s		Set a voltage starting time at restart.
162	**Automatic restart after instantaneous power failure selection**	0		0		With frequency search
				1		Without frequency search (reduced voltage system)
				2		Encoder detection frequency search
				10		Frequency search at every start
				11		Reduced voltage system at every start
				12		Encoder detection frequency search at every start
163	**First cushion time for restart**	0s		0 to 20s		Set a voltage starting time at restart. Consider using these parameters according to the load (moment of inertia, torque) magnitude.
164	**First cushion voltage for restart**	0%		0 to 100%		
165	**Stall prevention operation level for restart**	150%		0 to 220%		Consider the rated inverter current as 100% and set the stall prevention operation level during restart operation.
299	**Rotation direction detection selection at restarting**	0		0		Without rotation direction detection
				1		With rotation direction detection
				9999		When *Pr. 78* = "0", the rotation direction is detected. When *Pr. 78* = "1","2", the rotation direction is not detected.
611	**Acceleration time at a restart**	55K or less	5s	0 to 3600s, 9999		Set the acceleration time to reach the set frequency at a restart. Acceleration time for restart is the normal acceleration time (e.g. *Pr. 7*) when "9999" is set.
		75K or more	15 s			

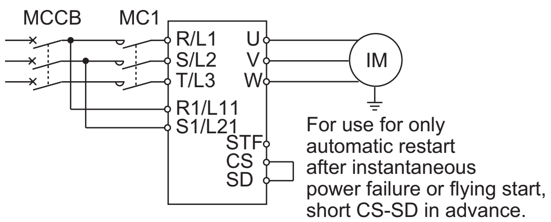
* The setting range differs according to the inverter capacity. (55K or less/75K or more)

(1) Automatic restart after instantaneous power failure operation



- When instantaneous power failure protection (E.IPF) and undervotage protection (E.UVT) are activated, the inverter output is shut off. (Refer to *page 272* for E.IPF and E.UVT.)
  When automatic restart after instantaneous power failure operation is set, the motor can be restarted if power is restored after an instantaneous power failure or undervoltage is corrected. (E.IPF and E.UVT are not activated.)
- When E.IPF and E.UVT are activated, instantaneous power failure/under voltage signal (IPF) is output.
- The IPF signal is assigned to the terminal IPF in the initial setting. The IPF signal can also be assigned to the other terminal by setting "2 (positive logic) or 102 (negative logic)" to any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

(2) Connection (CS signal)

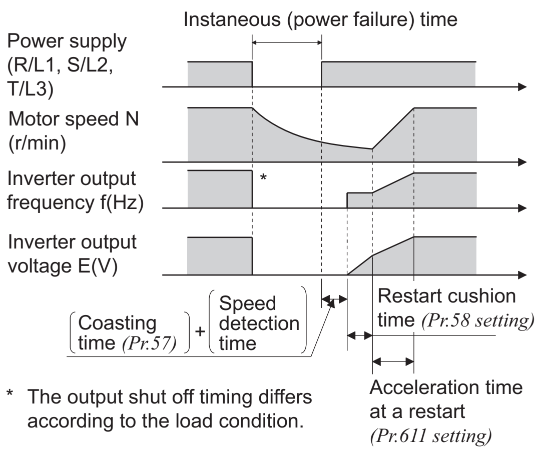


- When the automatic restart after instantaneous power failure selection signal (CS) is turned on, automatic restart operation is enabled.
- When *Pr. 57* is set to other than "9999" (automatic restart operation enabled), the inverter will not operate if used with the CS signal remained off.

REMARKS
- The CS signal is assigned to the terminal CS in the initial setting. By setting "6" in any of *Pr. 178 to Pr. 189 (input terminal function selection)*, you can assign the CS signal to the other terminal.

(3) Automatic restart operation selection *(Pr. 162, Pr. 299)*

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



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

● With frequency search

When "0 (initial value), 10" is set in *Pr. 162*, the inverter smoothly starts after detecting the motor speed upon power restoration.
- 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*.

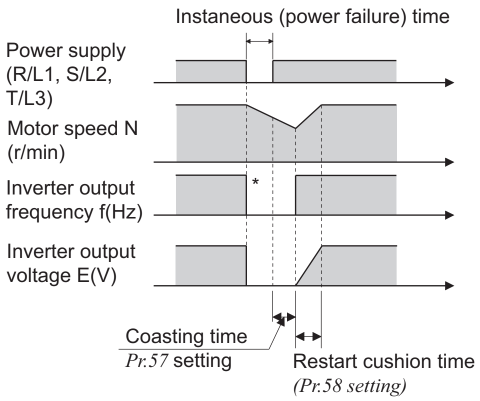
Pr. 299 Setting	*Pr. 78* Setting		
	0	1	2
9999	○	×	×
0 (initial value)	×	×	×
1	○	○	○

○:with rotation direction detection
×:without rotation direction detection

REMARKS
- Speed detection time (frequency search) changes according to the motor speed. (maximum 500ms)
- If two or more motors are connected to one inverter, the inverter functions abnormally. (The inverter does not start smoothly.)
- 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.
- When reverse rotation is detected when *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.

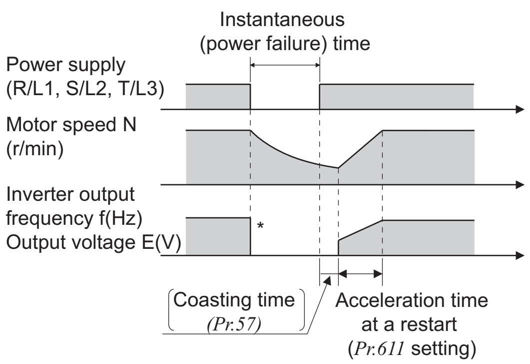
4
PARAMETERS

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



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

●When *Pr. 162* = 2, 12 (encoder detection frequency search)



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

● **Without frequency search**

When *Pr. 162* = "1" 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 prior to an instantaneous power failure and increases the voltage. Therefore, if the instantaneous power failure time exceeds 0.2s, the inverter starts at *Pr. 13 Starting frequency* (initial value = 0.5Hz) since the stored output frequency cannot be retained.

● **Encoder detection frequency search**

· When "2 or 12" is set in *Pr. 162* under encoder feedback control, the motor starts at the motor speed and in the rotation direction detected from the encoder at power restoration.
· The *Pr. 58* and *Pr. 299* settings are invalid for encoder detection frequency search.

REMARKS

· When encoder feedback control is invalid, setting "2 or 12" in *Pr. 162* enables frequency search (*Pr. 162* = "0, 10").

● **Restart operation at every start**

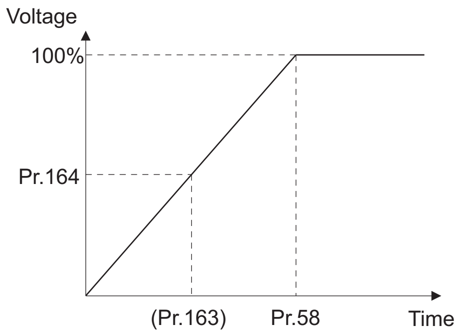
When *Pr. 162* = "10, 11 or 12", automatic restart operation is also performed every start, in addition to the automatic restart after instantaneous power failure. When *Pr. 162* = "0" or "2", automatic restart operation is performed at the first start after power supply-on, but the inverter starts at the starting frequency at the second time or later.

(4) 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.
1500 or less . . . . . 0.5s, 2200 to 7.5K . . . . . 1s, 11K to 55K . . . . 3.0s, 75K or more 5.0s
· Operation may not be performed well depending on the magnitude of the moment (J) of inertia of the load or running frequency. Adjust the coasting time between 0.1s and 5s according to the load specifications.

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

· Cushion time is the length of time taken to raise the voltage appropriate to the detected motor speed (output frequency prior to instantaneous power failure when *Pr. 162* = "1" or "11").
· Normally the initial value need not be changed for operation, but adjust it according to the magnitude of the moment (J) of inertia of the load or torque.
· *Pr. 58* is invalid during encoder feedback control (*Pr. 162* = "2, 12").



(6) Automatic restart operation adjustment *(Pr. 163 to Pr. 165, Pr. 611)*

· Using *Pr. 163* and *Pr. 164*, you can adjust the voltage rise time at a restart as shown on the left.
· Using *Pr. 165*, you can set the stall prevention operation level at a restart.
· Using *Pr. 611*, you can set the acceleration time until the set frequency is reached after automatic restart operation is performed besides the normal acceleration time.

REMARKS

· If the setting of *Pr. 21 Acceleration/deceleration time increments* is changed, the setting increments of *Pr. 611* does not change.

CAUTION

· Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.
· When automatic restart operation is selected, undervotage protection (E.UVT) and instantaneous power failure protection (E.IPF) among the alarm output signals will not be provided at occurrence of an instantaneous power failure.
· The SU and FU signals are not output during a restart. They are output after the restart cushion time has elapsed.
· Automatic restart operation will also be performed after a reset made by an inverter reset is canceled or when a retry is made by the retry function.
· Automatic restart after instantaneous power failure function is invalid when load torque high speed frequency control (*Pr. 270* = "2, 3") is set.

⚠ 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).

♦ Parameters referred to ♦

Pr. 7 Acceleration time, Pr. 21 Acceleration/deceleration time increments ☞ *Refer to page 88*
Pr. 13 Starting frequency ☞ *Refer to page 90*
Pr. 65, Pr. 67 to Pr. 69 Retry function ☞ *Refer to page 155*
Pr. 78 Reverse rotation prevention selection ☞ *Refer to page 180*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*

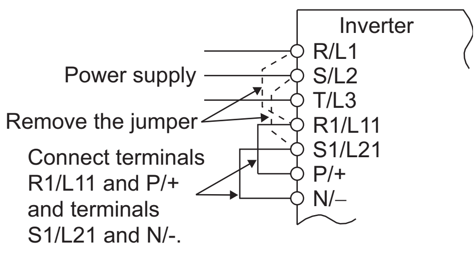
4.13.2 Power failure-time deceleration-to-stop function (Pr. 261 to Pr. 266, Pr. 294)

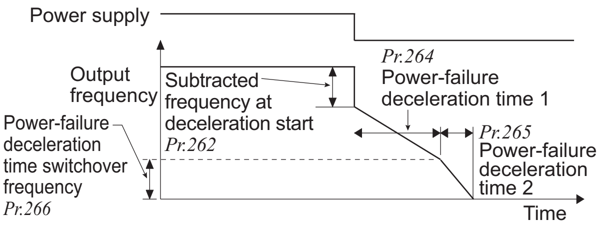
When a power failure or undervoltage occurs, the inverter can be decelerated to a stop or can be decelerated and re-accelerated to the set frequency.

Parameter Number	Name	Initial Value	Setting Range FR-B	Setting Range FR-B3	Description	
261	**Power failure stop selection**	0	0		Coasting to stop When undervoltage or power failure occurs, the inverter output is shut off.	
			1		Without under voltage avoidance	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.
			11		With under voltage avoidance	
			2		Without under voltage avoidance	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop. If power is restored during a power failure, the inverter accelerates again.
			12		With under voltage avoidance	
262	**Subtracted frequency at deceleration start**	3Hz	0 to 20Hz		Normally operation can be performed with the initial value unchanged. But adjust the frequency according to the magnitude of the load specifications (moment of inertia, torque).	
263	**Subtraction starting frequency**	60Hz	0 to 120Hz/ 0 to 60Hz *2	0 to 120Hz	When output frequency ≥ *Pr. 263* Decelerate from the speed obtained from output frequency minus *Pr. 262*. When output frequency < *Pr. 263* Decelerate from output frequency	
			9999		Decelerate from the speed obtained from output frequency minus *Pr. 262*.	
264	**Power-failure deceleration time 1**	5s	0 to 3600/ 360s *1		Set a deceleration slope down to the frequency set in *Pr. 266*.	
265	**Power-failure deceleration time 2**	9999	0 to 3600/ 360s *1		Set a deceleration slope below the frequency set in *Pr. 266*.	
			9999		Same slope as in *Pr. 264*	
266	**Power failure deceleration time switchover frequency**	60Hz	0 to 120Hz/ 0 to 60Hz *2	0 to 120Hz	Set the frequency at which the deceleration slope is switched from the *Pr. 264* setting to the *Pr. 265* setting.	
294	**UV avoidance voltage gain**	100%	0 to 200%		Adjust the response level during undervoltage avoidance operation. A larger setting will improve responsiveness to the bus voltage change.	

*1 When the setting of *Pr. 21 Acceleration/deceleration time increments* is "0" (initial value), the setting range is "0 to 3600s" and the setting increments are "0.1s", and when the setting is "1", the setting range is "0 to 360s" and the setting increments are "0.01s"

*2 The setting range differs according to the inverter capacity. (22K or less/30K or more)



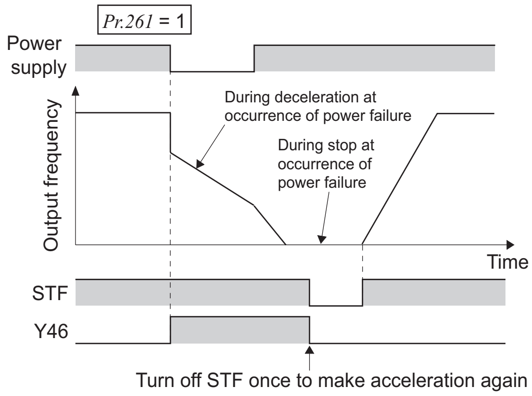


(1) Connection and parameter setting

- Remove the jumpers across terminals R/L1-R1/L11 and across terminals S/L2-S1/L21, and connect terminals R1/L11 and P/+ and terminals S1/L21 and N/-.
- 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

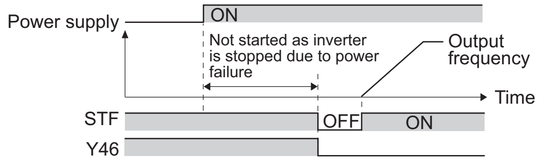
- If an undervoltage or power failure occurs, the output frequency is dropped by the frequency set in *Pr. 262* .
- Deceleration is made in the deceleration time set in *Pr. 264*. (The deceleration time setting is the time required from *Pr. 20 Acceleration/deceleration reference frequency* to a stop.)
- When the frequency is low and enough regeneration energy is not provided, for example, the deceleration time (slope) from *Pr. 265* to a stop can be changed.



(3) Power failure stop mode (*Pr. 261* = "1, 11")

· If power is restored during power failure deceleration, deceleration to a stop is continued and the inverter remains stopped. To restart, turn off the start signal once, then turn it on again.

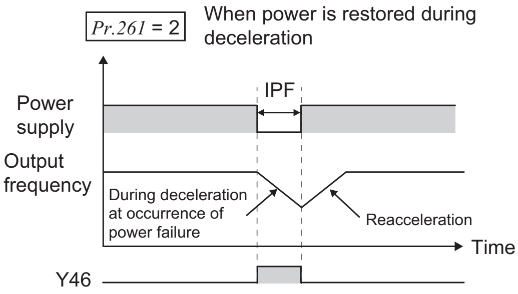
REMARKS

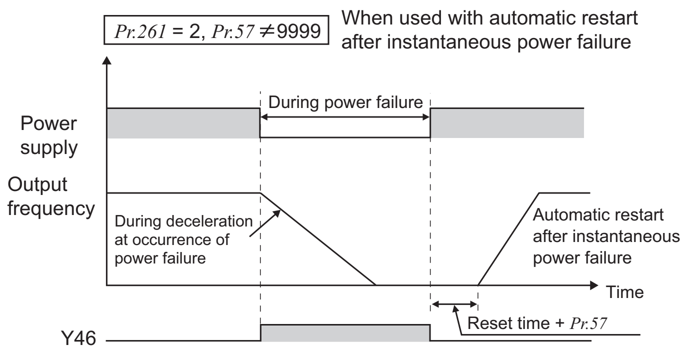


· When automatic restart after instantaneous power failure is selected (*Pr. 57* ≠ "9999"), deceleration to stop function is invalid and the restart after instantaneous power failure operation is performed.
· After a power failure stop, the inverter will not start if the power supply is switched on with the start signal (STF/STR) input. After switching on the power supply, turn off the start signal once and then on again to make a start.

(4) Original operation continuation at instantaneous power failure function (*Pr. 261* = "2, 12")

· When power is restored during deceleration after an instantaneous 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 operation, deceleration can be made at a power failure and acceleration can be made again after power restoration. When power is restored after a stop by deceleration at an instantaneous power failure, automatic restart operation is performed if automatic restart after instantaneous power failure has been selected (*Pr. 57* ≠ "9999")





(5) Undervoltage avoidance function (*Pr. 261* = "11, 12", *Pr. 294*)

· When *Pr. 261* = "11, 12", the deceleration time is automatically adjusted (shortened) to prevent undervoltage from occuring during deceleration at an instantaneous power failure.
· Adjust the slope of frequency decrease and response level with *Pr. 294*. A larger setting will improve responsiveness to the bus voltage.
Since the regeneration amount is large when the inertia is large, decrease the setting value.

(6) Power failure deceleration signal (Y46 signal)

- After deceleration at an instantaneous power failure, inverter can not start even if the start command is given. In this case, check the power failure deceleration signal (Y46 signal). (at occurrence of input phase failure protection (E.ILF), etc.)
- The Y46 signal is on during deceleration at an instantaneous power failure or during a stop after deceleration at an instantaneous power failure.
- For the Y46 signal, set "46 (positive logic)" or "146 (negative logic)" in any of *Pr. 190 to Pr. 196 (output terminal function selection)* to assign the function.

REMARKS

When *Pr. 872* = "1" (input phase failure protection provided) and *Pr. 261* ≠ "0" (power failure stop function valid), input phase failure protection (E.ILF) is not provided but power-failure deceleration is made.

CAUTION

- When *Pr. 30 Regenerative function selection* = "2" (MT-HC is used), the power failure deceleration function is invalid.
- When the (output frequency - *Pr. 262*) at undervoltage or power failure occurrence is negative, the calculation result is regarded as 0Hz. (DC injection brake operation is performed without deceleration).
- During a stop or error, the power failure stop selection is not performed.
- Changing the terminal assignment using *Pr. 190 to Pr. 196 (output terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.

⚠ CAUTION

⚠ If power-failure deceleration operation is set, some loads may cause the inverter to trip and the motor to coast. The motor will coast if enough regenerative energy is given from the motor.

♦ Parameters referred to ♦

Pr. 12 DC injection brake operation voltage ☞ *Refer to page 100*
Pr. 20 Acceleration/deceleration reference frequency, Pr. 21 Acceleration/deceleration time increments ☞ *Refer to page 88*
Pr. 30 Regenerative function selection ☞ *Refer to page 102*
Pr. 57 Restart coasting time ☞ *Refer to page 148*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*
Pr. 872 Input phase failure protection selection ☞ *Refer to page 158*

4.14 Operation setting at alarm occurrence

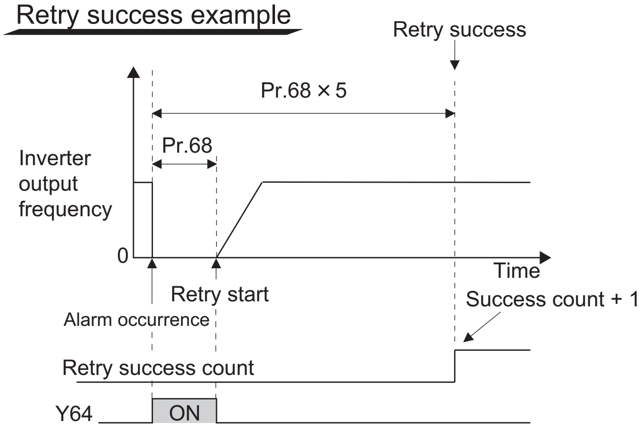
Purpose	Parameter that must be Set		Refer to Page
Recover by retry operation at alarm occurrence	Retry operatoin	Pr. 65, Pr. 67 to Pr. 69	155
Output alarm code from terminal	Alarm code output function	Pr. 76	157
Do not output input/output phase failure alarm	Input/output phase failure protection selection	Pr. 251, Pr. 872	158
The motor is decelerated to stop at motor thermal activation	Fault definition	Pr. 875	159

4.14.1 Retry function (Pr. 65, Pr. 67 to Pr. 69)

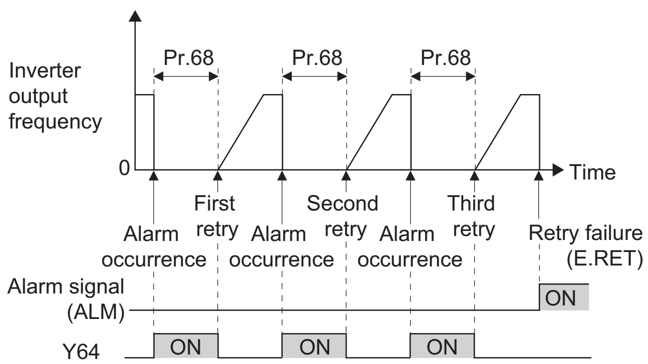
If an alarm occurs, the inverter resets itself automatically to restart. You can also select the alarm description for a retry.
When automatic restart after instantaneous power failure is selected (*Pr. 57 Restart coasting time* ≠ "9999"), restart operation is performed at retry operation as at an instantaneous power failure. (Refer to *page 148* for the restart function.)

Parameter Number	Name	Initial Value	Setting Range	Description
65	Retry selection	0	0 to 5	An alarm for retry can be selected. *(Refer to the next page)*
67	Number of retries at alarm occurrence	0	0	No retry function
			1 to 10	Set the number of retries at alarm occurrence. An alarm output is not provided during retry operation.
			101 to 110	Set the number of retries at alarm occurrence. (The setting value of minus 100 is the number of retries.) An alarm output is provided during retry operation.
68	Retry waiting time	1s	0 to 10s	Set the waiting time from when an inverter alarm occurs until a retry is made.
69	Retry count display erase	0	0	Clear the number of restarts succeeded by retry.

Retry success example



Retry failure example



- Retry operation automatically resets an alarm and restarts the inverter at the starting frequency when the time set in *Pr. 68* elapses after the inverter stopped due to the alarm.
- Retry operation is performed by setting *Pr. 67* to any value other than "0". Set the number of retries at alarm occurrence in *Pr. 67*.
- When retries fail consecutively more than the number of times set in *Pr. 67* , a retry count excess alarm (E.RET) occurs, stopping the inverter output.
  (Refer to retry failure example)
- Use *Pr. 68* to set the waiting time from when an inverter alarm occurs until a retry is made in the range 0 to 10s. (When the setting value is "0s", the actual time is 0.1s.)
- 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 alarms occurring for more than four times longer than the time set in *Pr. 68* after a retry start.
- Writing "0" in *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 logic)" or "164 (negative logic)" in any of *Pr. 190 to Pr. 196 (output terminal fnction selection)* .

CAUTION

When terminal assignment is changed using *Pr. 190 to Pr. 196*, the other functions may be affected. Please make setting after confirming the function of each terminal.

· Using *Pr. 65* you can select the alarm that will cause a retry to be executed. No retry will be made for the alarm not indicated. (Refer to *page 266* for the alarm description.)
● indicates the errors selected for retry.

Alarm Display 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.IPF	●				●	
E.UVT	●				●	
E. BE	●				●	
E. GF	●				●	
E.OHT	●					
E.OLT	●				●	
E.OPT	●				●	
E.OP3	●				●	

Alarm Display for Retry	*Pr. 65* Setting					
	0	1	2	3	4	5
E. PE	●				●	
E.MB1	●				●	
E.MB2	●				●	
E.MB3	●				●	
E.MB4	●				●	
E.MB5	●				●	
E.MB6	●				●	
E.MB7	●				●	
E.OS	●				●	
E.PTC	●					
E.CDO	●				●	
E.SER	●				●	
E.ILF	●				●	

CAUTION

· For a retry error, only the description of the first alarm is stored.
· When an inverter alarm is reset by the retry function at the retry time, the accumulated data of the electronic thermal relay function, regeneration converter duty etc. are not cleared. (Different from the power-on reset.)

⚠ CAUTION

⚠ When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the reset time has elapsed) after occurrence of an alarm.
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 148*

4.14.2 Alarm code output selection (Pr. 76)

At alarm occurrence, its description can be output as a 4-bit digital signal from the open collector output terminals.The alarm code can be read by a programmable controller, etc., and its corrective action can be shown on a display, etc.

Parameter Number	Name	Initial Value	Setting Range	Description
76	**Alarm code output selection**	0	0	Without alarm code output
			1	With alarm code output *(Refer to the following table)*
			2	Alarm code output at alarm occurrence only *(Refer to the following table)*

- By setting *Pr. 76* to "1" or "2", the alarm code can be output to the output terminals.
- When the setting is "2", an alarm code is output at only alarm occurrence, and during normal operation, the terminals output the signals assigned to *Pr. 190 to Pr. 196 (output terminal function selection)*.
- The following table indicates alarm codes to be output. (0: output transistor off, 1: output transistor on)

Operation Panel Indication (FR-DU07)	Output of Output Terminals				Alarm Code
	SU	IPF	OL	FU	
Normal *	0	0	0	0	0
E.OC1	0	0	0	1	1
E.OC2	0	0	1	0	2
E.OC3	0	0	1	1	3
E.OV1 to E.OV3	0	1	0	0	4
E.THM	0	1	0	1	5
E.THT	0	1	1	0	6
E.IPF	0	1	1	1	7
E.UVT	1	0	0	0	8
E.FIN	1	0	0	1	9
E. BE	1	0	1	0	A
E. GF	1	0	1	1	B
E.OHT	1	1	0	0	C
E.OLT	1	1	0	1	D
E.OPT	1	1	1	0	E
E.OP3	1	1	1	0	E
Other than the above	1	1	1	1	F

* When *Pr. 76* = "2", the output terminals output the signals assigned to *Pr. 190 to Pr. 196* .

CAUTION

- When a value other than "0" is set in *Pr. 76*
  When an alarm occurs, the output terminals SU, IPF, OL, FU output the signal in the above table, independently of the *Pr. 190 to Pr. 196 (output terminal function selection)* settings. Please be careful when inverter control setting has been made with the output signals of *Pr. 190 to Pr. 196*.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*

4.14.3 Input/output phase failure protection selection (Pr. 251, Pr. 872)

You can disable the output phase failure protection function that stops the inverter output if one of the inverter output side (load side) three phases (U, V, W) opens.
The input phase failure protection function of the inverter input side (R/L1, S/L2, T/L3) can be made valid.

Parameter Number	Name	Initial Value	Setting Range	Description
251	**Output phase failure protection selection**	1	0	Without output phase failure protection
			1	With output phase failure protection
872	**Input phase failure protection selection**	0	0	Without input phase failure protection
			1	With input phase failure protection

(1) Output phase failure protection selection *(Pr. 251)*

· When *Pr. 251* is set to "0", output phase failure protection (E.LF) becomes invalid.

(2) Input phase failure protection selection *(Pr. 872)*

· When *Pr. 872* is set to "1", input phase failure protection (E.ILF) is provided if a phase failure of one phase among the three phases is detected for 1s continuously.

REMARKS

If an input phase failure has occurred when *Pr. 872* = "1" (input phase failure protected) and a value other than "0" (power failure stop function valid) is set in *Pr. 261*, input phase failure protection (E.ILF) is not provided but power-failure deceleration is made.

CAUTION

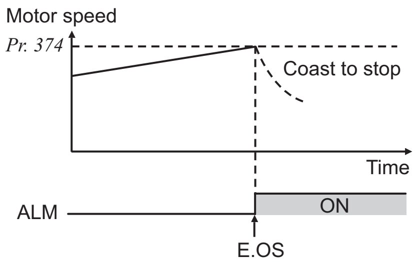
· When an input phase failure occurs in the R/L1 and S/L2 phases, input phase failure protection is not provided but the inverter output is shut off.
· If an input phase failure continues for a long time, the converter section and capacitor lives of the inverter will be shorter.

♦ Parameters referred to ♦

Pr. 261 Power failure stop selection ☞ *Refer to page 152*

4.14.4 Overspeed detection (Pr. 374)

Parameter Number	Name	Initial Value	Setting Range	Description
374	**Overspeed detection level**	140Hz	0 to 400Hz	When the motor speed reaches or exceeds the speed set in *Pr. 374* during encoder feedback control, real sensorless vector control, or vector control, over speed (E.OS) occurs and stops the inverter output.



4.14.5 Encoder signal loss detection (Pr. 376)

When the encoder signal is lost during encoder feedback control, orientation control, signal loss detection (E.ECT) is activated to stop the inverter output.

Parameter Number	Name	Initial Value	Setting Range	Description
376	**Encoder signal loss detection enable/disable selection**	0	0	Signal loss detection is invalid
			1	Signal loss detection is valid

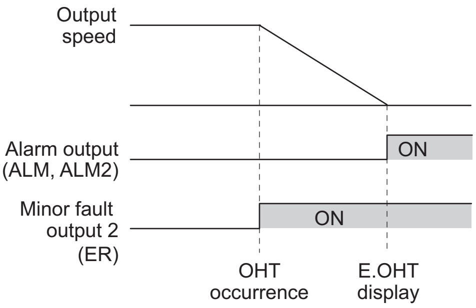
* Setting can be made only when the FR-A7AP is mounted.

4.14.6 Fault definition (Pr. 875)

When motor thermal protection is activated, an alarm can be output after the motor decelerates to a stop.

Parameter Number	Name	Initial Value	Setting Range	Description
875	**Fault definition**	0	0	Normal operation
			1	The motor decelerates to stop when motor thermal protection is activated.

When *Pr.875* = "1"



(1) Output is immediately shutoff at occurrence of any alarm (setting value is "0", initial value)

- Output is immediately shutoff and an alarm output is provided at alarm occurrence.

(2) The motor decelerates to stop when motor thermal protection is activated (setting value is "1")

- When external thermal relay E.OHT (OHT), motor overload shutoff (electronic thermal relay function) E.THM (THM) or PTC thermistor E.PTC (PTC) is activated, turning on the minor fault output 2 signal (ER) starts the motor to decelerate and an alarm is provided after deceleration to a stop.
- When the ER signal turns on, decrease load, etc. to allow the inverter to decelerate.
- At occurrence of an alarm other than OHT, THM and PTC, output is immediately shut off and an alarm is output.
- Set "97 (positive logic) or 197 (negative logic)" in *Pr. 190 to Pr. 196 (output terminal function selection)* and assign the ER signal to the output terminal.

CAUTION

- The value "0" is recommended for the system in which the motor continues running without deceleration due to a large torque on the load side.
- Changing the terminal assignment using *Pr. 190 to Pr. 196 (output terminal function selection)* may affect the other functions. Make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*

4.15 Energy saving operation and energy saving monitor

Purpose	Parameter that must be Set		Refer to Page
How much energy can be saved	**Energy saving monitor**	**Pr. 52, Pr. 54, Pr. 158, Pr. 891 to Pr. 899**	160

4.15.1 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
			FR-B	FR-B3	
52	**DU/PU main display data selection**	0 (output frequency)	0, 5, 6, 8 to 14, 17 to 20, 22 to 25, 50 to 57, 100	0, 5 to 14, 17 to 20, 22 to 25, 34, 50 to 57, 100	50:Power saving monitor 51:Cumulative saving power monitor
54	**FM terminal function selection**	1 (output frequency)	1 to 3, 5, 6, 8 to 14, 17, 18, 21, 24, 50, 52, 53	1 to 3, 5 to 14, 17, 18, 21, 24, 50, 52, 53	50:Power saving monitor
158	**AM terminal function selection**				
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 monitoring 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 163)* during commercial power supply operation.
893	**Energy saving monitor reference (motor capacity)**	Inverter rated capacity	0.1 to 55kW/0 to 3600kW *		Set the motor capacity (pump capacity). Set when calculating power saving rate, power saving rate average value, 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		Set the power unit cost. Displays the power saving amount charge 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		Totalization continued (communication data upper limit 9999)
			9999		Totalization continued (communication data upper limit 65535)
899	**Operation time rate (estimated value)**	9999	0 to 100%		Use for calculation of annual power saving amount. Set the annual operation ratio (consider 365 days × 24hr as 100%).
			9999		No function

The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.
* The setting range differs according to the inverter capacity. (55K or less/75K or more)

(1) Energy saving monitor list

· The following provides the items that can be monitored by the power saving monitor (*Pr. 52, Pr. 54, Pr. 158* = "50"). (Only 1) power saving and 3) power saving average value can be output to *Pr. 54* (terminal FM) and *Pr. 158* (terminal AM))

	Energy Saving Monitor Item	Description and Formula	Increments	Parameter Setting *Pr. 895*	*Pr. 896*	*Pr. 897*	*Pr. 899*
1)	**Power saving**	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**	0.01kW/ 0.1kW *3	9999	—	9999	—
2)	**Power saving rate**	Ratio of power saving on the assumption that power during commercial power supply operation is 100% $\frac{\textbf{1) Power saving}}{\textbf{Power during commercial power supply operation}} \times \mathbf{100}$	0.1%	0			
		Ratio of power saving on the assumption that *Pr. 893* is 100% $\frac{\textbf{1) Power saving}}{\textit{Pr. 893}} \times \mathbf{100}$		1			
3)	**Power saving average value**	Average value of power saving amount per hour during predetermined time (*Pr. 897*) $\frac{\Sigma(\textbf{ 1) Power saving} \times \Delta\mathbf{t})}{\textit{Pr. 897}}$	0.01kWh /0.1kWh *3	9999	9999	0 to 1000h	
4)	**Power saving rate average value**	Ratio of power saving average value on the assumption that the value during commercial power supply operation is 100% $\frac{\Sigma(\textbf{ 2) Power saving rate} \times \Delta\mathbf{t})}{\textit{Pr. 897}} \times \mathbf{100}$	0.1%	0			
		Ratio of power saving average value on the assumption that *Pr. 893* is 100% $\frac{\textbf{3) Power saving average value}}{\textit{Pr. 893}} \times \mathbf{100}$		1			
5)	**Power saving amount average value**	Power saving average value represented in terms of charge **3) Power saving average value** × ***Pr. 896***	0.01/0.1 *3	—	0 to 500		

· The following shows the items which can be monitored by the cumulative saving power monitor (*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*.)

	Energy Saving Monitor Item	Description and Formula	Increments	Parameter Setting *Pr. 895*	*Pr. 896*	*Pr. 897*	*Pr. 899*
6)	**Power saving amount**	Power saving is added up per hour. $\Sigma(\textbf{ 1) Power saving} \times \Delta\mathbf{t})$	0.01kWh /0.1kWh *1*2*3	—	9999	—	9999
7)	**Power saving amount charge**	Power saving amount represented in terms of charge **6) Power saving amount** × ***Pr. 896***	0.01/0.1 *1*3	—	0 to 500		
8)	**Annual power saving amount**	Estimated value of annual power saving amount $\frac{\textbf{6) Power saving amount}}{\textbf{Operation time during accumulation of power saving amount}} \times \mathbf{24} \times \mathbf{365} \times \frac{\textit{Pr. 899}}{\mathbf{100}}$	0.01kWh /0.1kWh *1*2*3	—	9999		0 to 100%
9)	**Annual power saving amount charge**	Annual power saving amount represented in terms of charge **8) Annual power saving amount** × ***Pr. 896***	0.01/0.1 *1*3	—	0 to 500		

*1 For communication (RS-485 communication, communication option), the display increments are 1. For example, the communication data is "10" for "10.00kWh".

*2 When using the parameter unit (FR-PU04/FR-PU07), "kW" is displayed.

*3 The setting depends on capacities. (55K or less/75K or more)

REMARKS

· As the operation panel (FR-DU07) is 4-digit display, it displays in 0.1 increments since a carry occurs, e.g. "100.0", when a monitor value in 0.01 increments exceeds "99.99". 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".

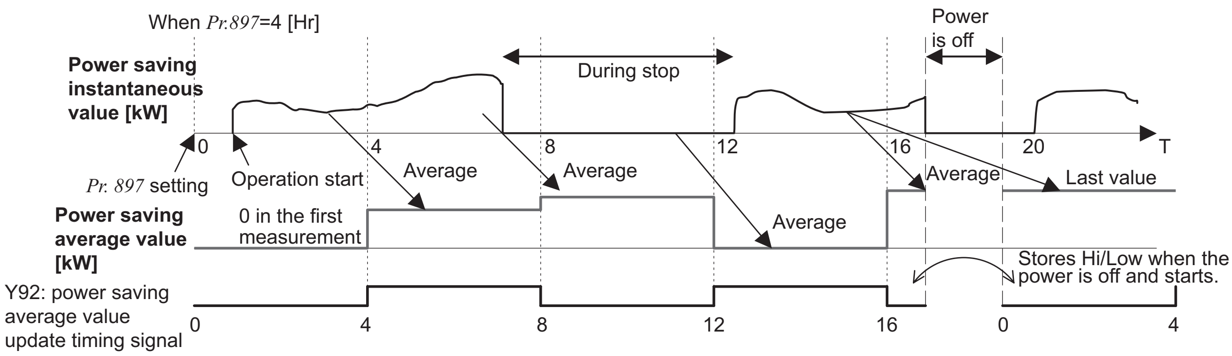
· The upper limit of communication (RS-485 communication, communication option) is "65535" when *Pr. 898 Power saving cumulative monitor clear* = "9999". The upper limit of 0.01 increments monitor is "655.35" and that of 0.1 increments monitor is "6553.5".

(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) Power saving average value monitor (3) power saving average value, 4) average power saving rate average value, 5) power saving amount average value)

- Power saving average value monitor can be displayed when a value other than "9999" is set in *Pr. 897 Power saving monitor average time*.
- The power saving average value monitor (3)) displays the average value per unit time 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.



- The power saving average value monitor (4)) displays the average value per unit time of power saving rate (2)) at every average time by setting "0" or "1" in *Pr. 895 Power saving rate reference value*.
- By setting the charge (power unit) per 1kWh of power amount in *Pr. 896 Power unit cost*, the power saving amount average value monitor (5)) displays the charge relative to the power saving average value (power saving average value (3)) × *Pr. 896*).

(4) Cumulative saving power monitor (6) power saving amount, 7) power saving amount charge, 8) annual power saving amount, 9) annual power saving amount charge)

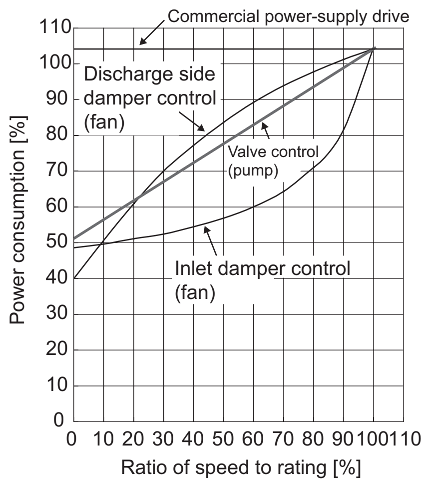
- On the cumulative saving power monitor, the monitor data digit can be shifted to the right by the number of *Pr. 891 Cumulative power monitor digit shifted times* settings. For example, if the cumulative power value is 1278.56kWh when *Pr. 891* = "2", the PU/DU display is 12.78 (display in 100kWh increments) 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 is 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 saving power 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 saving power monitor value and start totalization of power saving.
  3) Write "1" in *Pr. 898* at measurement end timing to hold the cumulative saving power monitor value.

REMARKS

- The cumulative saving power monitor value is stored every hour. Hence, when the power supply is switched on again within one hour after it was switched off, the previously stored monitor value is displayed and totalization 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/60Hz) 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

$$= Pr.\,893\ (\text{kW}) \times \frac{\text{Power consumption (\%)}}{100} \times \frac{Pr.\,892\ (\%)}{100}$$

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PARAMETERS

(6) Annual power saving amount, power charge *(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*.

$$\textbf{Operation time rate (\%)} = \frac{\textbf{Annual operation time (h/year)}}{\textbf{24 (h/day)} \times \textbf{365 (days/year)}} \times \textbf{100(\%)}$$

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)

$$\text{Operation time rate (\%)} = \frac{\text{4032 (h/year)}}{\text{24 (h/day)} \times \text{365 (days/year)}} \times \text{100(\%)} = \text{46.03\%}$$

Set 46.03% to *Pr. 899*.

- Calculate the annual power saving amount from *Pr. 899 Operation time rate (estimated value)* and power saving average value monitor

$$\textbf{Annual power saving amount (kWh/year)} = \textbf{Power saving average value (kW) during totalization when } \textit{Pr. 898} \textbf{ = 10 or 9999} \times \textbf{24h} \times \textbf{365 days} \times \frac{\textit{Pr. 899}}{\textbf{100}}$$

- The annual power saving amount charge can be monitored by setting the power charge per hour in *Pr. 896 Power unit cost*.
  Calculate the annual power saving amount charge in the following method.

Annual power saving amount charge = 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. 52 DU/PU main display data selection ☞ *Refer to page 137*
Pr. 54 FM terminal function selection ☞ *Refer to page 137*
Pr. 158 AM terminal function selection ☞ *Refer to page 137*

4.16 Frequency setting by analog input (terminal 1, 2, 4)

Purpose	Parameter that must be Set		Refer to Page
Function assignment of analog input terminal	**Terminal 1 and terminal 4 function assignment**	**Pr. 858, Pr. 868**	165
Selection of voltage/current input (terminal 1, 2, 4) Perform forward/ reverse rotation by analog input	**Analog input selection**	**Pr. 73, Pr. 267**	166
Adjust the main speed by analog auxiliary input	**Analog auxliary input and compensation (added compensation and override function)**	**Pr. 73, Pr. 242, Pr. 243, Pr. 252, Pr. 253**	169
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)**	172

4.16.1 Function assignment of analog input terminal (Pr. 858, Pr. 868)

Function assignment of terminal 1 and terminal 4 of analog input can be selected and changed by parameter.

Parameter Number	Name	Initial Value	Setting Range	Description
858	**Terminal 4 function assignment**	0	0, 4, 9999	Select the terminal 4 function. (Refer to the following list)
868	**Terminal 1 function assignment**	0	0, 4, 9999	Select the terminal 1 function. (Refer to the following list)

· For the terminal 1 and terminal 4 used for analog input, frequency (speed) command, magnetic flux command, torque command, etc. can be selected.
Functions change according to the control mode as in the table below.

●Terminal 1/ Terminal 4 function

Setting value	*Pr. 858* Terminal 4 function assignment	*Pr. 858* Terminal 1 function assignment
0 (Initial value)	Frequency command (AU signal-ON)	Frequency setting auxiliary
4	Stall prevention operation level input	Stall prevention operation level input
9999	—	—

— :No function

REMARKS

- When "4" is set in both *Pr. 868* and *Pr. 858*, terminal 1 is made valid and terminal 4 has no function.
- When "4" (stall prevention) is set in *Pr. 868*, functions of terminal 4 become valid independently of whether the AU terminal is on or off.

♦ Parameters referred to ♦

Advanced magnetic flux vector control ☞ *Refer to page 68*

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PARAMETERS

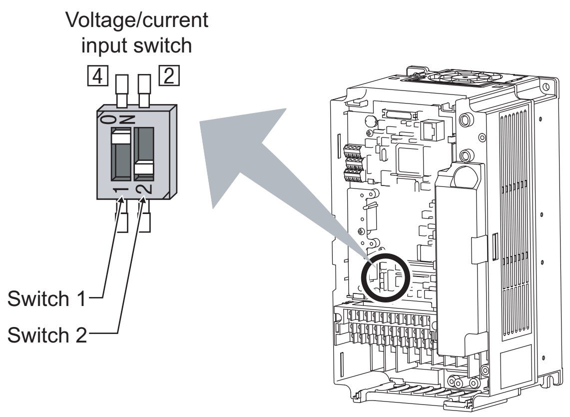
4.16.2 Analog input selection (Pr. 73, Pr. 267)

You can select the function that switches between forward rotation and reverse rotation according to the analog input terminal selection specifications, the override function and the input signal polarity.

Parameter Number	Name	Initial Value	Setting Range	Description	
				Voltage/current input switch	
73	Analog input selection	1	0 to 5, 10 to 15	Switch 2 - OFF (initial status)	You can select the input specifications of terminal 2 (0 to 5V, 0 to 10V, 0 to 20mA) and input specifications of terminal 1 (0 to $\pm$5V, 0 to $\pm$10V). Override and reversible operation can be selected.
			6, 7, 16, 17	Switch 2 - ON	
267	Terminal 4 input selection	0	0	Switch 1 - ON (initial status)	Terminal 4 input 4 to 20mA
			1	Switch 1 - OFF	Terminal 4 input 0 to 5V
			2		Terminal 4 input 0 to 10V

(1) Selection of analog input specifications

- For the terminals 2, 4 used for analog input, voltage input (0 to 5V, 0 to 10V) or current input (0 to 20mA) can be selected.
  Change parameters *(Pr.73, Pr.267)* and a voltage/current input switch (switch 1, 2) to change input specifications. (refer to the table below)



Switch 1:Terminal 4 input
ON: Current input (initial status)
OFF: Voltage input

Switch 2: Terminal 2 input
ON: Current input
OFF: Voltage input (initial status)

- Rated specifications of terminal 2, 4
  Voltage input: Input resistance 10kΩ ± 1kΩ, Maximum permissible voltage 20VDC
  Current input: Input resistance 245Ω ± 5Ω, Maximum permissible current 30mA

CAUTION

- Set *Pr.73, 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 may result in failure. Incorrect settings other than below can cause abnormal operation.

Setting Causing Failure		Operation
Switch setting	Terminal input	
ON (current input)	Voltage input	This could lead to damage to the analog signal output circuit of external devices. (electrical load in the analog signal output circuit of external devices increases)
OFF (voltage input)	Current input	This could lead to damage to the input circuit of the inverter. (output power in the analog signal output circuit of external devices increases)

· Refer to the following table and set *Pr. 73* and *Pr. 267*. (☐ indicates the main speed setting)

Pr. 73 Setting	Terminal 2 Input	Terminal 1 Input	Terminal 4 Input
0	0 to 10V	0 to ±10V	When the AU signal is off ×
1 (initial value)	0 to 5V	0 to ±10V	
2	0 to 10V	0 to ±5V	
3	0 to 5V	0 to ±5V	
4	0 to 10V	0 to ±10V	
5	0 to 5V	0 to ±5V	
6	0 to 20mA	0 to ±10V	
7	0 to 20mA	0 to ±5V	
10	0 to 10V	0 to ±10V	
11	0 to 5V	0 to ±10V	
12	0 to 10V	0 to ±5V	
13	0 to 5V	0 to ±5V	
14	0 to 10V	0 to ±10V	
15	0 to 5V	0 to ±5V	
16	0 to 20mA	0 to ±10V	
17	0 to 20mA	0 to ±5V	
0	×	0 to ±10V	According to *Pr. 267* setting when the AU signal is on 0: 0 to 20mA (initial value) 1: 0 to 5V 2: 0 to 10V
1 (initial value)		0 to ±10V	
2		0 to ±5V	
3		0 to ±5V	
4	0 to 10V	×	
5	0 to 5V		
6	×	0 to ±10V	
7		0 to ±5V	
10	×	0 to ±10V	
11		0 to ±10V	
12		0 to ±5V	
13		0 to ±5V	
14	0 to 10V	×	
15	0 to 5V		
16	×	0 to ±10V	
17		0 to ±5V	

Pr. 73 Setting	Compensation Input Terminal and Compensation Method	Polarity Reversible
0	Terminal 1 Added compensation	No (Indicates that a frequency command signal of negative polarity is not accepted.)
1 (initial value)		
2		
3		
4	Terminal 2 Override	
5		
6	Terminal 1 Added compensation	
7		
10		Yes
11		
12		
13		
14	Terminal 2 Override	
15		
16	Terminal 1 Added compensation	
17		
0	Terminal 1 Added compensation	No (Indicates that a frequency command signal of negative polarity is not accepted.)
1 (initial value)		
2		
3		
4	Terminal 2 Override	
5		
6	Terminal 1 Added compensation	
7		
10		Yes
11		
12		
13		
14	Terminal 2 Override	
15		
16	Terminal 1 Added compensation	
17		

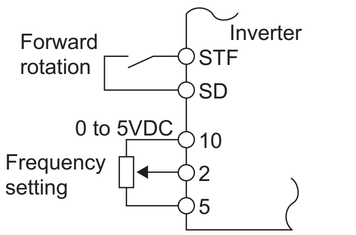
· Set the voltage/current input switch referring to the table below.
(☐ indicates an initial value.)

Terminal 2 Input Specifications	*Pr. 73* Setting	Switch 2
Voltage input (0 to 10V)	0, 2, 4, 10, 12, 14	OFF
Voltage input (0 to 5V)	1 (initial value), 3, 5, 11, 13, 15	OFF
Current input (0 to 20mA)	6, 7, 16, 17	ON

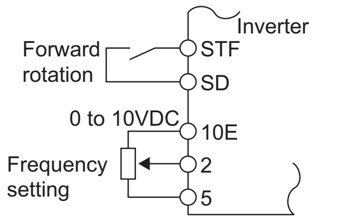
Terminal 4 Input Specifications	*Pr. 267* Setting	Switch 1
Voltage input (0 to 10V)	2	OFF
Voltage input (0 to 5V)	1	OFF
Current input (0 to 20mA)	0 (initial value)	ON

CAUTION

- Turn the AU signal on to make terminal 4 valid.
- Match the setting of parameter and switch. A different setting may cause a fault, failure or malfunction.
- The terminal 1 (frequency setting auxiliary input) signal is added to the main speed setting signal of the terminal 2 or 4.
- When an override is selected, the terminal 1 or 4 is used for the main speed setting and the terminal 2 for the override signal (50% to 150% at 0 to 5V or 0 to 10V). (When the main speed of the terminal 1 or terminal 4 is not input, compensation by the terminal 2 is made invalid.))
- 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.
- When *Pr. 858 Terminal 4 function assignment, Pr. 868 Terminal 1 function assignment* = "4", the value of the terminal 1 or terminal 4 is as set to the stall prevention operation level. When terminal 1 and terminal 4 are used for frequency setting, set "0" (initial value) in *Pr. 858* and *Pr. 868*.



Connection diagram using terminal 2 (0 to 5VDC)



Connection diagram using terminal 2 (0 to 10VDC)

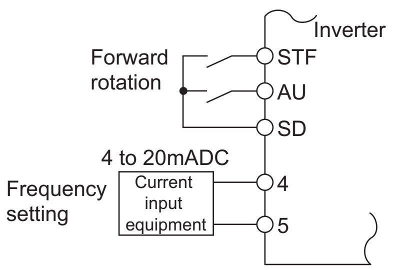
(2) Perform operation by analog input voltage

- The frequency setting signal inputs 0 to 5VDC (or 0 to 10VDC) to across the terminals 2-5. The 5V (10V) input is the maximum output frequency. The maximum output frequency is reached when 5V (10V) is input.
- The power supply 5V (10V) can be input by either using the internal power supply or preparing an external power supply. The internal power supply outputs 5VDC across terminals 10-5, or 10V across terminals 10E-5.

Terminal	Inverter Built-in Power Supply Voltage	Frequency Setting Resolution	*Pr. 73* (terminal 2 input voltage)
10	5VDC	0.030Hz/60Hz	0 to 5VDC input
10E	10VDC	0.015Hz/60Hz	0 to 10VDC input

- When inputting 10VDC to the terminal 2, set any of "0, 2, 4, 10, 12, 14" 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 OFF position changes the terminal 4 to the voltage input specification. When the AU signal turns on, the terminal 4 input becomes valid.

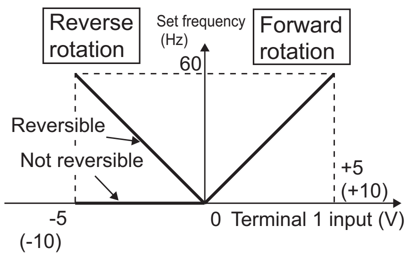
REMARKS
The wiring length of the terminal 10, 2, 5 should be 30m maximum.



Connection diagram using terminal 4 (4 to 20mADC)

(3) Perform operation by analog input current

- When the pressure or temperature is controlled constant by a fan, pump, etc., automatic operation can be performed by inputting the output signal 0 to 20mADC of the adjuster to across the terminals 4-5.
- The AU signal must be turned on to use the terminal 4.
- Setting any of "6, 7, 16, 17" in *Pr. 73* and a voltage/current input switch in the ON position changes the terminal 2 to the current input specification. At this time, the AU signal need not be turned on.



Compensation input characteristic when STF is on

(4) Perform forward/reverse rotation by analog input (polarity reversible operation)

- Setting any of "10 to 17" in *Pr. 73* enables polarity reversible operation.
- Providing ± input (0 to ±5V or 0 to ±10V) to the terminal 1 enables forward/reverse rotation operation according to the polarity.

♦ Parameters referred to ♦

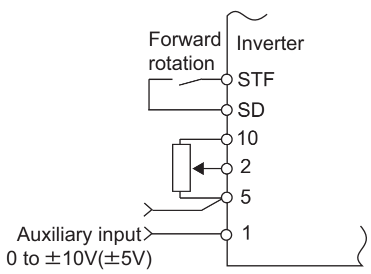
Pr. 22 Stall prevention operation level ☞ *Refer to page 74*
Pr. 125 Terminal 2 frequency setting gain frequency, Pr. 126 Terminal 4 frequency setting gain frequency ☞ *Refer to page 172*
Pr. 252, Pr. 253 Override bias/gain ☞ *Refer to page 169*
Pr. 858 Terminal 4 function assignment, Pr. 868 Terminal 1 function assignment ☞ *Refer to page 165*

4.16.3 Analog input compensation (Pr. 73, Pr. 242, Pr. 243, Pr. 252, Pr. 253)

A fixed ratio of analog compensation (override) can be made by the added compensation or terminal 2 as an auxiliary input for multi-speed operation or the speed setting signal (main speed) of the terminal 2 or terminal 4.

Parameter Number	Name	Initial Value	Setting Range	Description
73	**Analog input selection**	1	0 to 3, 6, 7, 10 to 13, 16, 17	Added compensation
			4, 5, 14, 15	Override compensation
242	**Terminal 1 added compensation amount (terminal 2)**	100%	0 to 100%	Set the ratio of added compensation amount when terminal 2 is the main speed.
243	**Terminal 1 added compensation amount (terminal 4)**	75%	0 to 100%	Set the ratio of added compensation amount when terminal 4 is the main speed.
252	**Override bias**	50%	0 to 200%	Set the bias side compensation value of override function.
253	**Override gain**	150%	0 to 200%	Set the gain side compensation value of override function.

(1) Added compensation *(Pr. 242, Pr. 243)*



Added compensation connection example

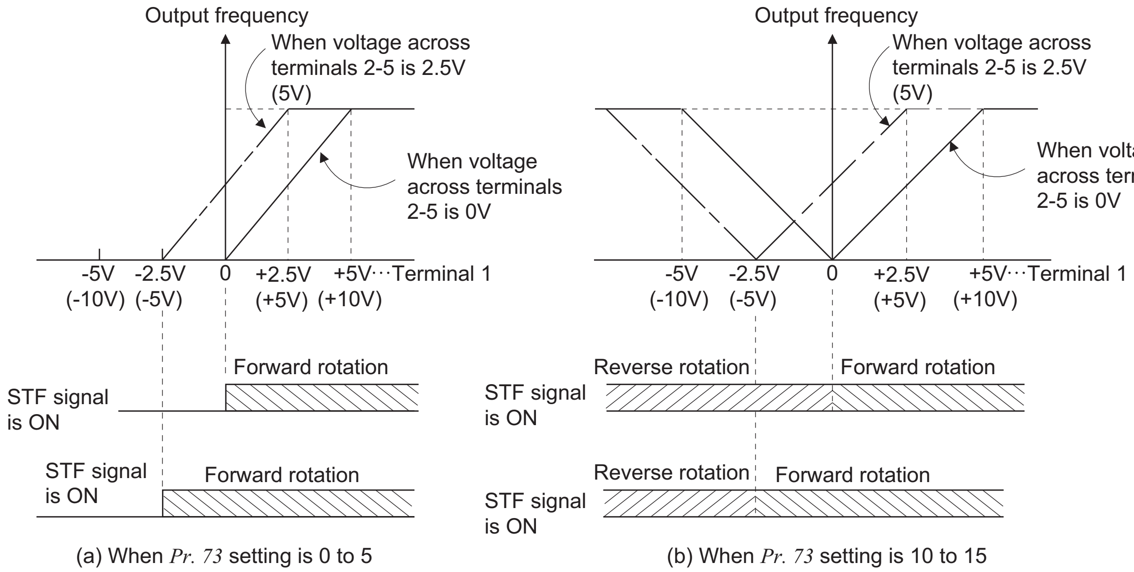
- The compensation signal can be input for the main speed setting for synchronous/continuous speed control operation, etc.
- Setting any of "0 to 3, 6, 7, 10 to 13, 16, 17" in *Pr. 73* adds the voltage across terminals 1-5 to the voltage signal across terminals 2-5.
- If the result of addition is negative, it is regarded as 0 at the *Pr. 73* setting of any of "0 to 3, 6, 7", or reverse rotation operation (polarity reversible operation) is performed when the STF signal turns on at the *Pr. 73* setting of any of "10 to 13, 16, 17".
- The compensation input of the terminal 1 can also be added to the multi-speed setting or terminal 4 (initial value 4 to 20mA).
- The added compensation for terminal 2 can be adjusted by *Pr. 242*, and the compensation for terminal 4 by *Pr. 243*.

Analog command value using terminal 2

$$= \text{Terminal 2 input} + \text{Terminal 1 input} \times \frac{Pr.\ 242}{100(\%)}$$

Analog command value using terminal 4

$$= \text{Terminal 4 input} + \text{Terminal 1 input} \times \frac{Pr.\ 243}{100(\%)}$$

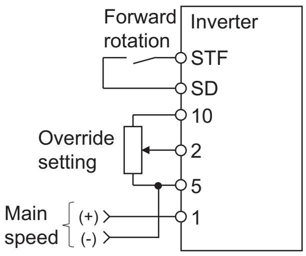


Auxiliary input characteristics

CAUTION

- When the *Pr. 73* setting was changed, check the voltage/current input switch setting. Different setting may cause a fault, failure or malfunction. (*Refer to page 166* for setting.)

(2) Override function *(Pr. 252, Pr. 253)*

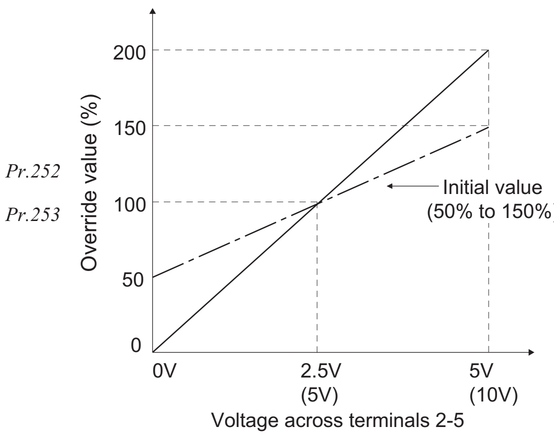


Override connection diagram

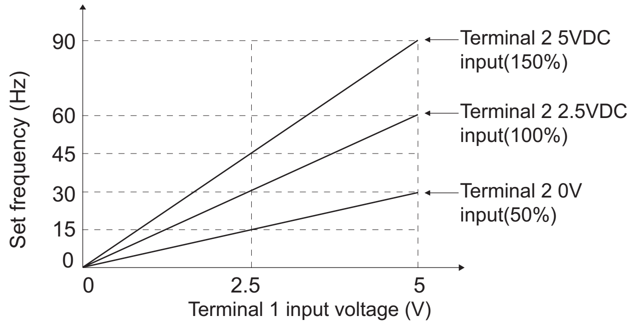
- Use the override function to change the main speed at a fixed ratio.
- Set any of "4, 5, 14, 15" in *Pr. 73* to select an override.
- When an override is selected, the terminal 1 or terminal 4 is used for the main speed setting and the terminal 2 for the override signal. (When the main speed of the terminal 1 or terminal 4 is not input, compensation made by the terminal 2 becomes invalid.)
- Using *Pr. 252* and *Pr. 253*, set the override range.
- How to find the set frequency for override

$$\text{Set frequency (Hz)} = \text{Main speed set frequency (Hz)} \times \frac{\text{Compensation amount (\%)}}{100(\%)}$$

Main speed set frequency (Hz): Terminal 1, 4 input, multi-speed setting
Compensation amount (%): Terminal 2 input



Example)When *Pr. 73* = "5"
The set frequency changes as shown below according to the terminal 1 (main speed) and terminal 2 (auxiliary) inputs.



CAUTION

- When the *Pr. 73* setting was changed, check the voltage/current input switch setting. Different setting may cause a fault, failure or malfunction. (*Refer to page 166* for setting.)

REMARKS

- The AU signal must be turned on to use the terminal 4.
- When inputting compensation to multi-speed operation or remote setting, set "1" (compensation made) in *Pr. 28 Multi-speed input compensation selection*. (Initial value is "0")

♦ Parameters referred to ♦

Pr. 28 Multi-speed input compensation selection ☞ *Refer to page 85*
Pr. 73 Analog input selection ☞ *Refer to page 166*

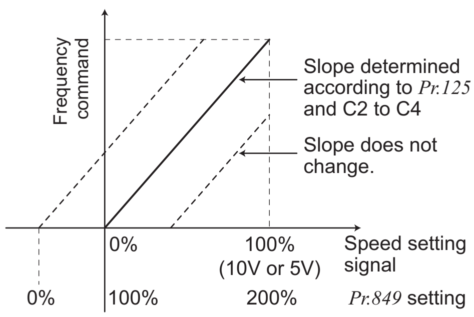
4.16.4 Response level of analog input and noise elimination (Pr. 74, Pr. 849)

Response level and stability of frequency reference command by analog input (terminal 1, 2, 4) signal can be adjusted.

Parameter Number	Name	Initial Value	Setting Range	Description
74	**Input filter time constant**	1	0 to 8	The primary delay filter time constant for the analog input can be set. A larger setting results in slower response.
849	**Analog input offset adjustment**	100%	0 to 200%	This function provides speed command by analog input (terminal 2) with offset. Motor rotation due to noise, etc. by analog input can be avoided at zero speed command.

(1) Time constant of analog input *(Pr. 74)*

- Effective for eliminating noise in 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 10ms to 1s with the setting of 0 to 8).



(2) Offset adjustment of analog speed command input *(Pr. 849)*

- When speed command by analog input is set, create the range where the motor remains stop to prevent malfunction at very low speed.
- On the assumption that the *Pr. 849* setting 100% as 0, the offset voltage is offset as follows:
  100% < *Pr. 849*........ positive side
  100% > *Pr. 849*........ negative side
  The offset voltage is found by the following formula.

$$\text{Offset voltage} = \frac{\text{Voltage at 100\%}}{\text{(5V or 10V *)}} \times \frac{Pr.\ 849 - 100}{100} [\text{V}]$$

* According to the *Pr. 73* setting

♦ Parameters referred to ♦

Pr. 73 Analog input selection ☞ *Refer to page 166*
Pr. 125, C2 to C4 (Bias and gain of the terminal 2 frequency setting) ☞ *Refer to page 172*

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4.16.5 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 5V, 0 to 10V or 0 to 20mADC).
Set *Pr. 73, Pr. 267* and voltage/current input switch to switch between 0 to 5VDC, 0 to 10VDC and 0 to 20mADC. *(Refer to page 165)*

Parameter Number	Name	Initial Value	Setting Range		Description	
			FR-B	FR-B3		
125	**Terminal 2 frequency setting gain frequency**	60Hz	0 to 120Hz/ 0 to 60Hz *3	0 to 120Hz	Set the frequency of terminal 2 input gain (maximum).	
126	**Terminal 4 frequency setting gain frequency**	60Hz	0 to 120Hz/ 0 to 60Hz *3	0 to 120Hz	Set the frequency of terminal 4 input gain (maximum).	
241 *2	**Analog input display unit switchover**	0	0		Displayed in %	Select the unit of analog input display.
			1		Displayed in V/mA	
C2(902) *1	**Terminal 2 frequency setting bias frequency**	0Hz	0 to 120Hz/ 0 to 60Hz *3	0 to 120Hz	Set the frequency on the bias side of terminal 2 input.	
C3(902) *1	**Terminal 2 frequency setting bias**	0%	0 to 300%		Set the converted % of the bias side voltage (current) of terminal 2 input.	
C4(903) *1	**Terminal 2 frequency setting gain**	100%	0 to 300%		Set the converted % of the gain side voltage (current) of terminal 2 input.	
C5(904) *1	**Terminal 4 frequency setting bias frequency**	0Hz	0 to 120Hz/ 0 to 60Hz *3	0 to 120Hz	Set the frequency on the bias side of terminal 4 input.	
C6(904) *1	**Terminal 4 frequency setting bias**	20%	0 to 300%		Set the converted % of the bias side current (voltage) of terminal 4 input.	
C7(905) *1	**Terminal 4 frequency setting gain**	100%	0 to 300%		Set the converted % of the gain side current (voltage) of terminal 4 input.	

*1 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).
*2 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*.
*3 The setting range differs according to the inverter capacity. (22K or less/30K or more)

(1) The relationship between analog input terminal and calibration parameter

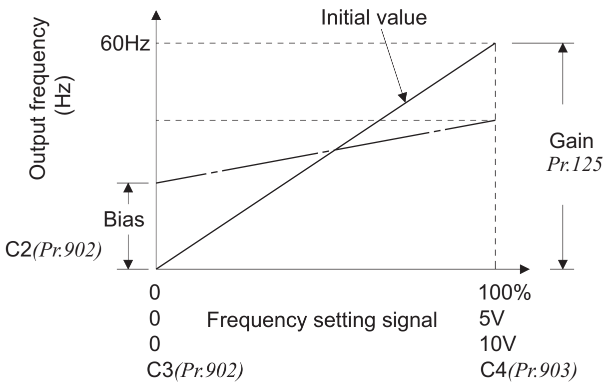
●Terminal 1 functional calibration parameter

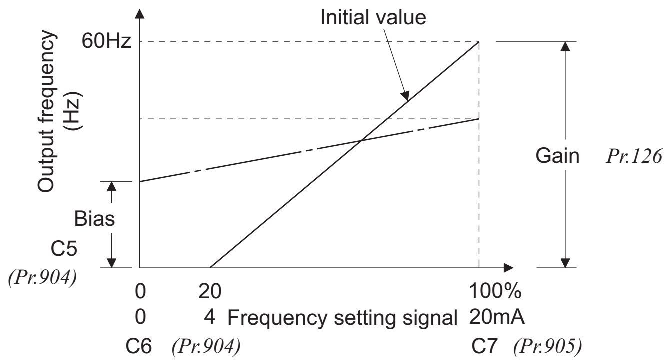
Pr. 868 Setting	Terminal Function	Calibration Parameters	
		Bias setting	Gain setting
0 (initial value)	Frequency (speed) setting auxiliary	*C2(Pr. 902) Terminal 2 frequency setting bias frequency* *C3(Pr. 902) Terminal 2 frequency setting bias* *C5(Pr. 904) Terminal 4 frequency setting bias frequency* *C6(Pr. 904) Terminal 4 frequency setting bias*	*Pr. 125 Terminal 2 frequency setting gain frequency* *C4(Pr. 903) Terminal 2 frequency setting gain* *Pr. 126 Terminal 4 frequency setting gain frequency* *C7(Pr. 905) Terminal 4 frequency setting gain*
4	Stall prevention operation level *	*Pr. 148 Stall prevention level at 0V input* *(Refer to page 74)*	*Pr. 149 Stall prevention level at 10V input* *(Refer to page 74)*
9999	—	—	—

●Terminal 4 functional calibration parameter

Pr. 858 Setting	Terminal Function	Calibration Parameters	
		Bias setting	Gain setting
0 (initial value)	Frequency command/speed command	*C5(Pr. 904) Terminal 4 frequency setting bias frequency* *C6(Pr. 904) Terminal 4 frequency setting bias*	*Pr. 126 Terminal 4 frequency setting gain frequency* *C7(Pr. 905) Terminal 4 frequency setting gain*
4	Stall prevention operation level *	*Pr. 148 Stall prevention level at 0V input* *(Refer to page 74)*	*Pr. 149 Stall prevention level at 10V input* *(Refer to page 74)*
9999	—	—	—

— : No function





(2) Change the frequency at maximum analog input. *(Pr. 125, Pr. 126)*

· Set a value in *Pr. 125 (Pr. 126)* when changing only the frequency setting (gain) of the maximum analog input power (current). (*C2 (Pr. 902) to C7 (Pr. 905)* setting need not be changed)

(3) 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 5V, 0 to 10V or 4 to 20mADC, and the output frequency.
· Set the bias frequency of the terminal 2 input using *C2 (Pr. 902)*. (factory-set to the frequency at 0V)
· Using *Pr. 125*, set the output frequency relative to the frequency command voltage (current) set in *Pr. 73 Analog input selection*.
· Set the bias frequency of the terminal 4 input using *C5 (Pr. 904)*. (factory-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 voltage (current) to across the terminals 2-5 (4-5). ☞ *page 174*
(b) Method to adjust any point without application of a voltage (current) to across terminals 2-5(4-5). ☞ *page 175*
(c) Adjusting only the frequency without adjusting the voltage (current). ☞ *page 176*

CAUTION

· When the terminal 2 is calibrated to change the inclination of the set frequency, the setting of the terminal 1 is also changed.
· When a voltage is input to the terminal 1 to make calibration, (terminal 2 (4) analog value + terminal 1 analog value) is the analog calibration value.
· When the voltage/current input specifications were changed using *Pr. 73, Pr. 267* and voltage/current input switch, be sure to make calibration.

(4) 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 *C3 (Pr. 902), C4 (Pr. 903), C6 (Pr. 904) C7 (Pr. 905)* change as shown below.

Analog Command (terminal 2, 4) (according to *Pr. 73*, *Pr. 267*, voltage/current input switch)	*Pr. 241* = 0 (initial value)	*Pr. 241* = 1
0 to 5V input	0 to 5V → desplayed in 0 to 100% (0.1%).	0 to 100% → desplayed in 0 to 5V (0.01V).
0 to 10V input	0 to 10V → desplayed in 0 to 100% (0.1%).	0 to 100% → desplayed in 0 to 10V (0.01V).
0 to 20mA input	0 to 20mA → desplayed in 0 to 100% (0.1%).	0 to 100% → desplayed in 0 to 20mA (0.01mA).

REMARKS

· Analog input display is not displayed correctly if voltage is applied to terminal 1 when terminal 1 input specifications (0 to ±5V, 0 to ±10V) and main speed (terminal 2, terminal 4 input) specifications (0 to 5V, 0 to 10V, 0 to 20mA) differ. (For example, 5V (100%) is analog displayed when 0V and 10V are applied to terminal 2 and terminal 1 respectively in the initial status.
In this case, set "0" (initial value is 0% display) in *Pr. 241* to use.

(5) Frequency setting voltage (current) bias/gain adjustment method

(a)Method to adjust any point by application of voltage (current) to across the terminals 2-5 (4-5).

Operation	Display
1. Confirmation of the RUN indication and operation mode indication ・The inverter must be at a stop. ・The inverter must be in the PU operation mode. (Using PU/EXT)	0.00 Hz MON P.RUN PU EXT NET REV FWD
2. Press MODE to choose the parameter setting mode.	MODE ⇨ P. 0 (The parameter number read previously appears.)
3. Turn [dial] until C. . . appears.	⇨ C. . .
4. Press SET to display C - - - .	SET ⇨ C - - - (*C0* to *C7* setting is enabled.)
5. Turn [dial] until C. 4 (C. 7) appears. Set to *C4 Terminal 2 frequency setting gain*.	⇨ C 4 / C 7 Terminal 2 input / Terminal 4 input
6. Press SET to display the analog voltage (current) value (%).	SET ⇨ 0.0 Analog voltage (current) value (%) across terminals 2-5 (across terminals 4-5)
7. Apply a 5V (20mA) voltage (current). (Turn the external potentiometer connected across terminals 2-5 (across terminals 4-5) to maximum (any position).)	⇨ 100 * * The value is nearly 100 (%) in the maximum position of the potentiometer.

CAUTION
After performing the operation in step 6, do not touch [dial] until completion of calibration.

Operation	Display
8. Press SET to set.	SET ⇨ 100 * ⟷ C 4 (Terminal 2 input) / C 7 (Terminal 4 input) Flicker...Parameter setting complete!! (Adjustment completed) * The value is nearly 100 (%) in the maximum position of the potentiometer.

・By turning [dial], you can 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 (indicator) connected to across terminals FM-SD does not indicate just 60Hz, set *calibration parameter C0 FM terminal calibration*. *(Refer to page 145)*
- If the gain and bias frequency settings are too close, an error (Er 3) may be displayed at the time of write.

(b) Method to adjust any point without application of a voltage (current) to across terminals 2-5(4-5).
(To change from 4V (80%) to 5V (100%))

Operation	Display
1. Confirmation of the RUN indication and operation mode indication • The inverter must be at a stop. • The inverter must be in the PU operation mode. (Using 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 the dial until C. . . appears.	⇨ C. . .
4. Press SET to display C---.	SET ⇨ C--- (*C0* to *C7* setting is enabled.)
5. Turn the dial until C. 4 (C. 7) appears. Set to *C4 Terminal 2 frequency setting gain*.	⇨ C 4 / C 7 Terminal 2 input / Terminal 4 input
6. Press SET to display the analog voltage (current) value (%).	SET ⇨ 0.0 — Analog voltage (current) value (%) across terminals 2-5 (across terminals 4-5)
7. Turn the dial to set the gain voltage (%). "0V (0mA) equals to 0%, 5V (10V, 20mA) to 100%" **Remarks** The current setting at the instant of turning the dial is displayed.	⇨ 100 — The gain frequency is reached when the analog voltage (current) value across terminals 2-5 (across terminals 4-5) is 100%. 80
8. Press SET to set.	SET ⇨ 100 ⟷ C 4 / C 7 Terminal 2 input / Terminal 4 input Flicker...Parameter setting complete!! (Adjustment completed)

- By turning the dial, you can 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 the dial after step 6, you can confirm the current frequency setting bias/gain setting.
It cannot be confirmed after execution of step 7.

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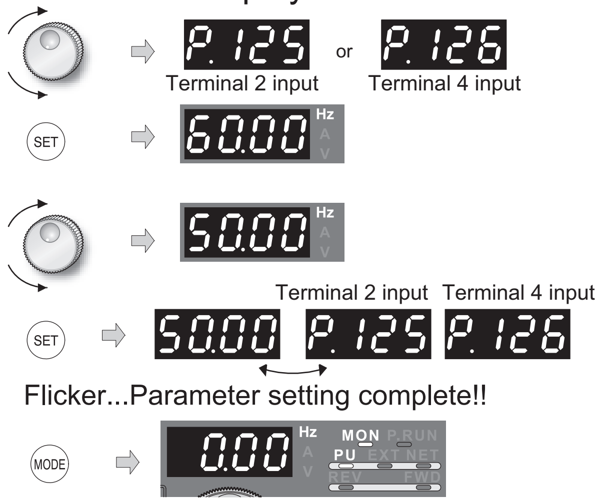
(c) Method to adjust only the frequency without adjustment of a gain voltage (current).
(When changing the gain frequency from 60Hz to 50Hz)

Operation

1. Turn the setting dial until P.125 (*Pr. 125*) or P.126 (*Pr. 126*) appears.
2. Press SET to show the currently set value. (60.00Hz)
3. Turn the setting dial 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 2-5 (across 4-5) 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* value. The input of terminal 1 (frequency setting auxiliary input) is added to the frequency setting signal.
- For the operating procedure using the parameter unit (FR-PU04/FR-PU07), refer to the FR-PU04/FR-PU07 instruction manual.
- Make the bias frequency setting using *calibration parameter C2 (Pr. 902) or C5 (Pr. 904). (Refer to page 173)*

⚠ CAUTION

⚠ Take care 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. 20 Acceleration/deceleration reference frequency ☞ *Refer to page 88*
Pr. 73 Analog input selection, Pr. 267 Terminal 4 input selection ☞ *Refer to page 166*
Pr. 79 Operation mode selection ☞ *Refer to page 182*

4.17 Misoperation prevention and parameter setting restriction

Purpose	Parameter that must be Set		Refer to Page
Limit reset function **Make alarm stop when PU is disconnected** **Stop from PU**	**Reset selection/disconnected PU detection/PU stop selection**	**Pr. 75**	177
Prevention of parameter rewrite	**Parameter write disable selection**	**Pr. 77**	179
Prevention of reverse rotation of the motor	**Reverse rotation prevention selection**	**Pr. 78**	180
Display necessary parameters	**Display of applied parameters and user group function**	**Pr. 160, Pr. 172 to Pr. 174**	180
Control of parameter write by communication	**EEPROM write selection**	**Pr. 342**	202

4.17.1 Reset selection/disconnected PU detection/PU stop selection (Pr. 75)

You can select the reset input acceptance, disconnected PU (FR-DU07/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 are set.

·The *Pr. 75* value can be set any time. Also, if parameter (all) clear is executed, this setting will not return to the initial value.

Pr. 75 Setting	Reset Selection	Disconnected PU Detection	PU Stop Selection
0	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing STOP RESET decelerates the motor to a stop only in the PU operation mode.
1	Reset input enabled only when the protective function is activated		
2	Reset input normally enabled.	When the PU is disconnected, the inverter output is shut off.	
3	Reset input enabled only when the protective function is activated		
14 (initial value)	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing STOP RESET decelerates the motor to a stop in any of the PU, external and communication operation modes.
15	Reset input enabled only when the protective function is activated		
16	Reset input normally enabled.	When the PU is disconnected, the inverter output is shut off.	
17	Reset input enabled only when the protective function is activated		

(1) Reset selection

- You can select the operation timing 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 protective function is activated.

CAUTION

· When the reset signal (RES) is input during operation, the motor coasts since the inverter being reset shuts off the output. Also, the cumulative value of the electronic thermal relay function and regenerative brake duty is cleared.
· The reset key of the PU is valid only when the protective function is activated, independently of the *Pr. 75* setting.

(2) Disconnected PU detection

- This function detects that the PU (FR-DU07/FR-PU04/FR-PU07) has been disconnected from the inverter for longer than 1s and causes the inverter to provide an alarm output (E.PUE) and come to an alarm stop.
- When *Pr. 75* is set to any of "0, 1, 14, 15", operation is continued if the PU is disconnected.

CAUTION

- When the PU has been disconnected since before power-on, it is not judged as an alarm.
- 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" (operation is 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.

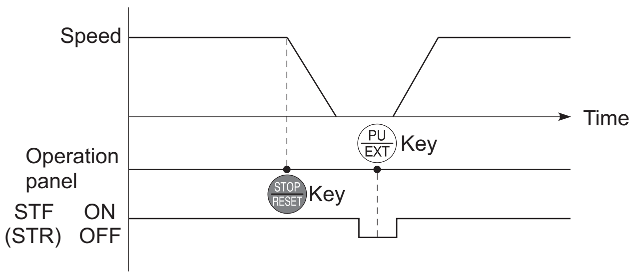
(3) PU stop selection

- In any of the PU operation, external operation and network operation modes, the motor can be stopped by pressing STOP/RESET of the PU.
- When the inverter is stopped by the PU stop function, "PS" is displayed but an alarm is not output. An alarm output is not provided.
- When *Pr. 75* is set to any of "0 to 3", deceleration to a stop by STOP/RESET is valid only in the PU operation mode.

REMARKS

The motor will also decelerate to a stop (PU stop) when STOP/RESET is input during operation in the PU mode through RS-485 communication with *Pr. 551 PU mode operation command source selection* set to "1" (PU mode RS-485 terminals).

(4) Restarting method when stop was made by pressing STOP/RESET from the PU during external operation



Stop/restart example for external operation

(a) When operation panel (FR- DU07) is used

1)After the motor has decelerated to a stop, turn off the STF or STR signal.

2)Press PU/EXT to display PU.••••••(PS canceled)

3)Press PU/EXT to return to EXT.

4)Turn on the STF or STR signal.

(b) Connection of the parameter unit (FR-PU04/FR-PU07)

1)After the motor has decelerated to a stop, turn off the STF or STR signal.

2)Press EXT.••••••(PS canceled)

3)Turn on the STF or STR signal.

- The motor can be restarted by making a reset using a power supply reset or RES signal.

CAUTION

- 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

⚠ CAUTION

⚠ Do not reset the inverter with the start signal on. Doing so will cause the inverter to start immediately after a reset, leading to hazardous conditions.

♦ Parameters referred to ♦

Pr. 250 Stop selection ☞ Refer to page 104

4.17.2 Parameter write 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 a stop.
			1	Parameter write is not enabled.
			2	Parameter write is enabled in any operation mode regardless of operating status.

Pr. 77 can be always set independently of the operation mode and operating status.

(1) Write parameters only at a 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 55)* 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 during operation in the PU operation mode, but cannot be written in external operation mode.

(2) Disable parameter write (setting "1")

·Parameter write is not enabled. (Reading 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	User group read selection

(3) Write parameters during operation (setting "2")

· Parameters can always be written.
· The following parameters cannot be written during operation if *Pr. 77* = "2". Stop operation when changing their parameter settings.

Parameter Number	Name
23	Stall prevention operation level compensation factor at double speed
48	Second stall prevention operation current
49	Second stall prevention operation frequency
61	Reference current
66	Stall prevention operation reduction starting frequency
71	Applied motor
79	Operation mode selection
80	Motor capacity
81	Number of motor poles
82	Motor excitation current
83	Motor rated voltage
84	Rated motor frequency
90 to 94	(Motor constants)
96	Auto tuning setting/status
178 to 196	(I/O terminal function selection)

Parameter Number	Name
255	Life alarm status display
256	Inrush current limit circuit life display
257	Control circuit capacitor life display
258	Main circuit capacitor life display
291	Pulse train I/O selection
292	Automatic acceleration/deceleration
293	Acceleration/deceleration individual operation selection
329	Digital input unit selection (Parameter for the plug-in option FR-A7AX)
343	Communication error count
541	Frequency command sign selection (CC-Link) (Parameter for the plug-in option FR-A7NC)
563	Energization time carrying-over times
564	Operating time carrying-over times
858	Terminal 4 function assignment
859	Torque current
868	Terminal 1 function assignment

♦ Parameters referred to ♦

Pr. 79 Operation mode selection ☞ *Refer to page 182*

4.17.3 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 disallowed

· 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 operation panel (FR-DU07), parameter unit (FR-PU04/FR-PU07), start signals (STF, STR signals) via external terminals, and the forward and reverse rotation commands through communication.

4.17.4 Display of applied parameters and user group function (Pr. 160, Pr. 172 to Pr. 174)

Parameter which can be read from the operation panel and parameter unit can be restricted.

Parameter Number	Name	Initial Value	Setting Range	Description
160	User group read selection	0	9999	Only the simple mode parameters can be displayed.
			0	The simple mode and extended parameters can be displayed
			1	Only parameters registered in the user group can be displayed.
172	User group registered display/ batch clear	0	(0 to 16)	Displays the number of cases registered as a user group. (Reading only)
			9999	Batch clear the user group registration
173 *1	User group registration	9999	0 to 999, 9999	Set the parameter numbers to be registered to the user group.
174 *1	User group clear	9999	0 to 999, 9999	Set the parameter numbers to be cleared from the user group.

*1 The values read from *Pr. 173* and *Pr. 174* are always "9999".

(1) Display of simple mode parameters and extended parameters (*Pr. 160*)

· When *Pr. 160* = "9999", only the simple mode parameters can be displayed on the operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07). (Refer to the parameter list, *pages 55 to 64*, for the simple mode parameters.)
· In the initial setting (*Pr. 160* = "0") status, simple mode parameters and extended parameters can be displayed.

REMARKS

· When a plug-in option is fitted to the inverter, the option parameters can also be read.
· When reading the parameters using the communication option, all parameters (simple mode, extended mode, parameters for options) can be read regardless of the *Pr. 160* setting.
· When reading the parameters using the RS-485 terminals, all parameters can be read reagrdless of the *Pr. 160* setting by setting *Pr.550 NET mode operation command source selection* and *Pr. 551 PU mode operation command source selection*.

Pr. 551	*Pr. 550*	*Pr. 160* Valid/Invalid
1 (RS-485)	—	Valid
2 (PU) (initial value)	0 (OP)	Valid
	1 (RS-485)	Invalid (all readable)
	9999 (auto-detect) (initial value)	With OP: valid
		Without OP: invalid (all readable)

* OP indicates a communication option

· *Pr. 15 Jog frequency*, *Pr. 16 Jog acceleration/deceleration time Pr. 991 PU contrast adjustment* are displayed as simple mode parameters when the parameter unit (FR-PU04/FR-PU07) is mounted.

(2) User group function (*Pr. 160, Pr. 172 to Pr. 174*)

- The user group function is designed to display only the parameters necessary for setting.
- From among all parameters, a maximum of 16 parameters can be registered to a user group. When *Pr. 160* is set to "1", only the parameters registered to the user group can be accessed. (Reading of parameters other than the user group registration is disabled.)
- To register a parameter to the user group, set its parameter number to *Pr. 173*.
- To delete a parameter from the user group, set its parameter number to *Pr. 174*. To batch-delete the registered parameters, set *Pr. 172* to "9999".

(3) Registration of parameter to user group (*Pr. 173*)

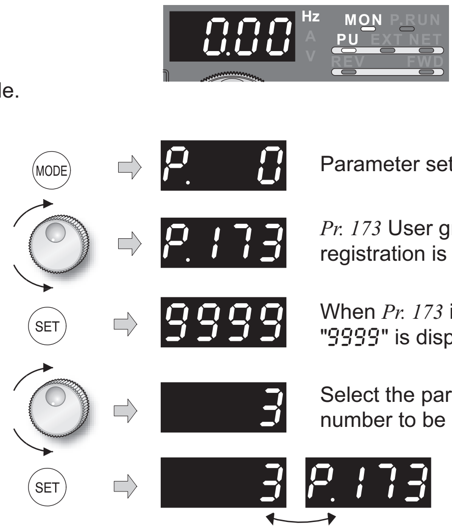
When registering *Pr. 3* to user group

Operation

1. Confirm the operation display and operation mode display.
   - The inverter must be at a stop.
   - The inverter must be in the PU operation mode. (Press PU/EXT in the external operation mode.)
2. Press MODE to choose the parameter setting mode.
3. Turn [dial] until P.173 appears.
4. Press SET to display. "9999"
5. Turn [dial] until *Pr. 3* appears.
6. Press SET to set. "P.173" and "3" are displayed alternately.

   To continue parameter registration, repeat steps 3 to 6.

Indication



Parameter setting mode

Pr. 173 User group registration is displayed.

When *Pr. 173* is read, "9999" is displayed.

Select the parameter number to be registered.

Flicker ··· Registration of *Pr. 3* to user group completed!!

(4) Deletion of parameter from user group (*Pr. 174*)

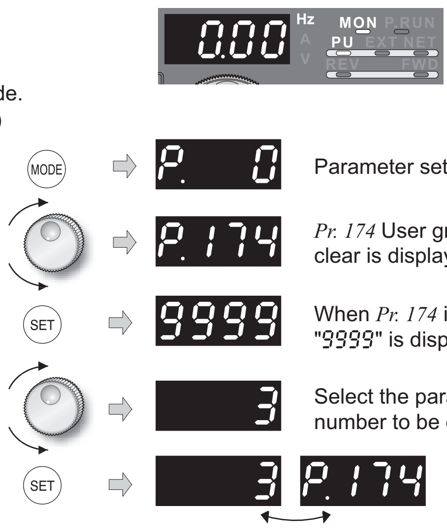
When deleting *Pr. 3* from user group

Operation

1. Confirm the operation display and operation mode display.
   - The inverter must be at a stop.
   - The inverter must be in the PU operation mode. (Press PU/EXT in the external operation mode.)
2. Press MODE to choose the parameter setting mode.
3. Turn [dial] until P.174 appears.
4. Press SET to display. "9999"
5. Turn [dial] until *Pr. 3* appears.
6. Press SET to clear. "P.174" and "3" are displayed alternately.

   To continue parameter registration, repeat steps 3 to 6.

Indication



Parameter setting mode

Pr. 174 User group clear is displayed.

When *Pr. 174* is read, "9999" is displayed.

Select the parameter number to be deleted.

Flicker ··· Deletion of *Pr. 3* from user group completed!!

REMARKS

- *Pr. 77, Pr. 160* and *Pr. 991* can always be read, independently of the user group setting.
- *Pr. 77, Pr. 160* and *Pr. 172 to Pr. 174* cannot be registered to the user group.
- When *Pr. 174* or *Pr. 175* is read, "9999" is always displayed. Although "9999" can be written, no function is available.
- When any value other than "9999" is set to *Pr. 172*, no function is available.

♦ Parameters referred to ♦

Pr. 550 NET mode operation command source selection ☞ Refer to page 191
Pr. 551 PU mode operation command source selection ☞ Refer to page 191

4

PARAMETERS

4.18 Selection of operation mode and operation location

Purpose	Parameter that must be Set		Refer to Page
Operation mode selection	**Operation mode selection**	**Pr. 79**	182
Started in network operation mode	**Operation mode at power on**	**Pr. 79, Pr. 340**	190
Selection of control location	**Sslection of control source, speed command source and control location during communication operation**	**Pr. 338, Pr. 339, Pr. 550, Pr. 551**	191

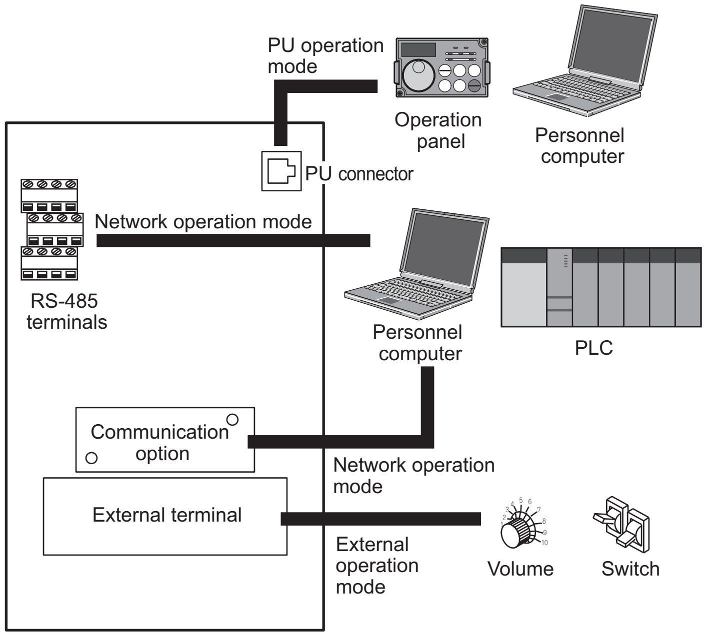
4.18.1 Operation mode selection (Pr. 79)

Used to select the operation mode of the inverter.
Mode can be changed as desired between operation using external signals (external operation), operation from the PU (FR-DU07/FR-PU07/FR-PU04), combined operation of PU operation and external operation (external/PU combined operation, and network operation (when RS-485 terminals or a communication option is used).

<table>
<tr><th>Parameter Number</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="2">Description</th><th>LED Indication
: Off
: On</th></tr>
<tr><td rowspan="11">79</td><td rowspan="11">Operation mode selection</td><td rowspan="11">0</td><td>0</td><td colspan="2">Use external/PU switchover mode (PU/EXT) to switch between the PU and external operation mode.
At power on, the inverter is placed in the external operation mode.</td><td>External operation mode
EXT
PU operation mode
PU</td></tr>
<tr><td>1</td><td colspan="2">Fixed to PU operation mode</td><td>PU</td></tr>
<tr><td>2</td><td colspan="2">Fixed to external operation mode
Operation can be performed by switching between the external and Net operation mode.</td><td>External operation mode
EXT
NET operation mode
NET</td></tr>
<tr><td rowspan="3">3</td><td colspan="2">External/PU combined operation mode 1</td><td rowspan="6">PU EXT</td></tr>
<tr><td>Running frequency</td><td>Start signal</td></tr>
<tr><td>PU (FR-DU07/FR-PU04/FR-PU07) setting or external signal input (multi-speed setting, across terminals 4-5 (valid when AU signal turns on)).</td><td>External signal input (terminal STF, STR)</td></tr>
<tr><td rowspan="3">4</td><td colspan="2">External/PU combined operation mode 2</td></tr>
<tr><td>Running frequency</td><td>Start signal</td></tr>
<tr><td>External signal input (Terminal 2, 4, 1, JOG, multi-speed selection, etc.)</td><td>Input from the PU (FR-DU07/FR-PU04/FR-PU07)
(FWD, REV)</td></tr>
<tr><td>6</td><td colspan="2">Switch-over mode
Switch among PU operation, external operation, and NET operation while keeping the same operating status.</td><td>PU operation mode
PU
External operation mode
EXT
NET operation mode
NET</td></tr>
<tr><td>7</td><td colspan="2">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 can not be switched to the PU operation mode.</td><td>PU operation mode
PU
External operation mode
EXT</td></tr>
</table>

The above parameters can be changed during a stop in any operation mode.

(1) Operation mode basics

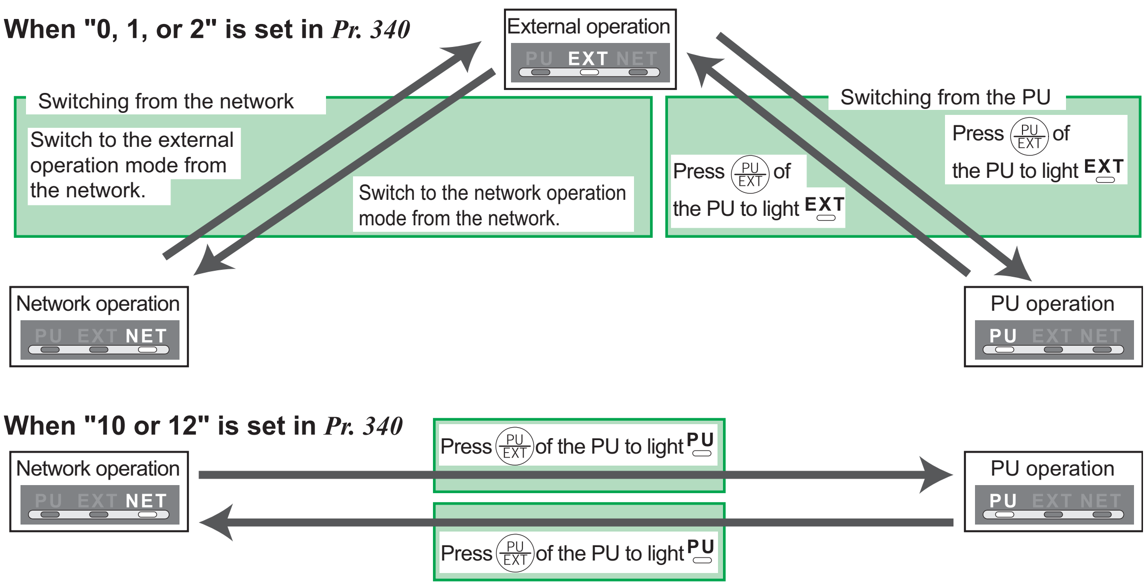


- The operation mode is to specify the source of inputting the start command and set frequency of the inverter.
- Select the "external operation mode" when performing operation by basically using the control circuit terminals and providing potentiometers, switches, etc. externally, select the "PU operation mode" when inputting the start command and frequency setting through communication from the operation panel (FR-DU07), parameter unit (FR-PU04/FR-PU07), PU connector, or select the "network operation mode (NET operation mode)" when using the RS-485 terminals or communication option.
- 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 operation, and these settings differ in starting method.
- In the initial setting, the stop function by STOP/RESET of the PU (FR-DU07/FR-PU07) (PU stop selection) is valid also in other than the PU operation mode. *(Pr. 75 Reset selection/disconnected PU detection/PU stop selection. Refer to page 177.)*

(2) Operation mode switching method



REMARKS

- For switching of operation by external terminals, refer to the following:

PU operation external interlock signal (X12 signal) ☞ *page 187*
PU-external operation switch-over signal (X16) ☞ *page 188*
PU-NET operation switchover signal (X65), External-NET operation switchover signal (X66) ☞ *page 189*
Pr. 340 Communication startup mode selection ☞ *page 190*

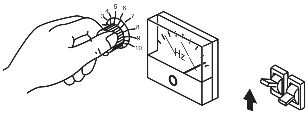
(3) Operation mode selection flow

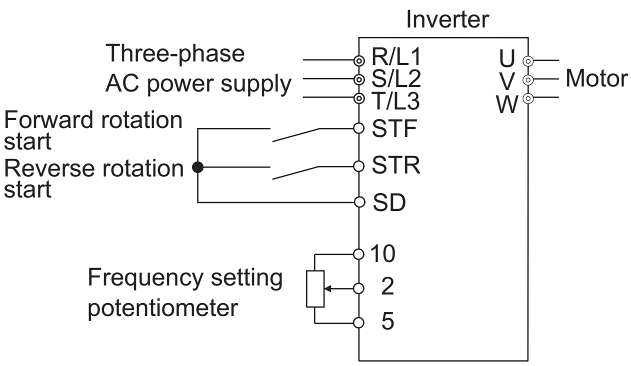
In the following flowchart, select the basic parameter setting and terminal connection related to the operation mode.

START

Where is the start command source?	Where is the frequency set?	Connection	Parameter setting	Operation
From external (STF/STR terminal)	From external (Terminal 2, 4, JOG, multi-speed, etc.)	STF (forward rotation)/STR (reverse rotation) -SD *(Refer to page 118.)* Terminal 2, 4-5 (analog), RL, RM, RH, JOG-SD, etc.		Frequency setting terminal ON STF(STR) ON
From external (STF/STR terminal)	From PU (Digital setting)	STF (forward rotation)/STR (reverse rotation) -SD *(Refer to page 118.)*	*Pr. 79* = "3" (External/PU combined operation 1)	DU digital setting STF(STR) ON
From external (STF/STR terminal)	From communication (RS-485 terminals/communication option) — RS-485 terminals or communication option? RS-485 terminals	STF (forward rotation)/STR (reverse rotation) -SD *(Refer to page 118.)* Connection of RS-485 terminals *(Refer to page 198.)*	*Pr. 338* = "1" *Pr. 340* = "1, 2"	Communication frequency setting command sending STF(STR) ON
From external (STF/STR terminal)	From communication (RS-485 terminals/communication option) — Communication option	Connection of communication option (Refer to the corresponding communication option instruction manual)	*Pr. 338* = "1" *Pr. 340* = "1"	Communication frequency setting command sending STF(STR) ON
From PU (FWD/REV key)	From external (Terminal 2, 4, JOG, multi-speed, etc.)	Terminal 2, 4-5 (analog), RL, RM, RH, JOG-SD, etc.	*Pr. 79* = "4" (External/PU combined operation 2)	Frequency setting terminal ON FWD/REV key ON
From PU (FWD/REV key)	From PU (Digital setting)		*Pr. 79* = "1" (Fixed to PU operation)	Digital setting FWD/REV key ON
From PU (FWD/REV key)	From communication (RS-485 terminals/communication option)	Disabled		
From communication (RS-485 terminals/communication option) — RS-485 terminals	From external (Terminal 2, 4, JOG, multi-speed, etc.)	Connection of RS-485 terminals *(Refer to page 198.)* Terminal 2, 4-5 (analog), RL, RM, RH, JOG-SD, etc.	*Pr. 339* = "1" *Pr. 340* = "1, 2"	Frequency setting terminal ON Communication start command sending
From communication — RS-485 terminals	From PU (Digital setting)		Disabled	
From communication — RS-485 terminals	From communication RS-485 terminals	Connection of RS-485 terminals *(Refer to page 198.)*	*Pr. 340* = "1, 2"	Communication frequency setting command sending Communication start command sending
From communication — Communication option	From external (Terminal 2, 4, JOG, multi-speed, etc.)	Connection of communication option (Refer to the corresponding communication option instruction manual) Terminal 2, 4-5 (analog), RL, RM, RH, JOG-SD, etc.	*Pr. 339* = "1" *Pr. 340* = "1"	Frequency setting terminal ON Communication start command sending
From communication — Communication option	From PU (Digital setting)		Disabled	
From communication — Communication option	From communication (communication option)	Connection of communication option (Refer to the corresponding communication option instruction manual)	*Pr. 340* = "1"	Communication frequency setting command sending Communication start command sending

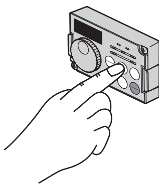
(4) External operation mode (setting "0" (initial value), "2")

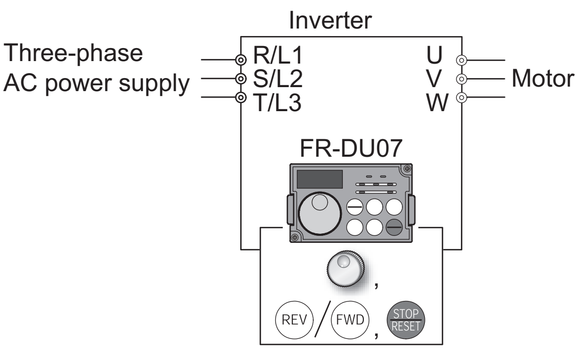




- Select the external operation mode when performing operation by providing a frequency setting potentiometer, start switch, etc. externally and connecting them to the control circuit terminals of the inverter.
- Basically, parameter changing is disabled in external operation mode. (Some parameters can be changed. Refer to *page 55* for the parameter list.)
- 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 190*)
- When parameter changing is seldom necessary, setting "2" fixes the operation mode to external operation mode. When frequent parameter changing is necessary, setting "0" (initial value) allows the operation mode to be changed easily to PU operation mode by pressing PU/EXT of the operation panel. When you switched to PU operation mode, always return to external operation mode.
- The STF and STR signal are used as a start command, and the terminal 2, 4, multi-speed setting, JOG signal, etc. are used as frequency setting.

(5) PU operation mode (setting "1")





- Select the PU operation mode when performing operation by only the key operation of the operation panel (FR-DU07) or parameter unit (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. *(Pr. 161 Frequency setting/key lock operation selection, refer to page 253.)*
- When PU operation mode is selected, the PU operation mode signal (PU) can be output.
  For the terminal used for the PU signal output, assign the function by setting "10 (positive logic) or 110 (negative logic)" in any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

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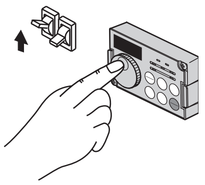
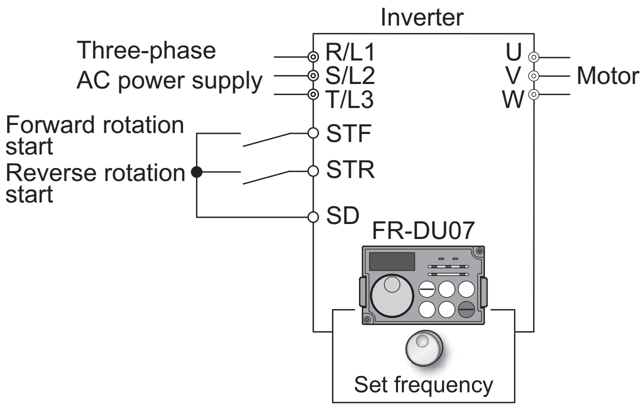
PARAMETERS

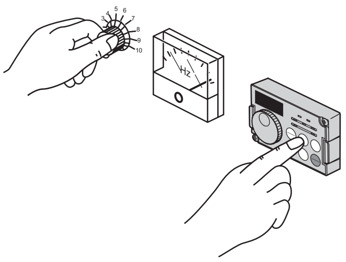
(6) PU/external combined operation mode 1 (setting "3")

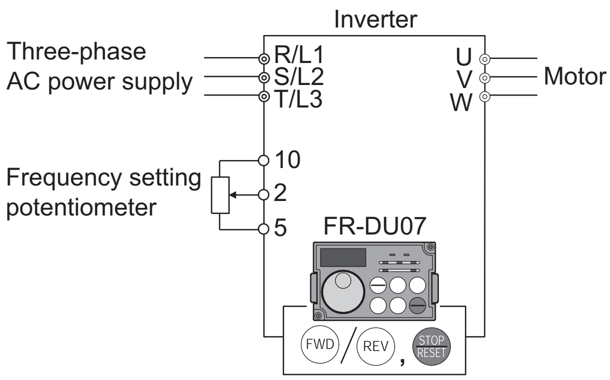




· Select the PU/external combined operation mode 1 when making frequency setting from the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07) and inputting the start command with the external start switch.
· Select "3" for *Pr. 79*. You cannot change to the other operation mode.
· When a frequency is input from the external signal by multi-speed setting, it has a higher priority than the frequency setting of the PU. When AU is on, the terminal 4 is used.

(7) PU/external combined operation mode 2 (setting "4")





· Select the PU/external combined operation mode 2 when making frequency setting from the external potentiometer, multi-speed or JOG signal and inputting the start command by key operation of the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07).
· Select "4" for *Pr. 79*. You cannot change to the other operation mode.

(8) Switch-over mode (setting "6")

· While continuing operation, you can switch between the PU operation, external operation and network operation (when RS-485 terminals or communication option is used).

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 volume (frequency setting potentiometer), etc. 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 network operation mode through communication. · Rotation direction is the same as that of external operation. · The value set with the setting volume (frequency setting potentiometer) 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, parameter unit. · The rotation direction is determined by the input signal of the external operation. · The set frequency is determined by the external frequency setting signal.
PU operation → NET operation	Send the mode change command to network operation mode through communication. · Rotation direction and set frequency are the same as those of PU operation.
NET operation → external operation	Command to change to external mode is transmitted by communication. · Rotation direction is determined by the external operation input signal. · The set frequency is determined by the external frequency setting signal.
NET operation → PU operation	Select the PU operation mode with the operation panel or parameter unit. · The rotation direction and set frequency signal in 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 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 the 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" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function. (Refer to *page 118* for *Pr. 178 to Pr. 189*.)

· When the X12 signal has not been assigned, the function of the MRS signal switches from MRS (output stop) to the 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 (*Pr. 77 Parameter write selection*, depending on the corresponding parameter write condition (Refer to *page 55* for the parameter list))
OFF	Forcibly switched to external operation mode External operation allowed Switching to PU or NET operation mode disabled	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.	Disallowed
	Running	ON→OFF *1			Disallowed
External	During stop	OFF→ON	External *2	During stop	Allowed
		ON→OFF			Disallowed
	Running	OFF→ON		During operation → output stop	Disallowed
		ON→OFF		Output stop → operation	Disallowed

*1 The operation mode switches to 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 alarm occurrence, pressing STOP RESET of the operation panel resets the inverter.

CAUTION

· If the X12 (MRS) signal is on, the operation mode cannot be switched to 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. Also as soon as "7" is set in *Pr. 79*, the signal acts as the PU interlock signal.

· When the MRS signal is used as the PU operation 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. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.

(10) Switching of operation mode by external terminal (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" switch-over mode can be changed during operation)
- For the terminal used for X16 signal input, set "16" in any of *Pr. 178 to Pr. 189 (input terminal function selection)* to assign the function.

Pr. 79 Setting		X16 Signal State Operation Mode		Remarks
		ON (external)	OFF (PU)	
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	Can be switched to external, PU or NET operation mode with operation continued
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 189*.)
- The priorities of *Pr. 79*, *Pr. 340* and signals are *Pr. 79* > X12 > X66 > X65 > X16 > *Pr. 340*.

CAUTION

- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.

(11) Switching of operation mode by external terminal (X65, X66 signal)

- When *Pr. 79* = any of "0, 2, 6, 7", the operation mode switching signals (X65, X66) can be used to change the PU or external operation mode to network operation mode during a stop (during a motor stop or start command off). (*Pr. 79* = "6" switch-over 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), "6" or "7". (At the *Pr. 79* setting of "7", the operation mode can be switched when the X12 (MRS) signal turns on.)
  2) Set "10 or 12" in *Pr. 340 Communication startup mode selection*.
  3) Set "65" in any of *Pr. 178 to Pr. 189* to assign the NET-PU operation switchover signal (X65) to the external terminal.
  4) The operation mode changes to PU operation mode when the X65 signal turns on, or to network operation mode when the X65 signal turns off.

Pr. 340 Setting	*Pr. 79* Setting	X65 Signal State ON (PU)	X65 Signal State OFF (NET)	Remarks
10, 12	0 (initial value)	PU operation mode *1	NET operation mode *2	Cannot be switched to external operation mode
10, 12	1	PU operation mode	PU operation mode	Fixed to PU operation mode
10, 12	2	NET operation mode	NET operation mode	Fixed to NET operation mode
10, 12	3, 4	External/PU combined operation mode	External/PU combined operation mode	External/PU combined mode fixed
10, 12	6	PU operation mode *1	NET operation mode *2	Operation mode can be switched with operation continued Cannot be switched to external operation mode
10, 12	7: X12(MRS) ON	PU operation mode *1	NET operation mode *2, 3	Output stop in external operation mode
10, 12	7: X12(MRS) OFF	External operation mode	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. PU operation mode also when *Pr. 550 NET mode operation command source selection* = "1" (communication option control source) and the communication option is not fitted.
*3 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 turns on.)
  2) Set "0 (initial value), 1 or 2" in *Pr. 340 Communication startup mode selection*.
  3) Set "66" in any of *Pr. 178 to Pr. 189* to assign the NET-external operation switchover signal (X66) to the external terminal.
  4) The operation mode changes to network operation mode when the X66 signal turns on, or to external operation mode when the X66 signal turns off.

Pr. 340 Setting	*Pr. 79* Setting	X66 Signal State ON (NET)	X66 Signal State OFF(external)	Remarks
0 (initial value), 1, 2	0 (initial value)	NET operation mode *1	External operation mode *2	
0 (initial value), 1, 2	1	PU operation mode	PU operation mode	Fixed to PU operation mode
0 (initial value), 1, 2	2	NET operation mode *1	External operation mode	Cannot be switched to PU operation mode
0 (initial value), 1, 2	3, 4	External/PU combined operation mode	External/PU combined operation mode	External/PU combined mode fixed
0 (initial value), 1, 2	6	NET operation mode *1	External operation mode *2	Operation mode can be switched with operation continued
0 (initial value), 1, 2	7: X12(MRS) ON	NET operation mode *1	External operation mode *2	Output stop in external operation mode
0 (initial value), 1, 2	7: X12(MRS) OFF	External operation mode	External operation mode	Forcibly switched to external operation mode

*1 PU operation mode is selected when *Pr. 550 NET mode operation command source selection* = "1" (communication option control source) and the communication option is not fitted.
*2 PU operation is selected 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*.

CAUTION

- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 15 Jog frequency ☞ Refer to page 83
Pr. 4 to 6, Pr. 24 to 27, Pr. 232 to Pr. 239 Multi-speed operation ☞ Refer to page 81
Pr. 75 Reset selection/disconnected PU detection/PU stop selection ☞ Refer to page 177
Pr. 161 Frequency setting/key lock operation selection ☞ Refer to page 253
Pr. 178 to Pr. 189 (input terminal function selection) ☞ Refer to page 118
Pr. 190 to Pr. 196 (output terminal function selection) ☞ Refer to page 125
Pr. 340 Communication startup mode selection ☞ Refer to page 190
Pr. 550 NET mode operation command source selection ☞ Refer to page 191

4.18.2 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 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 the RS-485 terminals or communication option.

Parameter Number	Name	Initial Value	Setting Range	Description
79	**Operation mode selection**	0	0 to 4, 6, 7	Select the operation mode. *(Refer to page 184.)*
340 *	**Communication startup mode selection**	0	0	As set in *Pr. 79*.
			1, 2	Started in network operation mode. When the setting is "2", it will resume the pre-instantaneous power failure operation mode after an instantaneous power failure occurs.
			10, 12	Started in network operation mode. Operation mode can be changed between the PU operation mode and network operation mode from the operation panel. When the setting is "12", it will resume the pre-instantaneous power failure operation mode after an instantaneous power failure occurs.

The above parameters can be changed during a stop in any operation mode.
* The parameters can be set whenever the communication option is connected. *(Refer to page 180.)*.

(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 *2
	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 is disabled
	3, 4	External/PU combined operation mode	Operation mode switching is disabled
	6	External operation mode	Switching among the external, PU, and NET operation mode is enabled while running
	7	X12 (MRS) signal ON ....External operation mode	Switching among the external, PU, and NET operation mode is enabled *2
		X12 (MRS) signal OFF ..External operation mode	Fixed to external operation mode (forcibly switched to external operation mode.)
1, 2 *1	0	NET operation mode	Same as when *Pr. 340* = "0"
	1	PU operation mode	
	2	NET operation mode	
	3, 4	External/PU combined operation mode	
	6	NET operation mode	
	7	X12 (MRS) signal ON ....NET operation mode	
		X12 (MRS) signal OFF ..External operation mode	
10, 12 *1	0	NET operation mode	Switching between the PU and NET operation mode is enabled *3
	1	PU operation mode	Same as when *Pr. 340* = "0"
	2	NET operation mode	Fixed to NET operation mode
	3, 4	External/PU combined operation mode	Same as when *Pr. 340* = "0"
	6	NET operation mode	Switching among the external, PU, and NET operation mode is enabled while running *3
	7	External operation mode	Same as when *Pr. 340* = "0"

*1 The *Pr. 340* setting "2" or "12" is mainly used for communication operation using the inverter RS-485 terminals. When a value other than "9999" (selection of automatic restart after instantaneous power failure) is set in *Pr. 57 Restart coasting time*, the inverter will resume the same operation state which was in before after power has been restored from an instantaneous power failure.
When *Pr. 340* = "1, 10", a start command turns off if power failure has occurred and then restored during a start command is on.
*2 The operation mode cannot be switched directly between the PU operation mode and network operation mode.
*3 Operation mode can be changed between the PU operation mode and network operation mode with PU/EXT key of the operation panel (FR-DU07) and X65 signal.

♦ Parameters referred to ♦

Pr. 57 Restart coasting time ☞ *Refer to page 148.*
Pr. 79 Operation mode selection ☞ *Refer to page 182.*

4.18.3 Operation command source and speed command source during communication operation (Pr. 338, Pr. 339, Pr. 550, Pr. 551)

When the RS-485 terminals or communication option is used, the external operation command and speed command can be made valid. Also, the control command source in the PU operation mode can be selected.

Parameter Number	Name	Initial Value	Setting Range	Description
338	**Communication operation command source**	0	0	Operation command source communication
			1	Operation command source external
339	**Communication speed command source**	0	0	Speed command source communication
			1	Speed command source external (Frequency setting from communication is invalid, terminal 2 and 1 setting from external is valid)
			2	Speed command source external (Frequency setting from communication is valid, terminal 2 and 1 setting from external is invalid)
550 *	**NET mode operation command source selection**	9999	0	Communication option valid
			1	RS-485 terminals valid
			9999	Automatic recognition of the communication option Normally, the RS-485 terminals are valid. When the communication option is fitted, the communication option is valid.
551 *	**PU mode operation command source selection**	2	1	Select the RS-485 terminals as the PU operation mode control source.
			2	Select the PU connector as the PU operation mode control source.
			3	Manufacturer setting. Do not set.

The above parameters can be set whenever the communication option is connected. *(Refer to page 180.)*

* *Pr 550* and *Pr. 551* are always write-enabled.

(1) Select the control source of the network operation mode *(Pr. 550)*

- Either the RS-485 terminals or communication option can be specified as the source of control in network operation mode.
- For example, set *Pr. 550* to "1" when executing parameter write, start command or frequency setting from the inverter RS-485 terminals in the network operation mode independently of whether the communication option is connected or not.

CAUTION

- Since *Pr. 550* = "9999" (automatic recognition of the communication option) in the initial setting, parameter write, start command and frequency setting cannot be executed by communication using the inverter RS-485 terminals when the communication option is fitted. (Monitor and parameter read can be performed.)

(2) Select the control source of the PU operation mode *(Pr. 551)*

- Either the PU connector, RS-485 terminals can be specified as the source of control in the PU operation mode.
- In the PU operation mode, set *Pr. 551* to "1" when executing parameter write, start command or frequency setting through communication from the unit RS-485 terminals.

CAUTION

- The PU operation mode has a higher priority when *Pr. 550* = "1" (NET mode RS-485 terminals) and *Pr. 551* = "1" (PU mode RS-485 terminals). When the communication option is not fitted, therefore, the operation mode cannot be switched to network operation mode.
- Changed setting value is made valid when powering on or resetting the inverter.

Pr. 550 Setting	*Pr. 551* Setting	Operation Mode of Control Source			Remarks
		PU connector	RS- 485 terminals	Communication option	
0	1	×	PU operation mode *1	NET operation mode *2	
	2 (initial value)	PU operation mode	×	NET operation mode *2	
1	1	×	PU operation mode *1	×	Switching to NET operation mode disabled
	2 (initial value)	PU operation mode	NET operation mode	×	
9999 (initial value)	1	×	PU operation mode *1	NET operation mode *2	
	2 (initial value)	PU operation mode	×	NET operation mode *2	Communication option fitted
			NET operation mode	×	Communication option not fitted

*1 The Modbus-RTU protocol cannot be used in the PU operation mode. When using the Modbus-RTU protocol, set *Pr. 551* to "2".
*2 When the communication option is not fitted, the operation mode cannot be switched to network operation mode.

4

PARAMETERS

(3) Controllability through communcation

<table>
<tr><th rowspan="2">Operation Location</th><th rowspan="2">Condition (Pr. 551 Setting)</th><th>Operation Mode</th><th rowspan="2">PU Operation</th><th rowspan="2">External Operation</th><th rowspan="2">External/PU Combined Operation Mode 1 (Pr. 79 = 3)</th><th rowspan="2">External/PU Combined Operation Mode 2 (Pr. 79 = 4)</th><th rowspan="2">NET Operation (when RS-485 terminals are used) *6</th><th rowspan="2">NET Operation (when communication option is used) *7</th></tr>
<tr><th>Item</th></tr>
<tr><td rowspan="12">Control by RS-485 communication from PU connector</td><td rowspan="6">2 (PU connector)</td><td>Run command (start, stop)</td><td>○</td><td>★ *3</td><td>★ *3</td><td>○</td><td colspan="2">★ *3</td></tr>
<tr><td>Running frequency setting</td><td>○</td><td>×</td><td>○</td><td>×</td><td colspan="2">×</td></tr>
<tr><td>Monitor</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Parameter write</td><td>○ *4</td><td>× *5</td><td>○ *4</td><td>○ *4</td><td colspan="2">× *5</td></tr>
<tr><td>Parameter read</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Inverter reset</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td rowspan="6">1 (RS-485 terminals)</td><td>Run command (start, stop)</td><td>★ *3</td><td>★ *3</td><td>★ *3</td><td>★ *3</td><td colspan="2">★ *3</td></tr>
<tr><td>Running frequency setting</td><td>×</td><td>×</td><td>×</td><td>×</td><td colspan="2">×</td></tr>
<tr><td>Monitor</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Parameter write</td><td>× *5</td><td>× *5</td><td>× *5</td><td>× *5</td><td colspan="2">× *5</td></tr>
<tr><td>Parameter read</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Inverter reset</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td rowspan="12">Control by communication from RS-485 terminals</td><td rowspan="6">1 (RS-485 terminals)</td><td>Run command (start, stop)</td><td>○</td><td>×</td><td>×</td><td>○</td><td colspan="2">×</td></tr>
<tr><td>Running frequency setting</td><td>○</td><td>×</td><td>○</td><td>×</td><td colspan="2">×</td></tr>
<tr><td>Monitor</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Parameter write</td><td>○ *4</td><td>× *5</td><td>○ *4</td><td>○ *4</td><td colspan="2">× *5</td></tr>
<tr><td>Parameter read</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Inverter reset</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td rowspan="6">2 (PU connector)</td><td>Run command (start, stop)</td><td>×</td><td>×</td><td>×</td><td>×</td><td>○ *1</td><td>×</td></tr>
<tr><td>Running frequency setting</td><td>×</td><td>×</td><td>×</td><td>×</td><td>○ *1</td><td>×</td></tr>
<tr><td>Monitor</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Parameter write</td><td>× *5</td><td>× *5</td><td>× *5</td><td>× *5</td><td>○ *4</td><td>× *5</td></tr>
<tr><td>Parameter read</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Inverter reset</td><td>×</td><td>×</td><td>×</td><td>×</td><td>○ *2</td><td>×</td></tr>
<tr><td rowspan="6">Control by communication from communication option</td><td rowspan="6">—</td><td>Run command (start, stop)</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td><td>○ *1</td></tr>
<tr><td>Running frequency setting</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td><td>○ *1</td></tr>
<tr><td>Monitor</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Parameter write</td><td>× *5</td><td>× *5</td><td>× *5</td><td>× *5</td><td>× *5</td><td>○ *4</td></tr>
<tr><td>Parameter read</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Inverter reset</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td><td>○ *2</td></tr>
<tr><td rowspan="3">Control circuit external terminals</td><td rowspan="3">—</td><td>Inverter reset</td><td>○</td><td>○</td><td>○</td><td>○</td><td colspan="2">○</td></tr>
<tr><td>Run command (start, stop)</td><td>×</td><td>○</td><td>○</td><td>×</td><td colspan="2">× *1</td></tr>
<tr><td>Frequency setting</td><td>×</td><td>○</td><td>×</td><td>○</td><td colspan="2">× *1</td></tr>
</table>

○: Enabled, ×: Disabled, ★ : Some are enabled

*1 As set in *Pr. 338 Communication operation command source* and *Pr. 339 Communication speed command source*. *(Refer to page 191)*
*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 Reset selection/disconnected PU detection/PU stop selection*. *(Refer to page 177)*
*4 Some parameters may be write-disabled according to the *Pr. 77 Parameter write selection* setting and operating status. *(Refer to page 179)*
*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 *page 55* for the parameter list)Parameter clear is disabled.
*6 When *Pr. 550 NET mode operation command source selection* = 1 (RS-485 terminals valid) or *Pr. 550 NET mode operation command source selection* = 9999 and the communication option is not fitted.
*7 When *Pr. 550 NET mode operation command source selection* = 0 (communication option valid) or *Pr. 550 NET mode operation command source selection* = 9999 and the communication option is fitted.

(4) Operation at alarm occurrence

<table>
<tr><th>Alarm Definition</th><th>Operation Mode
Condition
(Pr. 551 setting)</th><th>PU Operation</th><th>External Operation</th><th>External/PU Combined Operation Mode 1
(Pr. 79 = 3)</th><th>External/PU Combined Operation Mode 2
(Pr. 79 = 4)</th><th>NET Operation (when RS-485 terminals are used) *5</th><th>NET Operation (when communication option is used) *6</th></tr>
<tr><td>Inverter fault</td><td>—</td><td colspan="6">Stop</td></tr>
<tr><td rowspan="2">PU disconnection of the PU connector</td><td>2 (PU connector)</td><td colspan="6">Stop/continued *1, 4</td></tr>
<tr><td>1 (RS-485 terminals)</td><td colspan="6">Stop/continued *1</td></tr>
<tr><td rowspan="2">Communication alarm of PU connector</td><td>2 (PU connector)</td><td>Stop/continued *2</td><td colspan="2">Continued</td><td>Stop/continued *2</td><td colspan="2">Continued</td></tr>
<tr><td>1 (RS-485 terminals)</td><td colspan="6">Continued</td></tr>
<tr><td rowspan="2">Communication alarm of RS-485 terminals</td><td>1 (RS-485 terminals)</td><td>Stop/continued *2</td><td colspan="2">Continued</td><td>Stop/continued *2</td><td colspan="2">Continued</td></tr>
<tr><td>2 (PU connector)</td><td colspan="4">Continued</td><td>Stop/continued *2</td><td>Continued</td></tr>
<tr><td>Communication alarm of communication option</td><td>—</td><td colspan="4">Continued</td><td>Stop/continued *3</td><td>Continued</td></tr>
</table>

*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*, *Pr. 336 RS-485 communication check time interval.*

*3 As controlled by the communication option.

*4 In the PU jog operation mode, operation is always stopped when the PU is disconnected. Whether error (E.PEU) occurrence is allowed or not is as set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*.

*5 When *Pr. 550 NET mode operation command source selection* = 1 (RS-485 terminals valid) or *Pr. 550 NET mode operation command source selection* = 9999 and the communication option is not fitted

*6 When *Pr. 550 NET mode operation command source selection* = 0 (communication option valid) or *Pr. 550 NET mode operation command source selection* = 9999 and the communication option is fitted

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PARAMETERS

(5) Selection of control source in network operation mode *(Pr. 338, Pr. 339)*

- As control sources, there are the operation command sources that control the signals related to the inverter start command and function selection and the speed command source that controls the signals related to frequency setting.
- In network operation mode, the commands from the external terminals and communication (RS-485 terminals or communication option) 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	
				Terminal 2	—	External	—	—	External	—	
				Terminal 4	—	External		—	External		
				Terminal 1	Compensation						
Selective function	*Pr. 178 to Pr. 189* setting	0	RL	Low speed operation command/remote setting clear stop-on-contact selection 0	NET	External		NET	External		*Pr. 59* = "0" (multi-speeds) *Pr. 59* = "1 , 2" (remote) *Pr. 270* = "1 , 3" (stop-on-contact)
		1	RM	Middle-speed operation command/remote setting deceleration	NET	External		NET	External		
		2	RH	High speed operation command/remote setting acceleration	NET	External		NET	External		
		3	RT	Second function selection/ Stop-on contact selection 1	NET			External			*Pr. 270* = "1 , 3" (stop-on-contact)
		4	AU	Current input selection	—	Combined		—	Combined		
		5	JOG	Jog operation selection	—			External			
		6	CS	Selection of automatic restart after instantaneous power failure	External						
		7	OH	External thermal relay input	External						
		8	REX	Fifteen speed selection	NET	External		NET	External		*Pr. 59* = "0" (multi-speeds)
		9	X9	Third function selection	NET			External			
		10	X10	Inverter operation enable signal	External						
		11	X11	MT-HC connection, instantaneous power failure detection	External						
		12	X12	PU operation external interlock	External						
		13	X13	External DC injection brake operation start	NET			External			
		14	X14	PID control valid terminal	NET	External		NET	External		
		15	BRI	Brake opening completion signal	NET			External			
		16	X16	PU-external operation switchover	External						
		19	X19	Load torque high-speed frequency	NET			External			
		20	X20	S-pattern acceleration/deceleration C switchover	NET			External			
		22	X22	Orientation command	NET			External			
		24	MRS	Output stop	Combined			External			*Pr. 79* ≠ "7"
				PU operation interlock	External						*Pr. 79* = "7" When X12 signal is not assigned
		25	STOP	Start self-holding selection	—			External			
Selective function	*Pr. 178 to Pr. 189* setting	60	STF	Forward rotation command	NET			External			
		61	STR	Reverse rotation command	NET			External			
		62	RES	Reset	External						
		63	PTC	PID forward action switchover	External						
		64	X64	PID forward action switchover	NET	External		NET	External		
		65	X65	PU-NET operation switchover	External						
		66	X66	External-NET operation switchover	External						
		67	X67	Command source switchover	External						

[Explanation of table]

External : Control is valid only from external terminal signal.
NET : Control only from communication is valid
Combined : Control is valid from either of external terminal and communication.
— : Control is invalid from either of external terminal and communication.
Compensation : Control by signal from external terminal is only valid when *Pr. 28 Multi-speed input compensation selection* = "1"

REMARKS
- The control source of communication is as set in *Pr. 550* and *Pr. 551*.

(6) Switching of command source by external terminal (X67)

- In network operation mode, the command source switching signal (X67) can be used to switch the operation command source and speed command source. This signal can be utilized to control the signal input from both the external terminal and communication.
- Set "67" in any of *Pr. 178 to Pr. 189* (input terminal function selection) to assign the X67 signal to the external terminal.
- When the X67 signal is off, the operation command source and speed command source are external.

X67 Signal State	Operation Command Source	Speed Command Source
No signal assignment	According to *Pr. 338*	According to *Pr. 339*
ON		
OFF	Operation is valid only from external terminal signal.	

REMARKS
- The ON/OFF state of the X67 signal is reflected only during a stop. It is reflected after a stop when the terminal is switched during operation.
- When the X67 signal is off, a reset via communication is disabled.

CAUTION
- Changing the terminal assignment using *Pr. 178 to Pr. 189 (input terminal function selection)* may affect the other functions. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 28 Multi-speed input compensation selection ☞ Refer to page 85.
Pr. 59 Remote function selection ☞ Refer to page 85.
Pr. 79 Operation mode selection ☞ Refer to page 182.

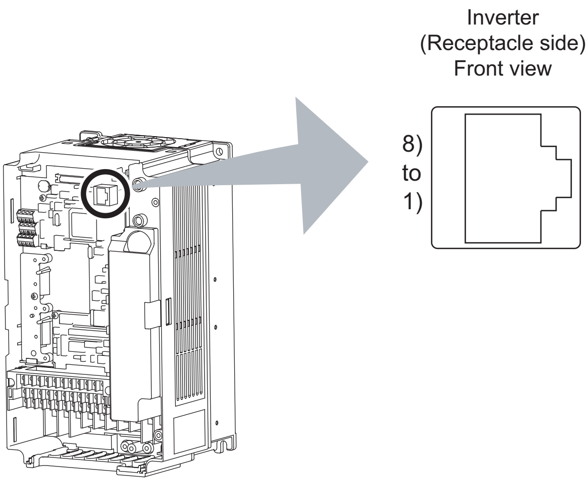
4.19 Communication operation and setting

Purpose	Parameter that must be Set		Refer to Page
Communication operation from PU connector	**Initial setting of computer link communication (PU connector)**	**Pr. 117 to Pr. 124**	201
Communication operation from RS-485 terminals	**Initial setting of computer link communication (RS-485 terminals)**	**Pr. 331 to Pr. 337, Pr. 341**	
	Modbus-RTU communication specifications	**Pr. 331, Pr. 332, Pr. 334, Pr. 343, Pr. 539, Pr. 549**	214
Restrictions on parameter write through communication	**Communication EEPROM write selection**	**Pr. 342**	202

4.19.1 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



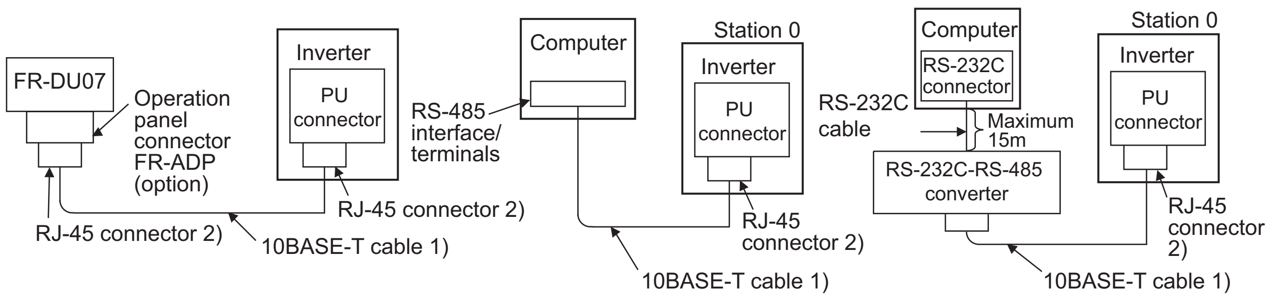
Pin Number	Name	Description
1)	SG	Earth (Ground) (connected to terminal 5)
2)	—	Operation panel power supply
3)	RDA	Inverter receive+
4)	SDB	Inverter send-
5)	SDA	Inverter send+
6)	RDB	Inverter receive-
7)	SG	Earth (Ground) (connected to terminal 5)
8)	—	Operation panel power supply

CAUTION

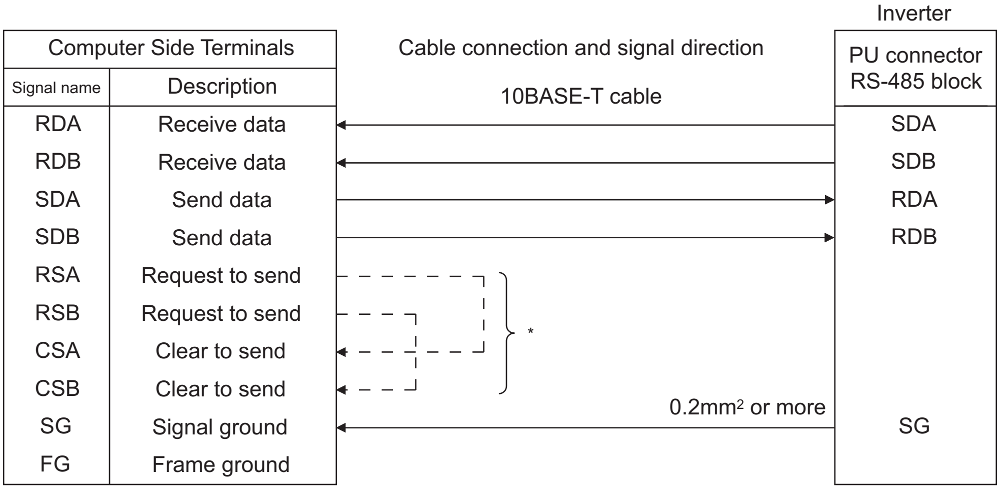
- Pins No. 2 and 8 provide power to the operation panel or parameter unit. Do not use these pins for RS-485 communication.
- Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. The product could be damaged due to differences in electrical specifications.

(2) PU connector communication system configuration and wiring

● System configuration



● Connection with RS-485 computer



* Make connections in accordance with the manual of the computer used. Fully check the terminal numbers of the computer since they change with the model.

REMARKS

· Computer-inverter connection cable
Refer to the following for the cable (RS-232C ⇔ RS-485 converter) for connection of the computer having the RS-232C interface with the inverter. Commercially available product examples (as of April, 2004)

Type	Maker
FA-T-RS40□ *	Mitsubishi Electric Engineering Co., Ltd.

* The converter cable cannot connect two or more inverters (the computer and inverter are connected on a 1:1 basis). Since the product is packed with the RS-232C cable and RS-485 cable (10BASE-T + RJ-45 connector), the cable and connector need not be prepared separately. Contact a maker for details of the product.

· Refer to the following when fabricating the cable on the user side.
Commercially available product examples (as of April, 2004)

	Product	Type	Maker
1)	10BASE-T cable	SGLPEV-T 0.5mm × 4P *	Mitsubishi Cable Industries, Ltd.
2)	RJ-45 connector	5-554720-3	Tyco Electronics Corporation

* Do not use pins No. 2, 8 of the 10- BASE-T cable.

CAUTION

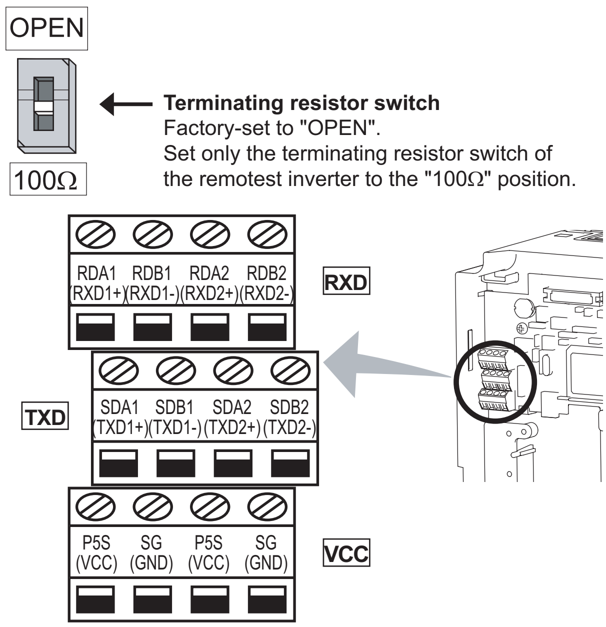
When performing RS-485 communication with multiple inverters, use the RS-485 terminals. *(Refer to page 199)*

4

PARAMETERS

4.19.2 Wiring and arrangement of RS-485 terminals

(1) RS-485 terminal layout



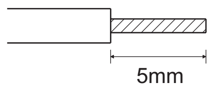
Name	Description
RDA1 (RXD1+)	Inverter receive+
RDB1 (RXD1-)	Inverter receive-
RDA2 (RXD2+)	Inverter receive+ (for branch)
RDB2 (RXD2-)	Inverter receive- (for branch)
SDA1 (TXD1+)	Inverter send+
SDB1 (TXD1-)	Inverter send-
SDA2 (TXD2+)	Inverter send+ (for branch)
SDB2 (TXD2-)	Inverter send- (for branch)
P5S (VCC)	5V Permissible load current 100mA
SG (GND)	Earth (Ground) (connected to terminal SD)

(2) Connection of RS-485 terminals and wires

Loosen the terminal screw and insert the cable into the terminal.

Screw size	M2
Tightening torque	0.22N•m to 0.25N•m
Cable size	0.3mm^2 to 0.75mm^2
Screwdriver	Small ⊖ flat-blade screwdriver (Tip thickness: 0.4mm /tip width: 2.5mm)

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



Use a bar terminal as necessary.

CAUTION

Undertightening can cause signal loss or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.

REMARKS

Information on bar terminals

Introduced products (as of Novenver, 2005): Phoenix Contact Co.,Ltd.

Terminal Screw Size	Bar Terminal Model (with insulation sleeve)	Bar Terminal Model (without insulation sleeve)	Wire Size (mm^2)
M2	AI 0.5-6WH	A 0.5-6	0.3 to 0.5

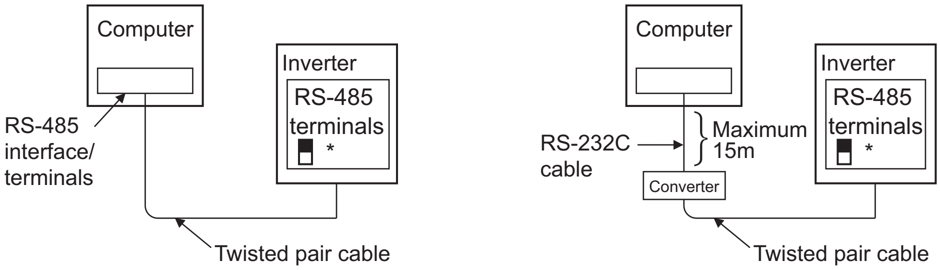
☞Bar terminal crimping tool: CRIMPFOX ZA3 (Phoenix Contact Co., (Ltd.))

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).

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

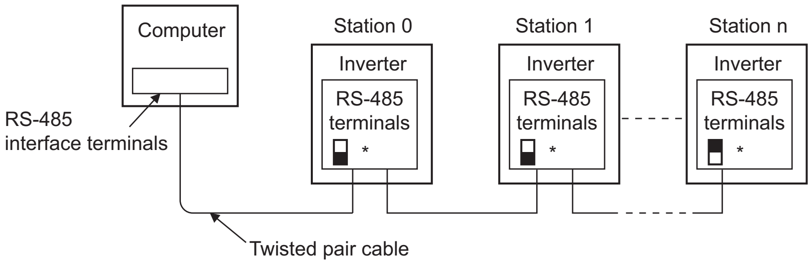
(3) RS-485 terminal system configuration

● Connection of a computer to the inverter (1:1 connection)

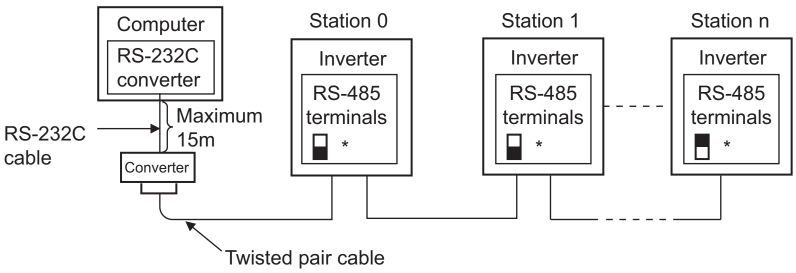


*Set the terminating resistor switch to the "100Ω" position.

● Combination of computer and multiple inverters (1:n connection)



*Set only the terminating resistor switch of the remotest inverter to the "100Ω" position.



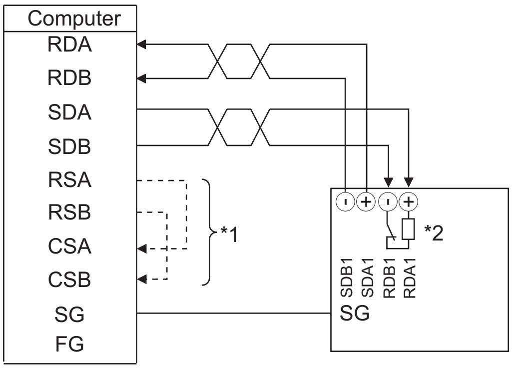
*Set only the terminating resistor switch of the remotest inverter to the "100Ω" position.

4

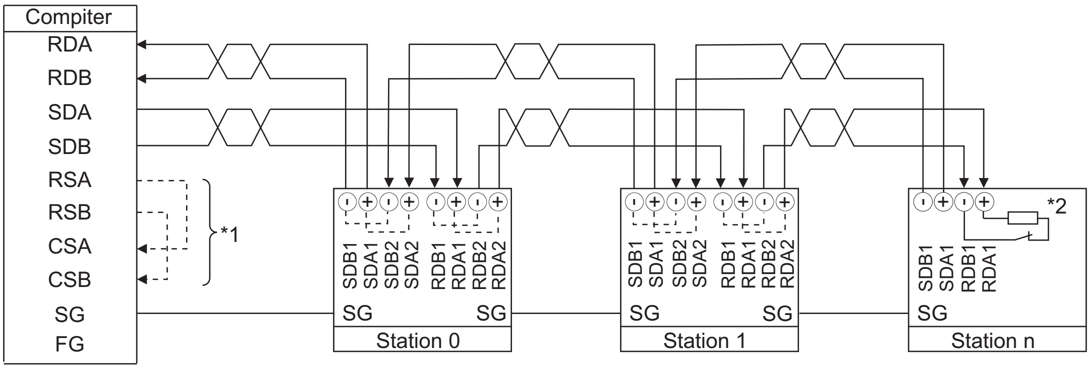
PARAMETERS

(4) RS-485 terminal wiring method

● Wiring of one RS-485 computer and one inverter



● Wiring of one RS-485 computer and "n" inverters (several inverters)

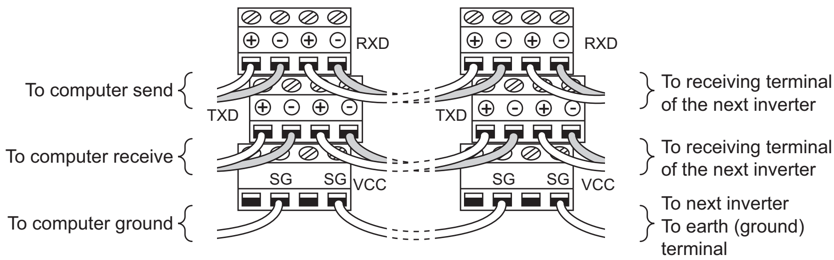


*1 Make connections in accordance with the manual of the computer used.
Fully check the terminal numbers of the computer since they change with the model.

*2 For the inverter farthest from the computer, set the terminating resistor switch to ON (100Ω side).

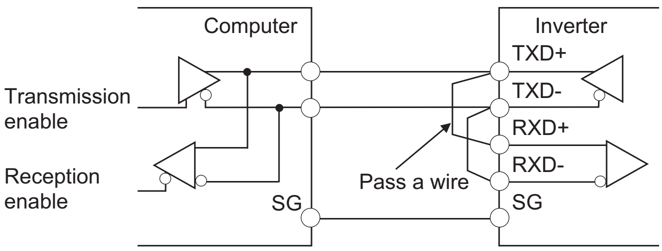
REMARKS

For branching, connect the wires as shown below.



(5) 2-wire type connection

If the computer is 2-wire type, pass wires across receiving terminals and transmission terminals of the RS-485 terminals to enable 2-wire type connection with the inverter.



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.

4.19.3 Initial settings and specifications of RS-485 communication (Pr. 117 to Pr. 124, Pr. 331 to Pr. 337, Pr. 341, Pr. 549)

Used to perform required settings for communication between the inverter and personal computer.

- There are two different communications: communication using the PU connector of the inverter and communication using the RS-485 terminals.
- You can perform parameter setting, monitor, etc. from the PU connector or RS-485 terminals of the inverter using the Mitsubishi inverter protocol (computer link communication).
- To make communication between the personal computer and inverter, initialization of the communication specifications must be made to the inverter.
  Data communication cannot be made if the initial settings are not made or there is any setting error.

[PU connector communication related parameter]

<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</td><td colspan="2">Specify the inverter station number.
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">Set the communication speed.
The setting value × 100 equals the communication speed.
For example, the communication speed is 19200bps when the setting value is "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>1bit</td><td rowspan="2">8bit</td></tr>
<tr><td>1</td><td>2bit</td></tr>
<tr><td>10</td><td>1bit</td><td rowspan="2">7bit</td></tr>
<tr><td>11</td><td>2bit</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">121</td><td rowspan="2">Number of PU communication retries</td><td rowspan="2">1</td><td>0 to 10</td><td colspan="2">Set the permissible number of retries at occurrence of a data receive error. If the number of consecutive errors exceeds the permissible value, the inverter will come to an alarm stop.</td></tr>
<tr><td>9999</td><td colspan="2">If a communication error occurs, the inverter will not come to an alarm stop.</td></tr>
<tr><td rowspan="3">122</td><td rowspan="3">PU communication check time interval</td><td rowspan="3">9999</td><td>0</td><td colspan="2">No PU connector communication</td></tr>
<tr><td>0.1 to 999.8s</td><td colspan="2">Set the interval of communication check time.
If a no-communication state persists for longer than the permissible time, the inverter will come to an alarm stop.</td></tr>
<tr><td>9999</td><td colspan="2">No communication check (signal loss detection)</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>
</table>

[RS-485 terminal communication related parameter]

Parameter Number	Name	Initial Value	Setting Range	Description
331	**RS-485 communication station number**	0	0 to 31 (0 to 247) *1	Set the inverter station number. (same specifications as *Pr. 117*)
332	**RS-485 communication speed**	96	3, 6, 12, 24, 48, 96, 192, 384	Used to select the communication speed. (same specifications as *Pr. 118*)
333 *2	**RS-485 communication stop bit length**	1	0, 1, 10, 11	Select stop bit length and data length. (same specifications as *Pr. 119*)
334	**RS-485 communication parity check selection**	2	0, 1, 2	Select the parity check specifications. (same specifications as *Pr. 120*)
335 *3	**RS-485 communication retry count**	1	0 to 10, 9999	Set the permissible number of retries at occurrence of a data receive error. (same specifications as *Pr. 121*)
336 *3	**RS-485 communication check time interval**	0s	0	RS-485 communication can be made, but the inverter will come to an alarm stop in the NET operation mode.
			0.1 to 999.8s	Set the interval of communication check time. (same specifications as *Pr. 122*)
			9999	No communication check (signal loss detection)
337 *3	**RS-485 communication waiting time setting**	9999	0 to 150ms, 9999	Set the waiting time between data transmission to the inverter and response. (same specifications as *Pr. 123*)
341 *3	**RS-485 communication CR/LF selection**	1	0, 1, 2	Select presence/absence of CR/LF. (same specifications as *Pr. 124*)
549	**Protocol selection**	0	0	Mitsubishi inverter (computer link) protocol
			1	Modbus-RTU protocol *4

*1 When "1" (Modbus-RTU protocol) is set in *Pr. 549*, the setting range within parenthesis is applied.
*2 For the Modbus-RTU protocol, the data length is fixed to 8 bits and the stop bit depends on the *Pr. 334* setting. *(Refer to page 214)*
*3 The Modbus-RTU protocol becomes invalid.
*4 The Modbus-RTU protocol is valid for only communication from the RS-485 terminals.

CAUTION

- If communication is made without *Pr. 336 RS-485 communication check time interval* being changed from "0" (initial value), monitor, parameter read, etc. can be performed, but the inverter results in an alarm as soon as it is switched to the NET operation mode. If the operation mode at power on is the network operation mode, a communication alarm (E.SER) occurs after first communication.
  When performing operation or parameter write through communication, set "9999" or a greater value to *Pr. 336*. (The setting depends on the computer side program.) *(Refer to page 207)*
- 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.

4.19.4 Communication EEPROM write selection (Pr. 342)

Parameters written via the inverter's PU connector, RS-485 terminals or from the communication option can be written to the RAM. Set this parameter when frequent parameter changes are required.

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 the RAM.

The above parameters can be set any time when the communication option is connected. *(Refer to page 180)*

- When changing the parameter values frequently, set "1" in *Pr. 342* to write them to the RAM. 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 *Pr. 342* is set to "1" (only RAM write), the new values of the parameters will be cleared at power supply-off of the inverter. Therefore, the parameter values available when power is switched on again are the values stored in EEPROM previously.

4.19.5 Mitsubishi inverter protocol (computer link communication)

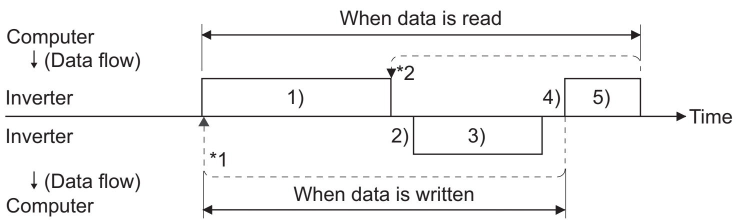
You can perform parameter setting, monitor, etc. from the PU connector or RS-485 terminals of the inverter using the Mitsubishi inverter protocol (computer link communication).

(1) Communication specifications

· The communication specifications are given below.

Item		Description	Related Parameters
Communication protocol		Mitsubishi protocol (computer link)	Pr. 551
Conforming standard		EIA-485 (RS-485)	—
Number of inverters connected		1:N (maximum 32 units), setting is 0 to 31 stations	Pr. 117 Pr. 331
Communication speed	**PU connector**	Selected from among 4800/9600/19200 and 38400bps	Pr. 118
	RS-485 terminal	Can be selected from 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400bps	Pr. 332
Control protocol		Asynchronous system	—
Communication method		Half-duplex system	—
Communication specifications	**Character system**	ASCII (7 bits or 8 bits can be selected)	Pr. 119 Pr. 333
	Start bit	1bit	—
	Stop bit length	1 bit or 2 bits can be selected	Pr. 119 Pr. 333
	Parity check	Check (even, odd) or no check can be selected	Pr. 120 Pr. 334
	Error check	Sum code check	—
	Terminator	CR/LF (presence or absence can be selected)	Pr. 124 Pr. 341
Waiting time setting		Selectable between presence and absence	Pr. 123 Pr. 337

(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 return data to the computer in response to the computer request.
4) After having waited for the time taken for inverter processing
5) Answer from computer in response to reply data 3) is sent. (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 comes to an alarm stop 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 comes to an alarm stop 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:

Symbol	Operation		Run Command	Running Frequency	Parameter Write	Inverter Reset	Monitor	Parameter Read
1)	Communication request is sent to the inverter in accordance with the user program in the computer.		A A'	A	A	A	B	B
2)	Inverter data processing time		Present	Present	Present	Absent	Present	Present
3)	Reply data from the inverter (Data 1) is checked for error)	No error *1 (Request accepted)	C	C	C	C *2	E E'	E
		With error. (Request rejected)	D	D	D	D *2	D	D
4)	Computer processing delay time		Absent	Absent	Absent	Absent	Absent	Absent
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	Absent	Absent (C)	Absent (C)
		With error (Inverter re-outputs 3))	Absent	Absent	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 205)*
*2 The inverter response to the inverter reset request can be selected. *(Refer to page 209)*

1)Communication request data from the computer to the inverter

Format	Number of Characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
A (Data write)	ENQ *1	Inverter station number *2		Instruction code		Waiting time *3	Data				Sum check		*4
A' (Data write)	ENQ *1	Inverter station number *2		Instruction code		Waiting time *3	Data		Sum check		*4		
B (Data read)	ENQ *1	Inverter station number *2		Instruction code		Waiting time *3	Sum check		*4				

3)Reply data from the inverter to the computer

· When data is written

Format	Number of Characters				
	1	2	3	4	5
C (No data error detected)	ACK *1	Inverter station number *2		*4	
D (Data error detected)	NAK *1	Inverter station number *2		Error Code	*4

· When data is read

Format	Number of Characters										
	1	2	3	4	5	6	7	8	9	10	11
E (No data error detected)	STX *1	Inverter station number *2		Read data				ETX *1	Sum check		*4
E' (No data error detected)	STX *1	Inverter station number *2		Read data		ETX *1	Sum check		*4		
D (Data error detected)	NAK *1	Inverter station number *2		Error Code	*4						

5)Send data from the computer to the inverter during data read

Format	Number of Characters			
	1	2	3	4
C (No data error detected)	ACK *1	Inverter station number *2		*4
F (Data error detected)	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 When *Pr. 123, Pr. 337 (waiting time setting)* ≠ "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, CR (carriage return) and LF (line feed) codes 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 or Pr. 341 (CR/LF selection)*.

(4) Data definitions

1) Control codes

Signal Name	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

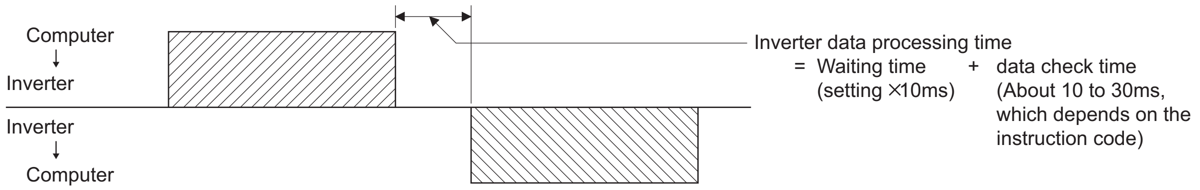
Specify the processing request, e.g. operation or monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. *(Refer to page 310)*

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 310)*

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 (e.g. 1 = 10ms, 2 = 20ms).

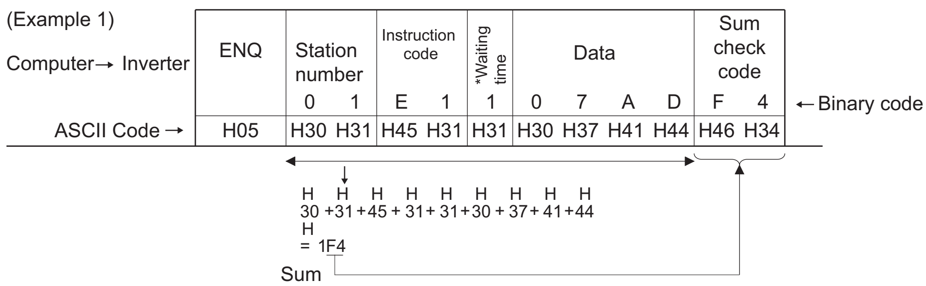


REMARKS

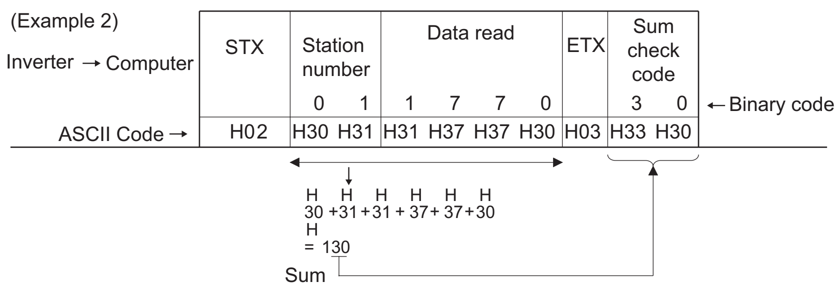
- When *Pr. 123, Pr. 337 (waiting time setting)* ≠ "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)
- The data check time changes depending on the instruction code. *(Refer to page 206)*

6) Sum check code

The 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



* 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.)

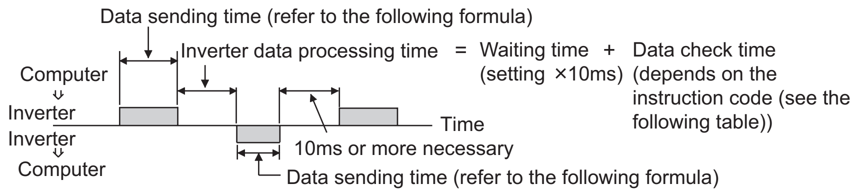


7) Error Code

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 consecutively detected in communication request data from the computer is greater than allowed number of retries.	Brought to an alarm stop if error occurs continuously more than the allowable number of retries. (E.PUE/E.SER)
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 receive 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 alarm stop.
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 is not brought to alarm stop.
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	—	—	—

(5) Response time



[Formula for data sending time]

$\dfrac{1}{\text{Communication speed (bps)}}$ × Number of data characters *(Refer to page 204)* × Communication specifications (total number of bits) = Data send time (s) (See below.)

●Communication specifications

Name		Number of Bits
Stop bit length		1 bit 2 bits
Data length		7 bits 8 bits
Parity check	Yes	1 bit
	No	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

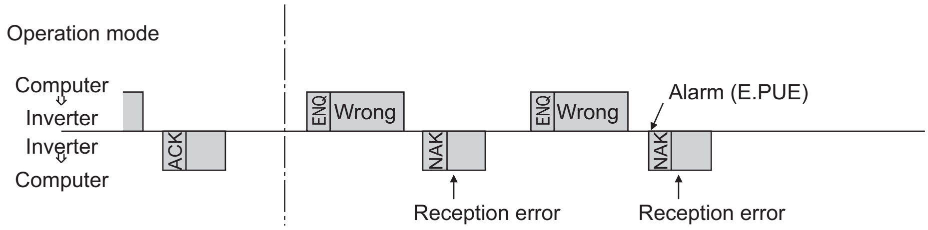
●Data check time

Item	Check Time
Various monitors, run command, frequency setting (RAM)	< 12ms
Parameter read/write, frequency setting (EEPROM)	< 30ms
Parameter clear/all clear	< 5s
Reset command	No answer

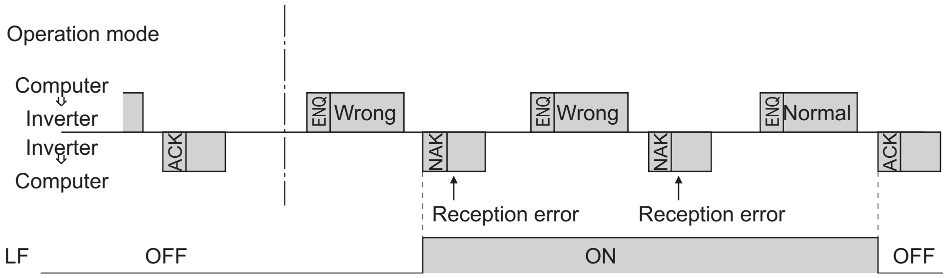
(6) Retry count setting (*Pr. 121, Pr. 335*)

- Set the permissible number of retries at occurrence of a data receive error. (Refer to *page 206* for data receive error for retry)
- When data receive errors occur consecutively and exceed the permissible number of retries set, an inverter alarm (E.PUE) is provided and the output is shut off.
- When "9999" is set, an inverter alarm is not provided even if data receive error occurs but a minor fault output 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 any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

Example: PU connector communication, *Pr. 121* = "1" (initial value)



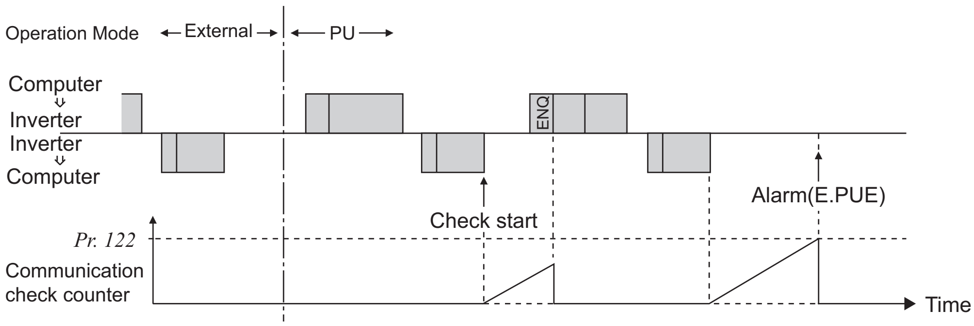
Example: PU connector communication, *Pr. 121* = "9999"



(7) Signal loss detection *(Pr. 122, Pr. 336 RS-485 communication check time interval)*

- If a signal loss (communication stop) is detected between the inverter and computer as a result of a signal loss detection, a communication error (PU connector communication: E.PUE, RS-485 terminal communication: E.SER) occurs and the inverter output is shut off.
- When the setting is "9999", communication check (signal loss detection) is not made.
- When the setting is "0", communication from the PU connector cannot be performed. For communication via the RS-485 terminals, monitor, parameter read, etc. can be peformed, but a communication error (E.SER) occurs as soon as the inverter is switched to network operation mode.
- 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 (control code *refer to page 205*) from the computer within the communication check time interval. (The send data has nothing to do with the station number)
- Communication check is started at the first communication in the operation mode having the operation source (PU operation mode for PU connector communication in the initial setting or network operation mode for RS-485 terminal communication).

Example: PU connector communication, *Pr. 122* = "0.1 to 999.8s"



4

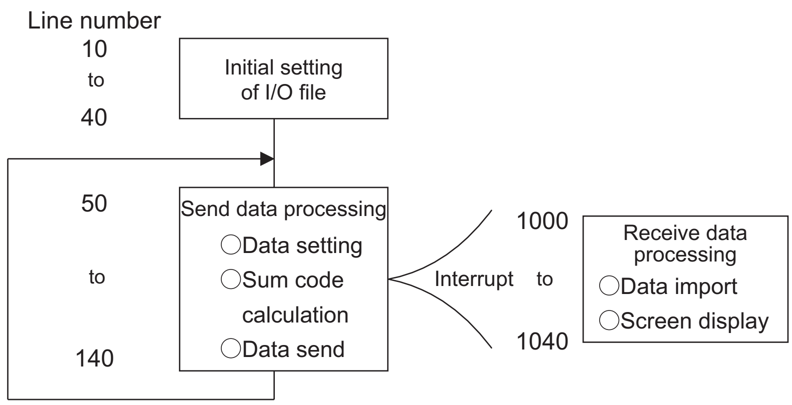
PARAMETERS

(8) Instructions for the program

1) When data from the computer has any error, the inverter does not accept that error. Hence, in the user program, always insert a retry program for data error.
2) All data communication, e.g. 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

```
                                              Initial setting of I/O file
  10 OPEN"COM1:9600,E,8,2,HD"AS #1            : Communication file open
  20 COMST1,1,1:COMST1,2,1                    : Circuit control signal (RS, ER) ON/OFF setting
  30 ON COM(1)GOSUB*REC                       : Interrupt definition at data receive
  40 COM(1)ON                                 : Interrupt enable
  50 D$="01FB10002"                           Send data setting
  60 S=0
  70 FOR I=1 TO LEN(D$)
  80 A$=MID$(D$,I,1)
  90 A=ASC(A$)
 100 S=S+A                                    Sum code calculation
 110 NEXTI
 120 D$=CHR$(&H5)+D$+RIGHT$(HEX$(S),2)        : Addition of control code and sum code
 130 PRINT#1,D$                               Data transmission
 140 GOTO 50
1000 *REC                                     Interrupt data receive
1010 IF LOC(1)=0 THEN RETURN                  : Interrupt occurrence at data receive
1020 PRINT"RECEIVE DATA"
1030 PRINT INPUT$(LOC(1),#1)
1040 RETURN
```

General flow



⚠ 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 loss etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to an alarm stop (E.PUE, E.SER). The inverter can be coasted to a stop by switching on its RES signal or by switching power off.

⚠ If communication is broken due to signal loss, computer fault etc., the inverter does not detect such a fault. This should be fully noted.

(9) Setting items and set data

After completion of parameter setting, set the instruction codes and data then start communication from the computer to allow various types of operation control and monitoring.

No.	Item		Read/ Write	Instruction Code	Data Description	Number of Data Digits (format)
1	Operation mode		Read	H7B	H0000: Network operation H0001: External operation H0002: PU operation (RS-485 communication operation via PU connector)	4 digits (B.E/D)
			Write	HFB		4 digits (A,C/D)
2	Monitor	Output frequency/ speed	Read	H6F	H0000 to HFFFF: Output frequency in 0.01Hz increments Speed in 1r/min increments (when *Pr. 37* = 1 to 9998 or *Pr. 144* = 2 to 10, 102 to 110)	4 digits (B.E/D)
		Output current	Read	H70	H0000 to HFFFF: Output current (hexadecimal) in 0.01A increments (55K or less) / 0.1A increments (75K or more)	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	4 digits (B.E/D)
		Special monitor selection No.	Read	H73	H01 to H3C: Monitor selection data Refer to the special monitor No. table *(page 211)*	2digits (B.E'/D)
			Write	HF3		2digits (A',C/D)
		Alarm definition	Read	H74 to H77	H0000 to HFFFF: Two most recent alarm definitions b15 b8 b7 b0 H74: Second alarm in past / Latest alarm H75: Fourth alarm in past / Third alarm in past H76: Sixth alarm in past / Fifth alarm in past H77: Eighth alarm in past / Seventh alarm in past Refer to the alarm data table *(page 212)*	4 digits (B.E/D)
3	Run command (extended)		Write	HF9	You can set the control input commands such as the forward rotation signal (STF) and reverse rotation signal (STR). (*Refer to page 212* for details)	4 digits (A,C/D)
	Run command		Write	HFA		2digits (A',C/D)
4	Inverter status monitor (extended)		Read	H79	You can monitor the status of the output signals such as forward rotation, reverse rotation and inverter running (RUN). (*Refer to page 213* for details)	4 digits (B.E/D)
	Inverter status monitor		Read	H7A		2digits (B.E'/D)
5	Set frequency (RAM)		Read	H6D	Read the set frequency/speed from the RAM or EEPROM. H0000 to HFFFF: Set frequency in 0.01Hz increments Speed in 1r/min increments (When *Pr. 37* = 1 to 9998 or *Pr. 144* = 2 to 10, 102 to 110)	4 digits (B.E/D)
	Set frequency (EEPROM)		Read	H6E		
	Set frequency (RAM)		Write	HED	Write the set frequency/speed into the RAM or EEPROM. H0000 to H2EE0 (0 to 120Hz (22K or less), 0 to 60Hz (30K or more) : frequency in 0.01Hz increments H0000 to H270E (0 to 9998) : speed in r/min increments (when *Pr. 37* = 1 to 9998 or *Pr. 144* = 2 to 10, 102 to 110) · To change the running frequency consecutively, write data to the inverter RAM. (Instruction code: HED)	4 digits (A,C/D)
	Set frequency (RAM, EEPROM)		Write	HEE		
6	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)
7	Alarm definition all clear		Write	HF4	H9696: Alarm history batch clear	4 digits (A,C/D)

Refer to *page 204* for data formats (A, A', B, B', C, D)

<table>
<tr><th>No.</th><th>Item</th><th>Read/ Write</th><th>Instruction Code</th><th>Data Description</th><th>Number of Data Digits (format)</th></tr>
<tr><td>8</td><td>All parameter clear</td><td>Write</td><td>HFC</td><td>All parameters return to the initial values.
Any of four different all clear operations are performed according to the data.
<table>
<tr><th>Data \ Pr.</th><th>Communi-cation Pr. *1</th><th>Calibration Pr. *2</th><th>Other Pr. *3</th><th>HEC HF3 HFF</th></tr>
<tr><td>H9696</td><td>○</td><td>×</td><td>○</td><td>○</td></tr>
<tr><td>H9966</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>H5A5A</td><td>×</td><td>×</td><td>○</td><td>○</td></tr>
<tr><td>H55AA</td><td>×</td><td>○</td><td>○</td><td>○</td></tr>
</table>
When all parameter clear is executed for H9696 or H9966, communication-related parameter settings also return to the initial values. When resuming operation, set the parameters again.
*1 Refer to page 201, 202.
*2 Refer to the list of calibration parameters on the next page for calibration parameters.
*3 Pr. 75 is not cleared</td><td>4 digits (A,C/D)</td></tr>
<tr><td>9</td><td rowspan="2">Parameters</td><td>Read</td><td>H00 to H63</td><td rowspan="2">Refer to the instruction code (page 310) and write and/or read the values as required.
When setting Pr. 100 and later, link parameter extended setting must be set.</td><td>4 digits (B.E/D)</td></tr>
<tr><td>10</td><td>Write</td><td>H80 to HE3</td><td>4 digits (A,C/D)</td></tr>
<tr><td rowspan="2">11</td><td 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 setting.
For details of the setting, refer to the instruction code (page 310).</td><td>2digits (B.E'/D)</td></tr>
<tr><td>Write</td><td>HFF</td><td>2digits (A',C/D)</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">Second parameter changing (instruction code HFF=1, 9)</td><td>Read</td><td>H6C</td><td rowspan="2">When setting the calibration parameters *1
H00:Frequency *2
H01: Parameter-set analog value
H02: Analog value input from terminal
*1 Refer to the list of calibration parameters on the next page for calibration parameters.
*2 The gain frequency can also be written using Pr. 125 (instruction code H99) or Pr. 126 (instruction code H9A).</td><td>2digits (B.E'/D)</td></tr>
<tr><td>Write</td><td>HEC</td><td>2digits (A',C/D)</td></tr>
</table>

Refer to *page 204* for data formats (A, A', B, B', C, D)

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" in the extended link parameter.
2)	ENQ 00 EC 0 01 7E	ACK 00	Set "H01" in 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 frquency	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

[Special monitor selection No.]

Refer to *page 137* for details of the monitor description.

Data	Description	Increments
H01	Output frequency	0.01Hz
H02	Output current	0.01A/ 0.1A *1
H03	Output voltage	0.1V
H05	Frequency setting	0.01Hz
H06	Running speed	1r/min
H07	Motor torque	0.1%
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/ 0.1A *1
H0C	Converter output voltage peak value	0.1V

Data	Description	Increments
H0D	Input power	0.01kW/ 0.1kW *1
H0E	Output power	0.01kW/ 0.1kW *1
H0F	Input terminal status *2	—
H10	Output terminal status *3	—
H11	Load meter	0.1%
H12	Motor excitation current	0.01A/ 0.1A *1
H13	Position pulse	—
H14	Cumulative energization time	1h
H16	Orientation status	—
H17	Actual operation time	1h
H18	Motor load factor	0.1%
H19	Cumulative power	1kWh

Data	Description	Increments
H22	Motor output	0.01kW/ 0.1kW *1
H32	Power saving effect	Variable
H33	Cumulative saving power	Variable
H34	PID set point	0.1%
H35	PID measured value	0.1%
H36	PID deviation value	0.1%
H3A	Option input terminal status1 *4	—
H3B	Option input terminal status2 *5	—
H3C	Option output terminal status *6	—

*1 The setting depends on capacities. (55K or less / 75K or more)

*2 Input terminal monitor details

b15 … b0

—	—	—	—	CS	RES	STOP	MRS	JOG	RH	RM	RL	RT	AU	STR	STF

*3 Output terminal monitor details

b15 … b0

—	—	—	—	—	—	—	—	—	ABC2	ABC1	FU	OL	IPF	SU	RUN

*4 Details of option input terminal monitor 1 (input terminal status of FR-A7AX)-all terminals are off when an option is not fitted

b15 … b0

X15	X14	X13	X12	X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1	X0

*5 Details of option input terminal monitor 2 (input terminal status of FR-A7AX)-all terminals are off when an option is not fitted

b15 … b0

—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	DY

*6 Details of option output terminal monitor (output terminal status of FR-A7AY/A7AR)-all terminals are off when an option is not fitted

b15 … b0

—	—	—	—	—	—	RA3	RA2	RA1	Y6	Y5	Y4	Y3	Y2	Y1	Y0

[Alarm data]

Refer to *page 265* for details of alarm description.

Data	Description	Data	Description	Data	Description
H00	No alarm	H91	E.PTC	HD6	E.MB2
H10	E.OC1	HA0	E.OPT	HD7	E.MB3
H11	E.OC2	HA3	E.OP3	HD8	E.MB4
H12	E.OC3	HB0	E.PE	HD9	E.MB5
H20	E.OV1	HB1	E.PUE	HDA	E.MB6
H21	E.OV2	HB2	E.RET	HDB	E.MB7
H22	E.OV3	HB3	E.PE2	HDC	E.EP
H30	E.THT	HC0	E.CPU	HF1	E.1
H31	E.THM	HC1	E.CTE	HF2	E.2
H40	E.FIN	HC2	E.P24	HF3	E.3
H50	E.IPF	HC4	E.CDO	HF6	E.6
H51	E.UVT	HC5	E.IOH	HF7	E.7
H52	E.ILF	HC6	E.SER	HFD	E.13
H60	E.OLT	HC7	E.AIE		
H70	E.BE	HC8	E.USB		
H80	E.GF	HD0	E.OS		
H81	E.LF	HD2	E.ECT		
H90	E.OHT	HD5	E.MB1		

Alarm description display example (instruction code H74)

For read data H30A0
(Previous alarm ...... THT)
(Latest alarm ...... OPT)

b15 b8 b7 b0

0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0

Previous alarm (H30) Latest alarm (HA0)

[Run command]

Item	Instruction Code	Bit Length	Description	Example
Run command	HFA	8bit	b0: AU (current input selection) *1 b1: Forward rotation command b2: Reverse rotation command b3: RL (low speed operation command) *1 b4: RM (middle speed operation command) *1 b5: RH (high speed operation command) *1 b6: RT (second function selection) *1 b7: MRS (output stop) *1	[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	16bit	b0:AU (current input selection) *1 b1:Forward rotation command b2:Reverse rotation command b3:RL (low speed operation command) *1 b4:RM (middle speed operation command) *1 b5: RH (high speed operation command) *1 b6:RT (second function selection) *1 b7:MRS (output stop) *1 b8:JOG (Jog operation) *2 b9:CS (selection of automatic restart after instantaneous power failure) *2 b10: STOP (start self-holding) *2 b11:RES (reset) *2 b12:— b13:— b14:— 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] H0800 low speed operation (When *Pr. 189 RES terminal function selection* is set to "0") b15 b0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0

*1 The signal within parentheses is the initial setting. The description changes depending on the setting of *Pr. 180 to Pr. 184, Pr. 187 (input terminal function selection) (page 118)*.

*2 The signal within parentheses is the initial setting. Since jog operation/selection of automatic restart after instantaneous power failure/start self-holding/reset cannot be controlled by the network, bit 8 to bit 11 are invalid in the initial status. When using bit 8 to bit 11, change the signals with *Pr. 185, Pr. 186, Pr. 188, Pr. 189 (input terminal function selection) (page 125)*. (Reset can be executed with the instruction code HFD.)

[Inverter status monitor]

Item	Instruction Code	Bit Length	Description	Example
Inverter status monitor	H7A	8bit	b0:RUN (inverter running)* b1:Forward rotation b2:Reverse rotation b3:SU (up to frequency) * b4:OL (overload) * b5:IPF (instantaneous power failure) * b6:FU (frequency detection)* b7:ABC1 (alarm) *	[Example 1] H02 ··· During forward rotation b7 b0 0 0 0 0 0 0 1 0 [Example 2] H80 ··· Stop at alarm occurrence b7 b0 0 0 0 0 0 0 1 0
Inverter status monitor (extended)	H79	16bit	b0:RUN (inverter running) * b1:Forward rotation b2:Reverse rotation b3:SU (up to frequency) * b4:OL (overload) * b5:IPF (instantaneous power failure) * b6:FU (frequency detection) * b7:ABC1 (alarm) * b8:ABC2 (—)* b9:— b10:— b11:— b12:— b13:— b14:— b15: Alarm 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 alarm occurrence b15 b0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0

* The signal within parentheses is the initial setting. The description changes depending on the setting of *Pr. 190 to Pr. 196 (output terminal function selection)*.

4

PARAMETERS

4.19.6 Modbus-RTU communication specifications (Pr. 331, Pr. 332, Pr. 334, Pr. 343, Pr.539, Pr. 549)

Using the Modbus-RTU communication protocol, communication operation or parameter setting can be performed from the RS-485 terminals of the inverter.

Parameter Number	Name	Initial Value	Setting Range	Description
331	**RS-485 communication station number**	0	0	Broadcast communication is selected.
			1 to 247	Specify the inverter station number. Set the inverter station numbers when two or more inverters are connected to one personal computer.
332	**RS-485 communication speed**	96	3, 6, 12, 24, 48, 96, 192, 384	Set the communication speed. The setting value × 100 equals the communication speed. For example, the communication speed is 9600bps when the setting value is "96".
334	**RS-485 communication parity check selection**	2	0	Without parity check Stop bit length 2bits
			1	With odd parity check Stop bit length 1bit
			2	With even parity check Stop bit length 1bit
343	**Communication error count**	0	—	Display the number of communication errors during Modbus-RTU communication. Reading only
539	**Modbus-RTU communication check time interval**	9999	0	Modbus-RTU communication can be made, but the inverter will come to an alarm stop in the NET operation mode.
			0.1 to 999.8s	Set the interval of communication check time. (same specifications as *Pr. 122*)
			9999	No communication check (signal loss detection)
549	**Protocol selection**	0	0	Mitsubishi inverter (computer link) protocol
			1	Modbus-RTU protocol

CAUTION

When Modbus-RTU communication is performed from the master with address 0 (station 0) set, broadcast communication is selected and the inverter does not send a response message to the master.
When response from the inverter is necessary, set a value other than "0" in *Pr. 331* (initial value 0).
Some functions are invalid for broadcast communication. *(Refer to page 216)*

REMARKS

- When using the Modbus-RTU protocol, set *Pr. 549 Protocol selection* to "1".
- When the communication option is fitted with *Pr. 550 NET mode operation command source selection* set to "9999" (initial value), the command source (e.g. run command) from the RS-485 terminals is invalid. *(Refer to page 191)*

(1) Communication specifications

- The communication specifications are given below.

Item		Description	Related Parameters
Communication protocol		Modbus-RTU protocol	Pr. 549
Conforming standard		EIA-485 (RS-485)	—
Number of inverters connected		1: N (maximum 32 units), setting is 0 to 247 stations	Pr. 331
Communication speed		Can be selected from 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400bps	Pr. 332
Control protocol		Asynchronous system	—
Communication method		Half-duplex system	—
Communication specifications	**Character system**	Binary(fixed to 8 bits)	—
	Start bit	1bit	—
	Stop bit length	Select from the following three types · No parity, stop bit length 2 bits · Odd parity, stop bit length 1 bit · Even parity, stop bit length 1 bit	Pr. 334
	Parity check		
	Error check	CRC code check	—
	Terminator	Not used	—
Waiting time setting		Not used	—

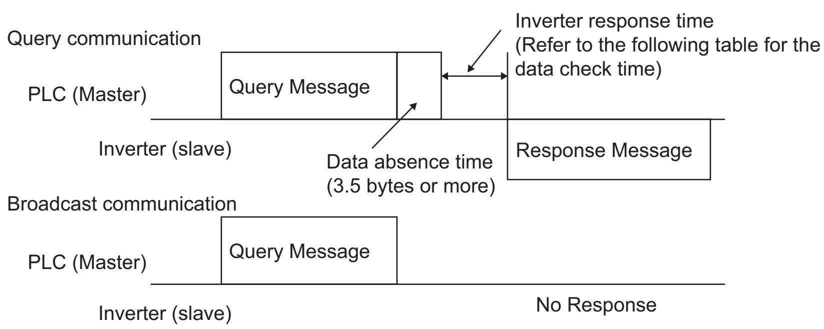
(2) Outline

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-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)	< 12ms
Parameter read/write, frequency setting (EEPROM)	< 30ms
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

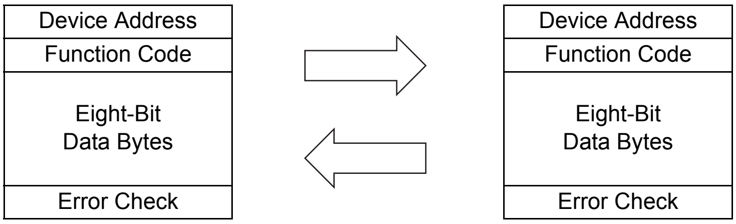
The slave executes the function independently of the inverter station number setting (*Pr. 331*) during broadcast communication.

(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 as they are, 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.

Query message from Master



Response message from slave

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
T1	8bit	8bit	n × 8bit	L 8bit	H 8bit	T1

<table>
<tr><th>Message Field</th><th>Description</th></tr>
<tr><td>1) ADDRESS field</td><td>The address 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. 331 RS-485 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 from 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>Disallowed</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>Makes a function diagnosis.
(communication check only)</td><td>Disallowed</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>Disallowed</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 217). 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 216* will be explained.

- **Read holding register data (H03 or 03)**
  Can read the description of 1) system environment variables, 2) real-time monitor, 3) alarm history, and 4) inverter parameters assigned to the holding register area (refer to the register list *(page 222)*).

Query Message

1) Slave Address	2) Function	3) Starting Address		4) No. of Points		CRC Check	
(8bit)	H03 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

Normal response (Response message)

1) Slave Address	2) Function	5) Byte Count	6) Data			CRC Check	
(8bit)	H03 (8bit)	(8bit)	H (8bit)	L (8bit)	... (n × 16bit)	L (8bit)	H (8bit)

· **Query message setting**

Message	Setting Description
1)Slave Address	Set the 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	Set the 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 H14 (2 to 20). Twice greater than the No. of Points specified at 4) is set.
6)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 (8bit)	H03 (8bit)	H03 (8bit)	HEB (8bit)	H00 (8bit)	H03 (8bit)	H77 (8bit)	H2B (8bit)

Normal response (Response message)

Slave Address	Function	Byte Count	Data						CRC Check	
H11 (8bit)	H03 (8bit)	H06 (8bit)	H17 (8bit)	H70 (8bit)	H0B (8bit)	HB8 (8bit)	H03 (8bit)	HE8 (8bit)	H2C (8bit)	HE6 (8bit)

Read value
Register 41004 *(Pr. 4)*: H1770 (60.00Hz)
Register 41005 *(Pr. 5)*: H0BB8 (30.00Hz)
Register 41006 *(Pr. 6)*: H03E8 (10.00Hz)

- **Write multiple holding register data (H06 or 06)**

  You 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 222)*).

Query message

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8bit)	H06 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

Normal response (Response message)

1) Slave Address	2) Function	3) Register Address		4) Preset Data		CRC Check	
(8bit)	H06 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

· **Query message setting**

Message	Setting Description
1) Slave Address	Set the address to which the message will be sent. Setting of address 0 enables broadcast communication
2) Function	Set H06.
3) RegisterAddress	Set the 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) Prese Data	Set the data that will be written to the holding register. The written data is fixed to 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 (8bit)	H06 (8bit)	H00 (8bit)	H0D (8bit)	H17 (8bit)	H70 (8bit)	H17 (8bit)	H99 (8bit)

Normal Response (Response message)
Same data as the query message

CAUTION

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 subfunction code H00).
Subfunction code H00 (Return Query Data)
Query Message

1) Slave Address	2) Function	3) Subfunction		4) Date		CRC Check	
(8bit)	H08 (8bit)	H00 (8bit)	H00 (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

Normal Response (Response message)

1) Slave Address	2) Function	3) Subfunction		4) Date		CRC Check	
(8bit)	H08 (8bit)	H00 (8bit)	H00 (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

· **Query message setting**

Message	Setting Description
1)Slave Address	Set the 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.

CAUTION

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	
(8bit)	H10 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	(8bit)	H (8bit)	L (8bit)	... (n × 2 × 8bit)	L (8bit)	H (8bit)

Normal Response (Response message)

1) Slave Address	2) Function	3) Starting Address		4) No. of Registers		CRC Check	
(8bit)	H10 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

· **Query message setting**

Message	Setting Description
1)Slave Address	Set the address to which the message will be sent. Setting of address 0 enables broadcast communication.
2)Function	Set H10.
3)Starting Address	Set the 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	Set the 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 (0 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 (8bit)	H10 (8bit)	H03 (8bit)	HEE (8bit)	H00 8bit)	H02 (8bit)	H04 (8bit)	H00 (8bit)	H05 (8bit)	H00 (8bit)	H0A (8bit)	H86 (8bit)	H3D (8bit)

Response message (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8bit)	H10 (8bit)	H03 (8bit)	HEE (8bit)	H00 (8bit)	H02 (8bit)	H22 (8bit)	H61 (8bit)

● **Read holding register access log (H46 or 70)**

A response can be made to a query made by the function code H03, H06 or H0F.
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	
(8bit)	H46 (8bit)	L (8bit)	H (8bit)

Normal Response (Response message)

1) Slave Address	2) Function	3) Starting Address		4) No. of Points		CRC Check	
(8bit)	H46 (8bit)	H (8bit)	L (8bit)	H (8bit)	L (8bit)	L (8bit)	H (8bit)

· **Query message setting**

Message	Setting Description
1) Slave Address	Set the 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 (8bit)	H46 (8bit)	H8B (8bit)	HD2 (8bit)

Normal Response (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8bit)	H10 (8bit)	H03 (8bit)	HEE (8bit)	H00 (8bit)	H02 (8bit)	H22 (8bit)	H61 (8bit)

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.

CAUTION

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	
(8bit)	H80 + Function (8bit)	(8bit)	L (8bit)	H (8bit)

Message	Setting Description
1) Slave address	Set the address received from the master.
2) Function	The master-requested function code + H80 is set.
3) Exception code	The code in the following table is set.

Error code list

Code	Error Item	Error Definition
01	ILLEGAL FUNCTION (Function code illegal)	The set function code in the query message from the master cannot be handled by the slave.
02	ILLEGAL DATA ADDRESS *1 (Address illegal)	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 (Data illegal)	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, they are checked for the following errors. If an error is detected, an alarm stop will not occur.

Error check item

Error Item	Error Definition	Inverter Side Operation
Parity error	The data received by the inverter differs from the specified parity (*Pr. 334* 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. 333*).	
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* and *Pr. 144* 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	Inverter status
0	Stop command	RUN (inverter running) *2
1	Forward rotation command	Forward rotation
2	Reverse rotation command	Reverse rotation
3	RH (high speed operation command) *1	SU (up to frequency) *2
4	RM (middle speed operation command) *1	OL (overload) *2
5	RL (low speed operation command) *1	IPF (instantaneous power failure) *2
6	JOG (Jog operation) *1	FU (frequency detection) *2
7	RT (second function selection) *1	ABC1 (alarm) *2
8	AU (current input selection) *1	ABC2 (—) *2
9	CS (selection of automatic restart after instantaneous power failure) *1	0
10	MRS (output stop) *1	0
11	STOP (start self-holding) *1	0
12	RES (reset) *1	0
13	0	0
14	0	0
15	0	Alarm occurrence

*1 The signal within parentheses is the initial setting. The description changes depending on the setting of *Pr. 180 to Pr. 189 (input terminal function selection) (page 118)*.
Each assigned signal is valid or invalid depending on NET. *(Refer to page 191)*
*2 The signal within parentheses is the initial setting. The description changes depending on the setting of *Pr. 190 to Pr. 196 (output terminal function selection) (page 125)*.

<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.

- Real-time monitor
  Refer to *page 137* for details of the monitor description.

Register	Definition	Increments
40201	Output frequency	0.01Hz
40202	Output current	0.01A/ 0.1A *6
40203	Output voltage	0.1V
40205	Frequency setting	0.01Hz
40206	Running speed	1r/min
40207	Motor torque	0.1%
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/ 0.1A *6
40212	Converter output voltage peak value	0.1V
40213	Input power	0.01kW/ 0.1kW *6
40214	Output power	0.01kW/ 0.1kW *6
40215	Input terminal status *1	—
40216	Output terminal status *2	—
40217	Load meter	0.1%
40218	Motor excitation current	0.01A/ 0.1A *6
40219	Position pulse	—
40220	Cumulative energization time	1h
40222	Orientation status	—
40223	Actual operation time	1h
40224	Motor load factor	0.1%
40225	Cumulative power	1kWh
40228	Motor output	0.01/ 0.1kW *6
40250	Power saving effect	Variable
40251	Cumulative saving power	Variable
40252	PID set point	0.1%
40253	PID measured value	0.1%
40254	PID deviation value	0.1%
40258	Option input terminal status1 *3	—
40259	Option input terminal status2 *4	—
40260	Option output terminal status *5	—

*1 Input terminal monitor details

b15															b0
—	—	—	—	CS	RES	STOP	MRS	JOG	RH	RM	RL	RT	AU	STR	STF

*2 Output terminal monitor details

b15															b0
—	—	—	—	—	—	—	—	—	ABC2	ABC1	FU	OL	IPF	SU	RUN

*3 Details of option input terminal monitor 1 (input terminal status of FR-A7AX)-all terminals are off when an option is not fitted

b15															b0
X15	X14	X13	X12	X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1	X0

*4 Details of option input terminal monitor 2 (input terminal status of FR-A7AX)-all terminals are off when an option is not fitted

b15															b0
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	DY

*5 Details of option input terminal monitor (output terminal status of FR-A7AY/A7AR)-all terminals are off when an option is not fitted

b15															b0
—	—	—	—	—	—	RA3	RA2	RA1	Y6	Y5	Y4	Y3	Y2	Y1	Y0

*6 The setting depends on capacities. (55K or less / 75K or more)

- Parameter

Parameters	Register	Parameter Name	Read/Write	Remarks
0 to 999	**41000 to 41999**	Refer to the parameter list *(page 55)* 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 (current) 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 (current) 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.

- Alarm history

Register	Definition	Read/Write	Remarks
40501	Alarm history 1	Read/write	Being 2 bytes in length, the data is stored as "H00○○". The error code can be referrred to in the low-order 1 byte. Performing write using the register 40501 batch-clears the alarm history. Set any value as data.
40502	Alarm history 2	Read	
40503	Alarm history 3	Read	
40504	Alarm history 4	Read	
40505	Alarm history 5	Read	
40506	Alarm history 6	Read	
40507	Alarm history 7	Read	
40508	Alarm history 8	Read	

Alarm code list

Data	Description
H00	No alarm
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
H50	E.IPF
H51	E.UVT
H52	E.ILF
H60	E.OLT
H70	E.BE
H80	E.GF
H81	E.LF
H90	E.OHT

Data	Description
H91	E.PTC
HA0	E.OPT
HA3	E.OP3
HB0	E.PE
HB1	E.PUE
HB2	E.RET
HB3	E.PE2
HC0	E.CPU
HC1	E.CTE
HC2	E.P24
HC4	E.CDO
HC5	E.IOH
HC6	E.SER
HC7	E.AIE
HD0	E.OS
HD2	E.ECT
HD5	E.MB1
HD6	E.MB2

Data	Description
HD7	E.MB3
HD8	E.MB4
HD9	E.MB5
HDA	E.MB6
HDB	E.MB7
HDC	E.EP
HF1	E.1
HF2	E.2
HF3	E.3
HF6	E.6
HF7	E.7
HFD	E.13

* Refer to *page 265* for details of alarm definition.

(7) *Pr. 343 Communication error count*

You can check the cumulative number of communication errors.

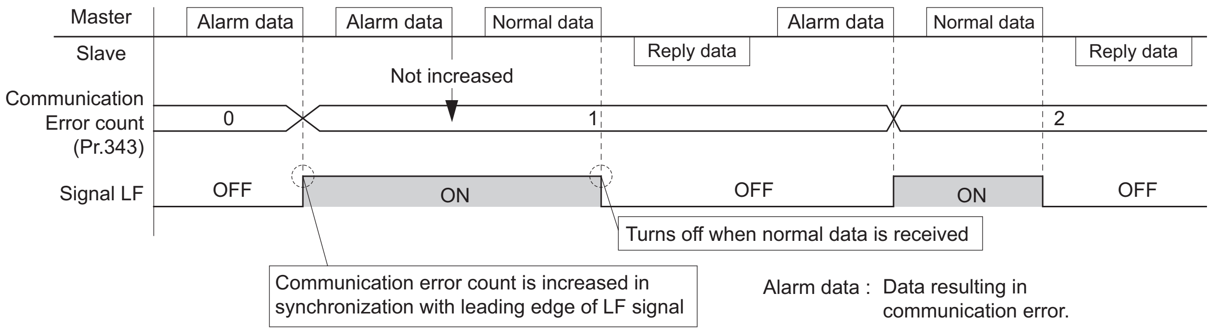
Parameters	Setting Range	Minimum Setting Range	Initial Value
343	(Read only)	1	0

CAUTION

The number of commnication 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 signal LF "minor failure output(communication error warnings)"

During a communication error, the minor failure output (LF signal) is output by open collector output. Assign the used terminal using any of *Pr. 190 to Pr. 196 (output terminal function selection)*.



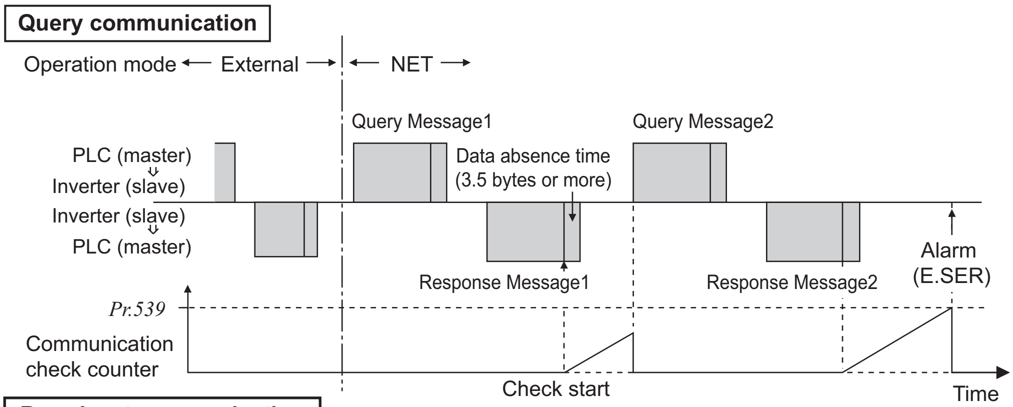
CAUTION

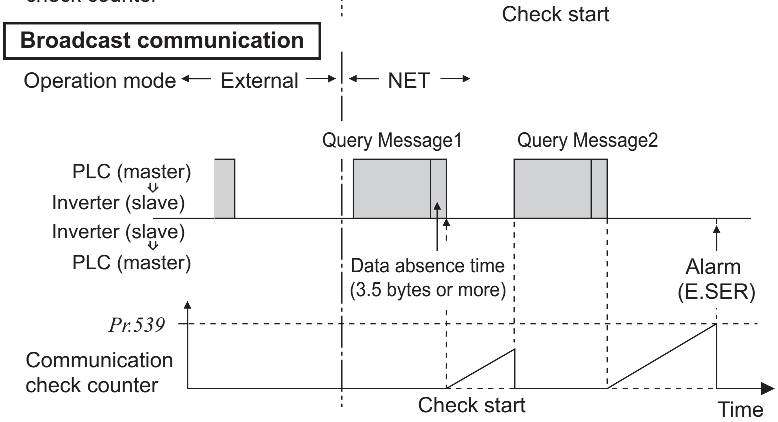
The LF signal can be assigned to the output terminal using any of *Pr. 190 to Pr. 196*. When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.

(9) Signal loss detection (*Pr. 539 Modbus-RTU communication check time interval*)

- If a signal loss (communication stop) is detected between the inverter and master as a result of a signal loss detection, a communication error (E.SER) occurs and the inverter output is shut off.
- When the setting is "9999", communication check (signal loss detection) is not made.
- When the setting value is "0", monitor, parameter read, etc. can be performed. However, a communication error (E.SER) occurs as soon as the inverter is switched to the network operation mode.
- 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 from the master 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 started from the first communication after switching to the network operation mode (use *Pr.551 PU mode operation source selection* to change).
- Communication check time of query communication includes data absence time (3.5 byte).
  Since this data absence time differs according to the communication speed, make setting considering this absence time.

Example: RS-485 terminal communication, *Pr. 539* **= "0.1 to 999.8s"**





4.20 Special operation and frequency control

Purpose	Parameter that must be Set		Refer to Page
Perform process control such as pump and air volume.	**PID control**	**Pr. 127 to Pr. 134, Pr. 575 to Pr. 577**	228
Increase speed when the load is light.	**Load torque high speed frequency control**	**Pr. 4, Pr. 5, Pr. 270 to Pr. 274**	236
Frequency control appropriate for the load torque	**Droop control**	**Pr. 286, Pr. 287**	238
Frequency setting by pulse train input	**Pulse train input**	**Pr. 291, Pr. 384 to Pr. 386**	239
Make the motor speed constant by encoder	**Encoder feedback control**	**Pr. 144, Pr. 285, Pr. 359, Pr. 367 to Pr. 369**	242
Avoid overvoltage alarm due to regeneration by automatic adjustment of output frequency	**Regeneration avoidance function**	**Pr. 882 to Pr. 886**	244

4.20.1 PID control (Pr. 127 to Pr. 134, Pr. 575 to Pr. 577)

The inverter can be used to exercise 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.

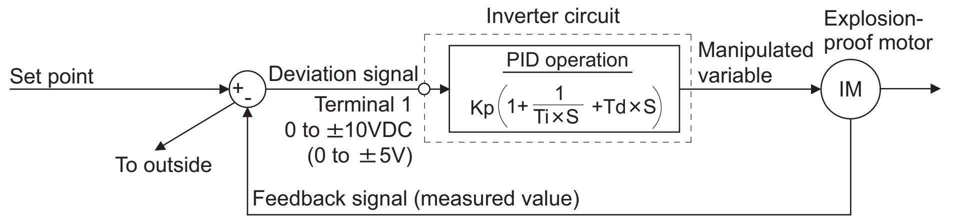
Parameter Number	Name	Initial Value	Setting Range FR-B	Setting Range FR-B3	Description	
127	**PID control automatic switchover frequency**	9999	0 to 120Hz/ 0 to 60Hz *2	0 to 120Hz	Set the frequency at which the control is automatically changed to PID control.	
			9999		Without PID automatic switchover function	
128	**PID action selection**	10	10		PID reverse action	Deviation value signal input (terminal 1)
			11		PID forward action	
			20		PID reverse action	Measured value (terminal 4) Set point (terminal 2 or *Pr. 133*)
			21		PID forward action	
			50		PID reverse action	Deviation value signal input (LONWORKS , CC-Link communication)
			51		PID forward action	
			60		PID reverse action	Measured value, set point input (LONWORKS , CC-Link communication)
			61		PID forward action	
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, e.g. hunting occurs. Gain Kp = 1/proportional band	
			9999		No proportional control	
130 *1	**PID integral time**	1s	0.1 to 3600s		For deviation step input, time (Ti) required for only the integral (I) action to provide the same manipulated variable as that for 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%		Set the upper limit value. If the feedback value exceeds the setting, the FUP signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	
			9999		No function	
132	**PID lower limit**	9999	0 to 100%		Set the lower limit value. If the measured value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	
			9999		No function	
133 *1	**PID action set point**	9999	0 to 100%		Used to set the set point for PID control.	
			9999		Terminal 2 input is the set point.	

Parameter Number	Name	Initial Value	Setting Range		Description
			FR-B	FR-B3	
134 *1	**PID differential time**	9999	0.01 to 10.00s		For deviation lamp input, time (Td) required for providing only the manipulated variable for the proportional (P) action. As the differential time increases, greater response is made to a deviation change.
			9999		No differential control
575	**Output interruption detection time**	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 120Hz/ 0 to 60Hz *2	0 to 120Hz	Set the frequency at which the output interruption processing is performed.
577	**Output interruption cancel level**	1000%	900 to 1100%		Set the level (*Pr. 577* minus 1000%) at which the PID output interruption function is canceled.

*1 *Pr. 129, Pr. 130, Pr. 133* and *Pr. 134* can be set during operation. They can also be set independently of the operation mode.
*2 The setting range differs according to the inverter capacity. (22K or less/30K or more)

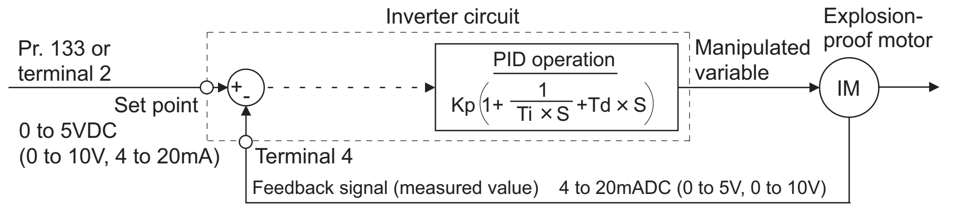
(1) PID control basic configuration

·*Pr. 128* = "10, 11" (Deviation value signal input)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

·*Pr. 128* = "20, 21" (Measured value input)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

4

PARAMETERS

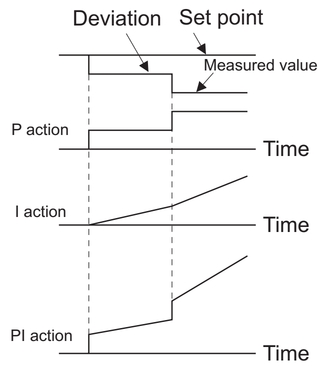
(2) PID action overview

1) PI action

A combination of P action (P) and I 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.

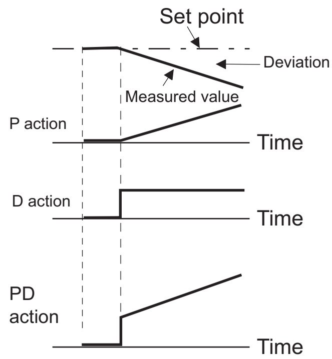


2) PD action

A combination of P 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]

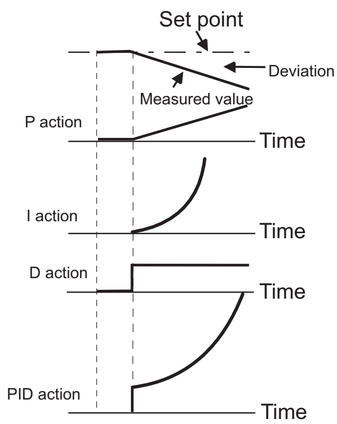
(Note) PD action is the sum of P and D actions.



3) PID action

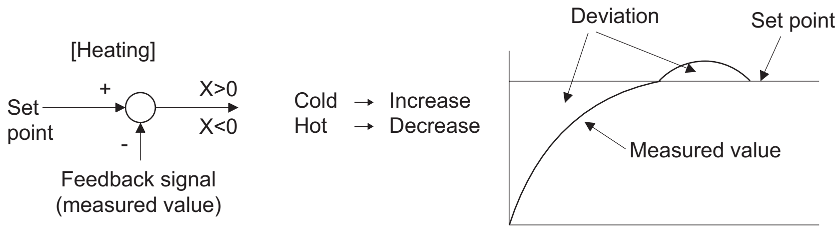
The PI action and PD action are combined to utilize the advantages of both actions for control.

(Note) PID action is the sum of P, I and D actions.



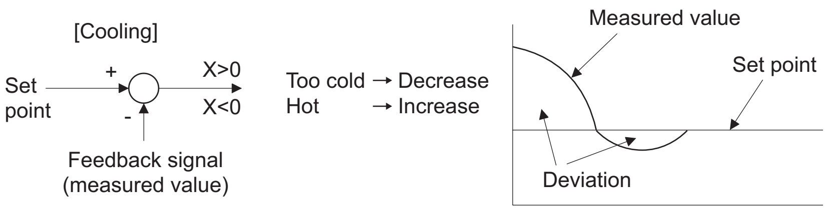
4)Reverse action

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.

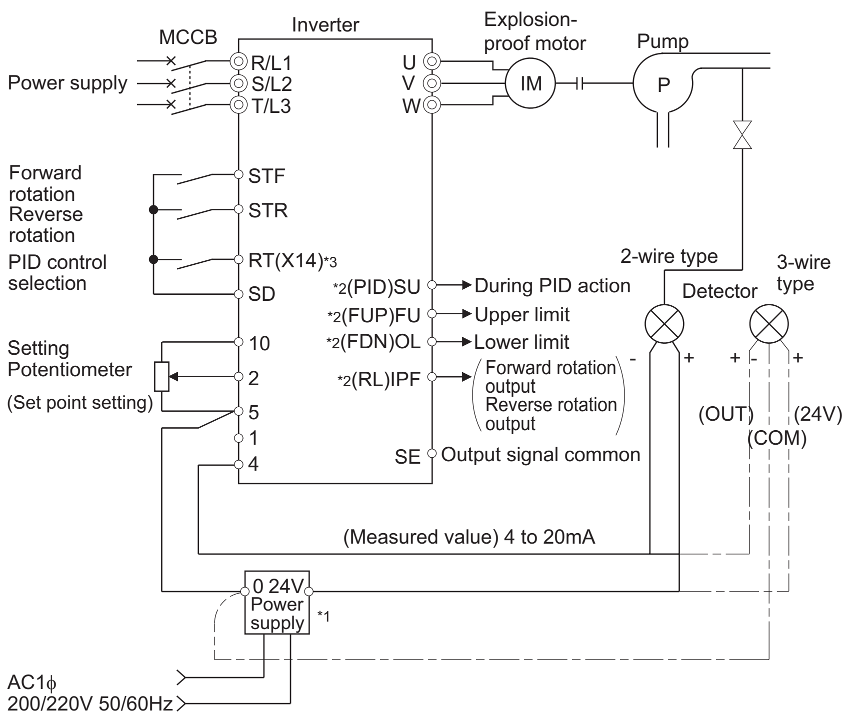


Relationships between deviation and manipulated variable (output frequency)

	Deviation	
	Positive	Negative
Reverse action	↗	↘
Forward action	↘	↗

(3) Connection diagram

- Sink logic
- *Pr. 128* = 20
- *Pr. 183* = 14
- *Pr. 191* = 47
- *Pr. 192* = 16
- *Pr. 193* = 14
- *Pr. 194* = 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 to Pr. 196 (output terminal selection)* setting.
*3 The used output signal terminal changes depending on the *Pr. 178 to Pr. 189 (input terminal selection)* setting.

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PARAMETERS

(4) I/O signals and parameter setting

- Turn on the X14 signal to perform PID control. When this signal is off, PID action is not performed and normal inverter operation is performed. (Note that the X14 signal need not be turned on for PID control via LONWORKS communication.)
- Enter the set point across inverter terminals 2-5 or into *Pr. 133* and enter the measured value signal across inverter terminals 4-5. At this time, set "20" or "21" in *Pr. 128*.
- When entering the externally calculated deviation signal, enter it across terminals 1-5. At this time, set "10" or "11" in *Pr. 128*.

	Signal	Terminal Used	Function	Description	Parameter Setting
Input	X14	Depending on *Pr. 178 to Pr. 189*	PID control selection	Turn on X14 to perform PID control.	Set 14 in any of *Pr. 178 to Pr. 189*.
	X64		PID forward/ reverse action switchover	By turning on X64, forward action can be selected for PID reverse action (*Pr. 128* = 10, 20), and reverse action for forward action (*Pr. 128* = 11, 21).	Set 64 in any of *Pr. 178 to Pr. 189*.
	2	2	Set point input	Enter the set point for PID control.	*Pr. 128* = 20, 21, *Pr. 133* = 9999
				0 to 5V...............0 to 100%	*Pr. 73* = 1 *1, 3, 5, 11, 13, 15
				0 to 10V.............0 to 100%	*Pr. 73* = 0, 2, 4, 10, 12, 14
				4 to 20mA...........0 to 100%	*Pr. 73* = 6, 7
	PU	—	Set point input	Set the set value (*Pr. 133*) from the operation panel or parameter unit.	*Pr. 128* = 20, 21, *Pr. 133* = 0 to 100%
	1	1	Deviation signal input	Input the deviation signal calculated externally.	*Pr. 128* = 10 *1, 11
				-5V to +5V ....-100% to +100%	*Pr. 73* = 2, 3, 5, 7, 12, 13, 15, 17
				-10V to +10V ......-100% to +100%	*Pr. 73* = 0, 1 *1, 4, 6, 10, 11, 14, 16
	4	4	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 *1
				0 to 5V...... 0 to 100%	*Pr. 267* = 1
				0 to 10V.... 0 to 100%	*Pr. 267* = 2
	Communi-cation *2	—	Deviation value input	Input the deviation value from LONWORKS, CC-Link communication.	*Pr. 128* = 50, 51
			Set value, measured value input	Input the set value and measured value from LONWORKS , CC-Link communication.	*Pr. 128* = 60, 61
Output	FUP	Depending on *Pr. 190 to Pr. 196*	Upper limit output	Output to indicate that the measured value signal exceeded the upper limit value (*Pr. 131*).	*Pr. 128* = 20, 21, 60, 61 *Pr. 131* ≠ 9999 Set 15 or 115 in any of *Pr. 190 to Pr. 196*. *3
	FDN		Lower limit output	Output when the measured value signal falls below the lower limit (*Pr. 132*).	*Pr. 128* = 20, 21, 60, 61 *Pr. 132* ≠ 9999 Set 14 or 114 in any of *Pr. 190 to Pr. 196*. *3
	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 any of *Pr. 190 to Pr. 196*. *3
	PID		During PID control activated	Turns on during PID control.	Set 47 or 147 in any of *Pr. 190 to Pr. 196*. *3
	SLEEP		PID output interruption	Turns on when the PID output interruption function is performed.	*Pr. 575* ≠ 9999 Set 70 or 170 in any of *Pr. 190 to Pr. 196*. *3
	SE	SE	Output terminal common	Common terminal for terminals FUP, FDN, RL, PID and SLEEP	

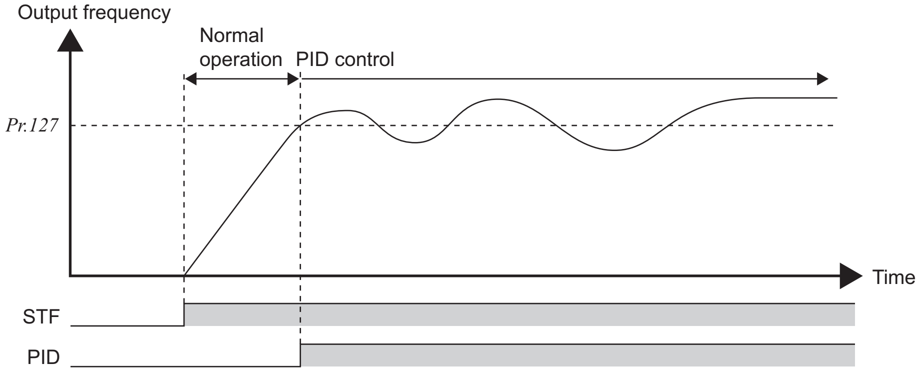
*1 The shaded area indicates the parameter initial value.
*2 For the setting method via LONWORKS communication, refer to the LONWORKS communication option (FR-A7NL) instruction manual.
For the setting method via CC-Link communication, refer to the CC-Link communication option (FR-A7NC) instruction manual.
*3 When 100 or larger value is set in any of *Pr. 190 to Pr. 196 (output terminal function selection)*, the terminal output has negative logic. *(Refer to page 125 for details)*

CAUTION

- Changing the terminal function using any of *Pr. 178 to Pr. 189, 190 to Pr. 196* may affect the other functions. Please make setting after confirming the function of each terminal.

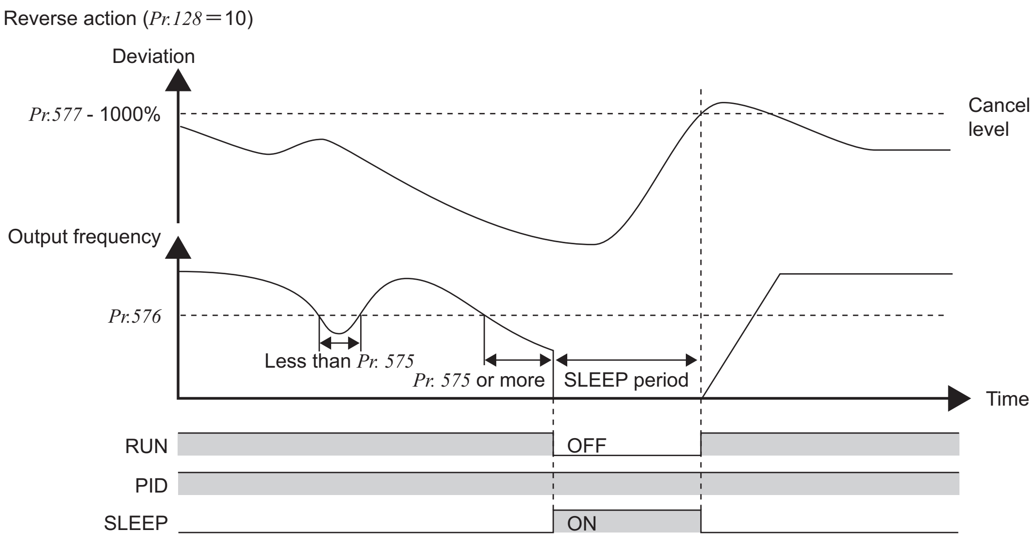
(5) PID control automatic switchover control *(Pr. 127)*

· For a fast system startup at an operation start, the system can be started up in normal operation mode only at a start.
· When the frequency is set to *Pr. 127 PID control automatic switchover frequency* within the range 0 to 400Hz, the system starts up in normal operation mode from a start until *Pr. 127* is reached, and then it shifts to PID control operation mode. Once the system has entered PID control operation, it continues PID control if the output frequency falls to or below *Pr. 127*.



(6) 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.
· 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.



(7) PID monitor function

· The PID control set value, measured value and deviation value can be output to the operation panel monitor display and terminal FM, AM.
· The deviation monitor can display a negative value on the assumption that 1000 is 0%. (The deviation monitor cannot be output from the terminal FM, AM.)
· For the monitors, set the following values in *Pr. 52 DU/PU main display data selection*, *Pr. 54 FM terminal function selection*, and *Pr. 158 AM terminal function selection*.

Setting	Monitor Description	Minimum Increments	Terminal FM, AM Full Scale	Remarks
52	**PID set point**	0.1%	100%	For deviation input (*Pr. 128* = 10, 11), the monitor value is always displayed as 0.
53	**PID measurement value**	0.1%	100%	
54	**PID deviation value**	0.1%	—	Value cannot be set to *Pr. 54* or *Pr. 158*. The PID deviation value of 0% is displayed as 1000.

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PARAMETERS

(8) Adjustment procedure

Parameter setting — Adjust the PID control parameters, *Pr. 127 to Pr. 134 and Pr. 575 to Pr. 577*.

Terminal setting — Set the I/O terminals for PID control. *(Pr. 178 to Pr. 189 (input terminal function selection), Pr. 190 to Pr. 196 (output terminal function selection))*

Turn on the X14 signal

Operation

(9) 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).)

Start

Determination of set point
Determine the set point of what is desired to be adjusted.
...... Set the room temperature to 25℃.
Set *Pr. 128* and turn on the X14 signal to enable PID control.

Conversion of set point into %
Calculate the ratio of the set point to the detector output.
...... Detector specifications
When 0℃→4mA and 50℃→20mA are used, the set point 25℃ is 50% on the assumption that 4mA is 0% and 20mA is 100%.

Make calibration.
...... Make the following calibration* when the target setting input (0 to 5V) and detector output (4 to 20mA) must be calibrated.

Setting of set point
Input a voltage across terminals 2-5 according to the set value %.
...... When the set point is 50%
As the terminal 2 specifications are 0% → 0V and 100% → 5V, input 2.5V to the terminal 2 for the set point of 50%.

Operation
Set the proportional band (*Pr. 129*) to a slightly larger value, the integral time (*Pr. 130*) to a slightly longer time, and the differential time (*Pr. 134*) to "9999" (no function), and turn on the start signal.
...... When the parameter unit is used for operation, input the set point (0 to 100%) in *Pr. 133*.
When performing operation, first set the proportional band (*Pr. 129*) to a slightly larger value, the integral time (*Pr. 130*) to a slightly longer time, and the differential time (*Pr. 134*) to "9999" (no function), and while looking at the system operation, decrease the proportional band (*Pr. 129*) and increase the integral time (*Pr. 130*).

Is the set point stable?

No → **Parameter adjustment**
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.

Yes → **Parameter optimization**
While the measured value is stable throughout the operation status, the proportional band (*Pr. 129*) may be decreased, the integral time (*Pr. 130*) decreased, and the differential time (*Pr. 134*) increased.

Adjustment end

*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.
Make calibration in the PU mode during an inverter stop.

<Set point input calibration>

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) to 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%.

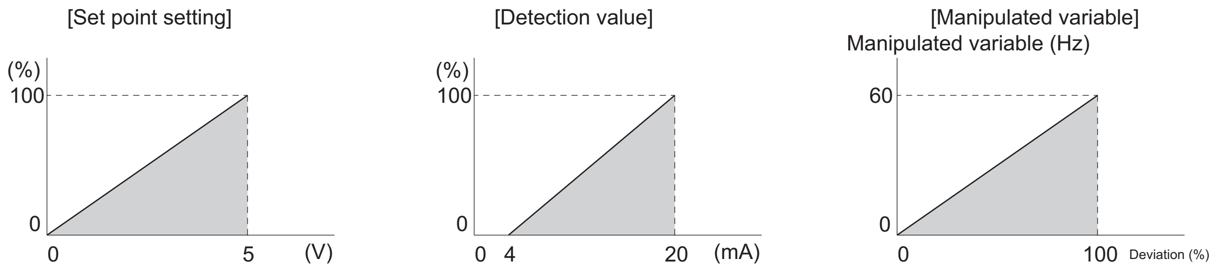
<Detector output calibration>

1. Apply the output current of 0% detector setting (e.g. 4mA) across terminals 4-5.
2. Make calibration using *C6 (Pr. 904)*.
3. Apply the output current of 100% detector setting (e.g. 20mA) across terminals 4-5.
4. Make calibration using *C7 (Pr. 905)*.

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:



CAUTION

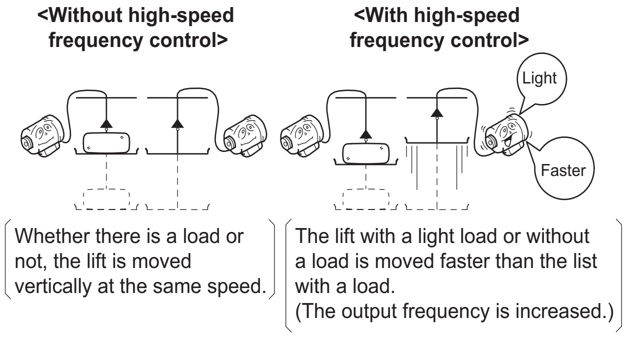
· If the multi-speed (RH, RM, RL signal) or jog operation (jog signal) is entered with the X14 signal on, PID control is stopped and multi-speed or jog operation is started.
· If the setting is as follows, PID control becomes invalid.
Pr. 79 Operation mode selection = "6" (switchover mode)
Pr. 858 Terminal 4 function assignment, Pr. 868 Terminal 1 function assignment = "4" (torque command)
· When the *Pr. 128* setting is "20" or "21", note that the input across inverter terminals 1-5 is added to the set value across terminals 2-5.
· When using terminal 4 (measured value input) and terminal 1 (deviation input) under PID control, set "0" (initial value) in *Pr. 858 Terminal 4 function assignment* and "0" (initial value) in *Pr. 868 Terminal 1 function assignment*.
· Changing the terminal function using any of *Pr. 178 to Pr. 189, Pr. 190 to Pr. 196* may affect the other functions. Please make setting 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.

♦ Parameters referred to ♦

Pr. 59 Remote function selection ☞ *Refer to page 85*
Pr. 73 Analog input selection ☞ *Refer to page 166*
Pr. 79 Operation mode selection ☞ *Refer to page 182*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*
C2 (Pr. 902) to C7 (Pr. 905) Frequency setting voltage (current) bias/gain ☞ *Refer to page 172*

4.20.2 Load torque high speed frequency control (Pr. 4, Pr. 5, Pr. 270 to Pr. 274)

Load torque high speed frequency control is a function which automatically sets the operational maximum frequency according to the load.
More specifically, the magnitude of the load is judged according to the average current at a certain time after starting to perform operation at higher than the preset frequency under light load.
This function is designed to increase speed automatically under light load, for example to minimize the incoming/outgoing time in a multi-story parking lot.

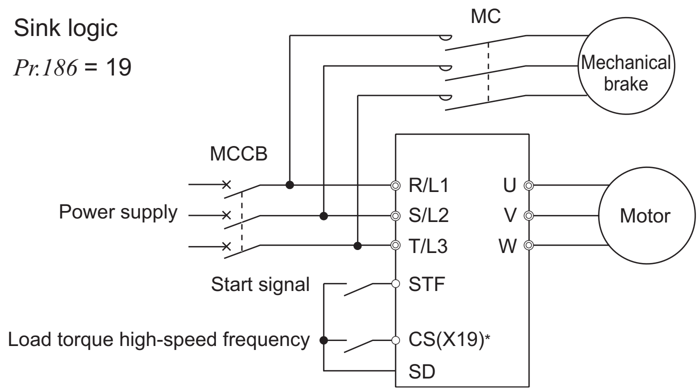


Parameter Number	Name	Initial Value	Setting Range FR-B	Setting Range FR-B3	Description
4	**Multi-speed setting (high speed)**	60Hz	0 to 120Hz/ 0 to 60Hz *	0 to 120Hz	Set the higher-speed frequency.
5	**Multi-speed setting (middle speed)**	30Hz	0 to 120Hz/ 0 to 60Hz *	0 to 120Hz	Set the lower-speed frequency.
270	**Stop-on contact/load torque high-speed frequency control selection**	0	0	0	Normal operation
			—	1	Stop-on-control *(refer to page 105)*
			2	2	Load torque high speed frequency control
			—	3	Stop-on-contact *(refer to page 105)* + load torque high speed frequency control
271	**High-speed setting maximum current**	50%	0 to 220%		Set the upper and lower limits of the current at high and middle speeds.
272	**Middle-speed setting minimum current**	100%	0 to 220%		
273	**Current averaging range**	9999	0 to 120Hz/ 0 to 60Hz *	0 to 120Hz	Average current during acceleration from (*Pr. 273* × 1/2) Hz to (*Pr. 273*) Hz can be achieved.
			9999		Average current during acceleration from (*Pr. 5* × 1/2) Hz to (*Pr. 5*) Hz is achieved.
274	**Current averaging filter time constant**	16	1 to 4000		Set the time constant of the primary delay filter relative to the output current. The time constant [ms] is 0.75 × *Pr. 274* and the initial value is 12ms. A larger setting provides higher stability but poorer response.

* The setting range differs according to the inverter capacity. (22K or less/30K or more)

<Connection diagram>

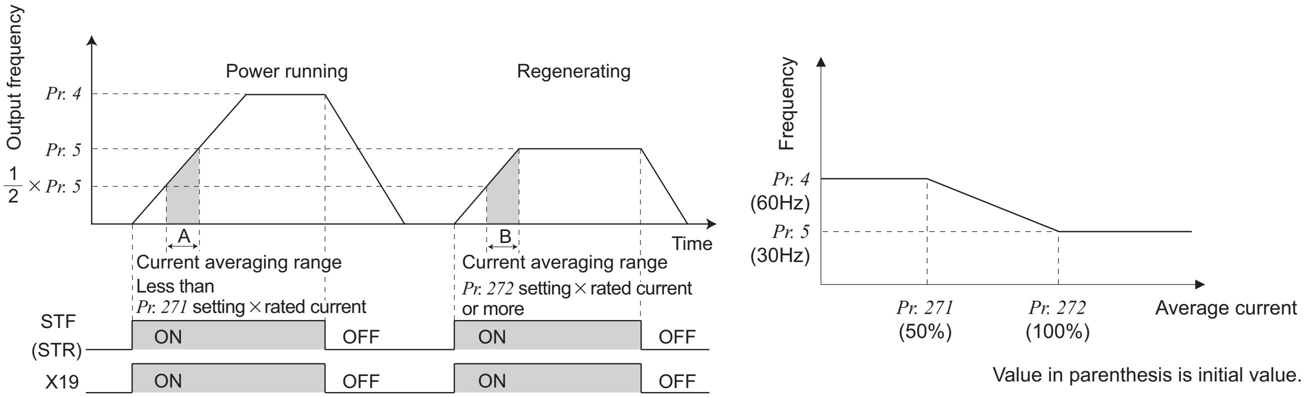
- Sink logic
- *Pr.186* = 19



* The used terminal changes according to the *Pr. 180 to Pr. 189 (input terminal function selection)* settings.

(1) Load torque high speed frequency control setting

- Set "2 or 3 (FR-B3 series only) " in *Pr. 270 Stop-on contact/load torque high-speed frequency control selection*.
- When operating with the load torque high speed frequency function selection signal (X19) on, the inverter automatically changes the maximum frequency within the setting range of *Pr. 4 Multi-speed setting (high speed)* and *Pr. 5* according to the magnitude of the average current during the time to accelerate from 1/2 of the frequency set in *Pr. 5 Multi-speed setting (middle speed)* to the frequency set in *Pr. 5* .
- Set "19" in *Pr. 178 to Pr. 189 (input terminal function selection)* and assign the X19 signal function to the input terminal.
- Made valid only in the external operation mode.
- This control can be activated at every start.



(2) Operation of load torque high speed frequency control setting

- When the average current of the current averaging range (above chart A) during operation with the X19 signal on is less than the "rated inverter current × *Pr. 271* setting (%)", the maximum frequency automatically becomes the *Pr. 4 Multi-speed setting (high speed)* setting value.
- When the average current of the current averaging range (above chart B) during operation with the X19 signal on is more than the "rated inverter current × *Pr. 272* setting (%)", the maximum frequency automatically becomes the *Pr. 5 Multi-speed setting (middle speed)* setting value.
- The current averaging range can be set between 1/2 frequency of the *Pr. 273* setting value and *Pr. 273* set frequency.

CAUTION

- When the current averaging range includes the constant power range, the output current may become large in the constant power range.
- When the average current value in the current averaging range is small, deceleration time becomes longer as the running frequency increases.
- The maximum output frequency is 120Hz. The output frequency is 120Hz even when the setting is above 120Hz.
- The fast-response current limit function is made invalid.
- When the average current during acceleration is too small, it may be judged as regeneration and the maximum frequency becomes the setting of *Pr. 5*.
- Changing the terminal function using any of *Pr. 178 to Pr. 189* may affect the other functions. Please make setting after confirming the function of each terminal.
- The load torque high speed frequency function is made invalid in the following operation conditions.
  PU operation *(Pr. 79)* , PU+external operation *(Pr. 79)* , JOG operation *(JOG signal)* , PID control function operation *(X14 signal)*, remote setting function operation *(Pr. 59)*, orientation control function operation, multi-speed setting (*RH, RM, RL signal*), 16 bit digital input option (FR-A7AX)

⚠CAUTION

⚠ When the load is light, the motor may suddenly accelerate to 120Hz maximum, causing hazard.
Securely provide mechanical interlock on the machine side to perform.

♦ Parameters referred to ♦

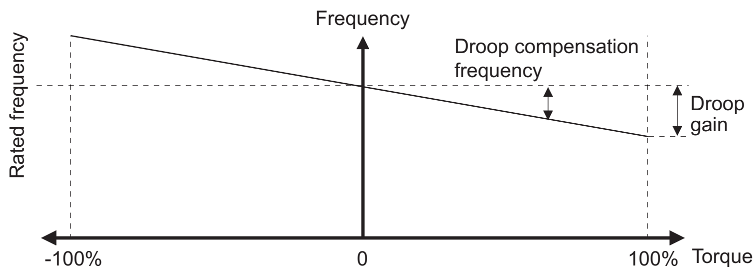
Pr. 4 to Pr. 6, Pr. 24 to Pr. 27 (multi-speed setting) ☞ *Refer to page 81*
Pr. 59 Remote function selection ☞ *Refer to page 85*
Pr. 79 Operation mode selection ☞ *Refer to page 182*
Pr. 128 PID action selection ☞ *Refer to page 228*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 118*

4.20.3 Droop control (Pr. 286 to Pr. 288) B3

Setting can be made only for FR-B3 series.

This function is designed to balance the load in proportion to the load torque to provide the speed drooping characteristic.
This function is effective for balancing the load when using multiple inverters

Parameter Number	Name	Initial Value	Setting Range	Description
286	**Droop gain**	0%	0	Normal operation
			0.1% to 100%	Droop control is valid Set the drooping amount at the rated torque as a percentage with respect to the rated motor frequency.
287	**Droop filter time constant**	0.3s	0 to 1s	Set the time constant of the filter applied on the torque amount current.



(1) Droop control

- The output frequency is changed according to the magnitude of torque amount current.
- The maximum droop compensation frequency is 120Hz.

$$\text{Droop compensation frequency} = \frac{\text{Amount of torque current after filtering}}{\text{Rated value of torque current}} \times \frac{\text{Rated motor frequency} \times \text{Droop gain}}{100}$$

REMARKS

Set the droop gain to about the rated slip of the motor.

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

REMARKS

The maximum value of frequency after droop compensation is either 120Hz or *Pr. 1 Maximum frequency* , whichever is smaller.

♦ Parameters referred to ♦

Pr. 1 Maximum frequency ☞ *Refer to page 79*

4.20.4 Frequency setting by pulse train input (Pr. 291, Pr. 384 to Pr. 386)

The inverter speed can be set by inputting pulse train from terminal JOG.
In addition, synchronous speed operation of inverters can be performed by combining pulse train I/O.

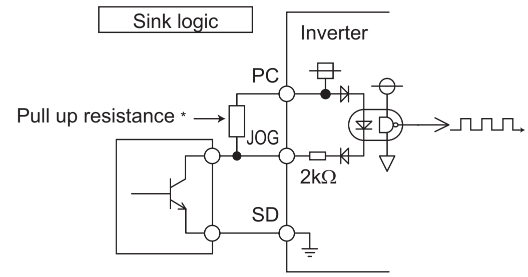
Parameter Number	Name	Initial Value	Setting Range		Description	
			FR-B	FR-B3		
291	**Pulse train I/O selection**	0			Pulse train input	Pulse train output
			0		Terminal JOG	FM output
			1		Pulse train input	FM output
			10		Terminal JOG	High speed pulse train output (50%Duty)
			11		Pulse train input	High speed pulse train output (50%Duty)
			20		Terminal JOG	High speed pulse train output (ON width is always same)
			21		Pulse train input	High speed pulse train output (ON width is always same)
			100		Pulse train input	High speed pulse train output (ON width is always same) The inverter outputs the signal input as pulse train as it
384	**Input pulse division scaling factor**	0	0		Pulse train input invalid	
			1 to 250		Indicates division scaling factor to the input pulse and the frequency resolution to the input pulse changes according to the value.	
385	**Frequency for zero input pulse**	0Hz	0 to 120Hz/ 0 to 60Hz *	0 to 120Hz	Set the frequency when the input pulse is 0 (bias).	
386	**Frequency for maximum input pulse**	60Hz	0 to 120Hz/ 0 to 60Hz *	0 to 120Hz	Set the frequency when the input pulse is maximum (gain).	

* The setting range differs according to the inverter capacity. (22K or less/30K or more)

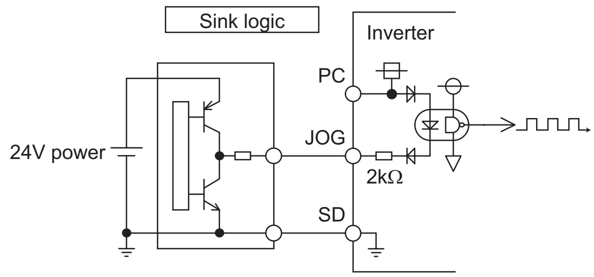
(1) Pulse train input selection *(Pr. 291)*

- Setting any of "1, 11, 21, 100" in *Pr. 291 Pulse train I/O selection* and a value other than "0" in *Pr. 384 Input pulse division scaling factor* switches terminal JOG to pulse train input terminal and frequency setting of the inverter can be performed. (The initial value is JOG signal)
  Pulse train input of maximum of 100k pulse/s is enabled.
- Output specifications (high speed pulse train output or FM output) of terminal FM can be selected using *Pr. 291*.

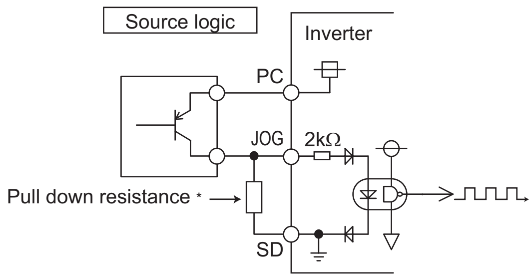
● **Connection with an open collector output system pulse generator**



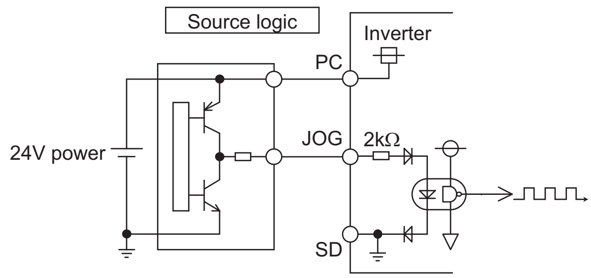
● **Connection with a complimentary output system pulse generator**



● **Connection with an open collector output system pulse generator**



● **Connection with a complimentary output system pulse generator**



4

PARAMETERS

* When the wiring length of the open collector output connection is long, input pulse can not be recognized because of a pulse shape deformation due to the stray capacitances of the wiring.
When wiring length is long (10m or more of 0.75mm^2 twisted cable is recommended), connect an open collector output signal and power supply using a pull up resistance. The reference of resistance value to the wiring length is as in the table below,

Wiring Length	Less than 10m	10 to 50m	50 to 100m
Pull up/down resistance	Not necessary	1kΩ	470Ω
Load current (for reference)	10mA	35mA	65mA

Stray capacitances of the wiring greately differ according to the cable type and cable laying, the above cable length is not a guaranteed value.
When using a pull up resistance, check the permissible power of the resistor and permissible load current of output transistor and use them within a permissible range.

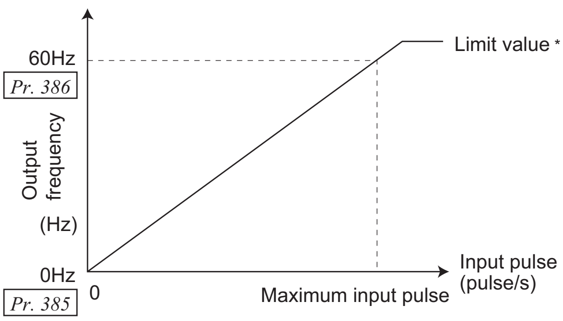
REMARKS
· When pulse train input is selected, a function assigned to terminal JOG using *Pr. 185 JOG terminal function selection* is made invalid.

CAUTION
· Since *Pr. 291* is a selection parameter for pulse train output/FM output, check the specifications of a device connected to terminal FM when changing the setting value. (Refer to *page 142* for pulse train output.)
· Output specifications (high speed pulse train output or FM output) of terminal FM can be selected using *Pr. 291*. Change the setting value using care not to change output specifications of terminal FM. (Refer to *page 142* for pulse train output.)

●Pulse train input specifications

Item		Specifications
Available pulse method		Open collector output Complimentary output (power supply voltage 24V)
H input level		20V or more (voltage between JOG-SD)
L input level		5V or less (voltage between JOG-SD)
Maximum input pulse rate		100kpps
Minimum input pulse width		2.5us
Input resistance/load current		2kΩ (typ) / 10mA (typ)
Maximum wiring length (reference value)	Open collector output system	10m (0.75mm^2/ twisted pair)
	Complemenraty output system	100m (output resistance 50Ω) *
Detection resolution		1/3750

* The wiring length of complementary output depends on the output wiring specifications of complementary output device.
Stray capacitances of the wiring greatly differ according to the cable type and cable laying, the maximum cable length is not a guaranteed value.



(2) Adjustment of pulse train input and frequency *(Pr. 385, Pr. 386)*

· Frequency for zero input pulse can be set using *Pr. 385 Frequency for zero input pulse* and frequency at maximum input pulse can be set using *Pr. 386 Frequency for maximum input pulse*.

* Limit value can be calculated from the following formula.
(*Pr. 386* - *Pr. 385*) × 1.1 + *Pr. 385*

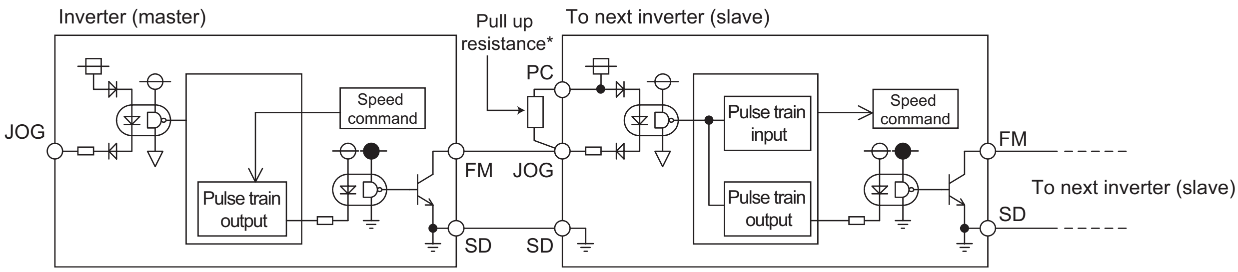
(3) Calculation method of division scaling factor of input pulse (*Pr. 384*)

· Maximum input pulse can be calcualted from the following formula using *Pr. 384 Input pulse division scaling factor*.
Maximum of input pulse (pulse/s) = *Pr. 384* × 400 (maximum of 100kpulse/s)
Detectable pulse = 11.45 pulse/s

· For example, when you want to operate at 0Hz when pulse train input is zero and operate at 30Hz when pulse train is 4000 pulse/s, set parameters as below.
Pr. 384 = 10 (maximum input pulse 4000 pulse/s)
Pr. 385 = 0Hz, *Pr. 386* = 30Hz (pulse train limit value is 33Hz)

REMARKS
The priorities of the frequency commands by the external signals are "jog operation > multi-speed operation > teminal 4 analog input > pulse train input > terminal 2 analog input".

(4) Synchronous speed operation by pulse I/O



* When the wiring length between FM and JOG is long, a pulse shape is deformed due to the stray capacitances of the wiring and input pulse can not be recognized.
When wiring length is long (10m or more of 0.75mm^2 twisted cable is recommended), connect terminal JOG and terminal PC using an external pull up resistance. The reference of resistance value to the wiring length is as in the table below.

Wiring Length	Less than 10m	10 to 50m	50 to 100m
Pull up resistance	Not necessary	1kΩ	470Ω
Load current (for reference)	10mA	35mA	65mA

Stray capacitances of the wiring greately differ according to the cable type and cable laying, the above cable length is not a guaranteed value.
When using a pull up resistance, check the permissible power and permissible load current (terminal PC : 100mA, high speed pulse train output : 85mA) of the resistor and use them within a permissible range.

· By setting "100" in *Pr. 291*, pulse train input can be output at pulse train output (terminal FM) as it is. Synchronous speed operation of multiple inverters can be enabled by daisy chain connection.
· Since maximum pulse train output is maximum of 50k pulse/s, set "125" in *Pr. 384* of the inverter receiving pulse train.
· When operating two or more inverters synchronously, perform wiring according to the following steps. (so that 24V contact input will not be applied to terminal FM)
1) Set pulse train output (a value other than "0, 1") in *Pr. 291* of the master side inverter.
2) Turn off the inverter power
3) Perform wiring of the master side terminal FM-SD and slave side terminal JOG-SD
4) Turn on the inverter power

CAUTION

· After changing a setting value of *Pr. 291* , connect JOG terminal between termial FM and SD. Take note that a voltage should not be applied to terminal FM specially when FM output (voltage output) pulse train is selected.
· For the slave side inverter, use sink logic (initial setting). The inverter will not function properly if source logic is selected.

●Specifications of synchronous speed operation

Item	Specifications
Output pulse type	Pulse width is fixed (10μs)
Pulse rate	0 to 50kpps
Pulse transmission delay	1 to 2μs per inverter *

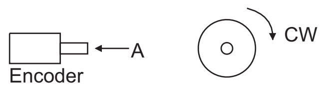
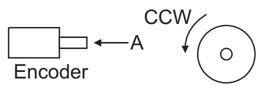
* When a pulse transmission delay in a slave is approximately 1 to 2μs and wiring length is long, the delay further increases.

♦ Parameters referred to ♦

Pr. 291 (pulse train output) ☞ *Refer to page 142*

4.20.5 Encoder feedback control (Pr. 144, Pr. 285, Pr. 359, Pr. 367 to Pr. 369)

This controls the inverter output frequency so that the motor speed is constant to the load variation by detecting the motor speed with the speed detector (encoder) to feed it back to the inverter.
Option FR-A7AP is necessary.

Parameter Numbers	Name	Initial Value	Setting Range FR-B	Setting Range FR-B3	Description
144	**Speed setting switchover**	4	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110		Set the number of motor poles when performing encoder feedback control under V/F control.
285	**Overspeed detection frequency (Speed deviation excess detection frequency)**	9999	—	0 to 30Hz	If (detected frequency) - (output frequency) > *Pr. 285* during encoder feedback control, the inverter alarm (E.MB1) is provided.
			—	9999	Overspeed is not detected.
359 *2	**Encoder rotation direction**	1	0		 Clockwise direction as viewed from A is forward rotation
			1		 Counter clockwise direction as viewed from A is forward rotation
367 *1	**Speed feedback range**	9999	0 to 120Hz/ 0 to 60Hz *2	0 to 120Hz	Set the region of speed feedback control.
			9999		Encoder feedback control is invalid
368 *1	**Feedback gain**	1	0 to 100		Set when the rotation is unstable or response is slow.
369 *1	**Number of encoder pulses**	1024	0 to 4096		Set the number of pulses of the encoder. Set the number of pulses before multiplied by four.

*1 The above parameters can be set when the FR-A7AP (option) is mounted.
*2 The setting range differs according to the inverter capacity. (22K or less/30K or more)

(1) Setting before the operation (*Pr. 144, Pr. 359, Pr. 369*)

- When performing encoder feedback control under FR-B series, set the number of motor poles in *Pr. 144 Speed setting switchover* according to the motor used. Under FR-B3 series, the *Pr. 81 Number of motor poles* setting is made valid and the *Pr. 144* setting is invalid.
- Set the rotation direction and the number of encoder pulses of the encoder using *Pr. 359 Encoder rotation direction* and *Pr. 369 Number of encoder pulses*.

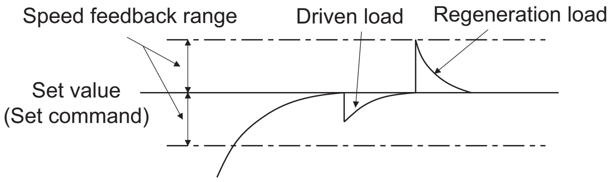
REMARKS

- When "0, 10, 110" is set in *Pr. 144* and run the inverter, error E.1 to E.3 occurs.
- When "102, 104, 106, 108" is set in *Pr. 144*, the value subtracting 100 is set as the number of motor poles.

CAUTION

- If the number of motor poles is wrong, control at correct speed can not be performed. Always check before operation.
- Encoder feedback control can not be performed when the setting of encoder rotation direction is wrong. (Inverter operation is enabled.)
  Encoder rotation direction can be checked with the rotation direction display of the parameter unit.

(2) Selection of encoder feedback control (*Pr. 367*)



· When a value other than "9999" is set in *Pr. 367 Speed feedback range*, encoder feedback control is valid.
Using the set point (frequency at which stable speed operation is performed) as reference, set the higher and lower setting range. Normally, set the frequency converted from the slip amount (r/min) of the rated motor speed (rated load). If the setting is too large, response becomes slow.

Example: Rated speed of a 4-pole motor is 1740r/min (60Hz)

Slip Nsp = Synchronous speed - Rated speed
= 1800 - 1740 = 60(r/min)

Frequency equivalent to slip (fsp)

$$fsp = \frac{\text{Nsp} \times \text{Number of poles}}{120} = \frac{60 \times 4}{120} = 2\ (\text{Hz})$$

(3) Feedback gain (*Pr. 368*)

· Set *Pr. 368 Feedback gain* when the rotation is unstable or response is slow.
· If the acceleration/deceleration time is long, feedback response becomes slower. In this case, increase the *Pr. 368* setting.

Pr. 368 Setting	Description
Pr. 368 > 1	Although the response becomes faster, overcurrent or unstable rotation is liable to occur.
1 < *Pr. 368*	Although the response becomes slower, the motor rotation becomes stable.

(4) Overspeed detection (*Pr. 285*)

· If (detection frequency) - (output frequency) > *Pr. 285* under encoder feedback control, E.MB1 occurs and the inverter output is stopped to prevent malfunction when the accurate pulse signal from the encoder can not be detected. Overspeed is not detected when *Pr. 285* = "9999".

CAUTION

· The encoder should be coupled on the same axis with the motor shaft with a speed ratio of 1 to 1 without any mechanical looseness.
· During acceleration/deceleration, encoder feedback control is not performed to prevent unstable phenomenon such as hunting.
· Encoder feedback control is performed once output frequency has reached within [set speed] ± [speed feedback range].
· If the following conditions occur during encoder feedback control, the inverter operates at the frequency within [set speed] ± [speed feedback range] without coming to an alarm stop nor tracking the motor speed.
  · The pulse signals are not received from the encoder due to a signal loss, etc.
  · The accurate pulse signal from the encoder can not be detected due to induction noise, etc.
  · The motor has been forcibly accelerated (regeneration) or decelerated (motor lock or the like) by large external force.
· For the motor with brake, use the RUN signal (inverter running) to open the brake. (The brake may not be opened if the FU (output frequency detection) signal is used.)
· Do not turn off the external power supply of the encoder during encoder feedback control. Encoder feedback control functions abnormally.

4.20.6 Regeneration avoidance function (Pr. 665, Pr. 882 to Pr. 886)

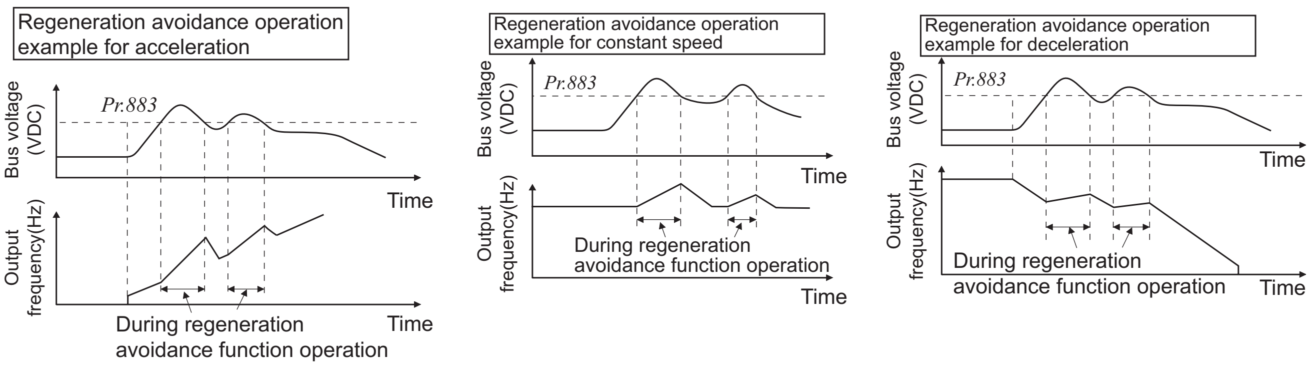
This function detects a regenerative status and increases the frequency to avoid the regenerative status.

- Possible to avoid regeneration by automatically increasing the frequency and 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**	380VDC/ 760VDC *	300 to 800V	Set the bus voltage level at which regeneration avoidance operates. When the bus voltage level is set to low, overvoltage error will be less apt to occur. However, the actual deceleration time increases. The set value must be higher than the power supply voltage × $\sqrt{2}$. * The initial value differs according to the voltage level. (200V / 400V)
884	**Regeneration avoidance at deceleration detection sensitivity**	0	0	Regeneration avoidance by bus voltage change ratio is invalid
			1 to 5	Set sensitivity to detect the bus voltage change ratio Setting 1 → 5 Detection sensitivity low → high
885	**Regeneration avoidance compensation frequency limit value**	6Hz	0 to 10Hz	Set the 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%	Adjust 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%	

(1) What is regeneration avoidance function? *(Pr. 882, Pr. 883)*

- When the regenerative status is serious, the DC bus voltage rises and an overvoltage alarm (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 regenerative status.
- For regeneration avoidance operation, you can select whether it is always activated or activated only at a constant speed.



- Setting *Pr. 882* to "1, 2" validates the regeneration avoidance function.

REMARKS

- The inclination of the frequency increased or decreased by the regeneration avoidance function changes depending on the regenerative status.
- The DC bus voltage of the inverter is normally about $\sqrt{2}$ times greater than the input voltage.
  When the input voltage is 220VAC(440VAC), the bus voltage is about 311VDC(622VDC).
  However, it varies with the input power supply waveform.
- The *Pr. 883* setting should be kept higher than the DC bus voltage level. Otherwise, the regeneration avoidance function is always on.
- While overvoltage stall (oL) is activated only during deceleration and stops the decrease in 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.

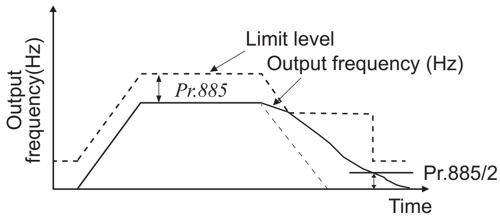
(2) To detect the regenerative status during deceleration faster *(Pr. 884)*

- As the regeneration avoidance function cannot respond to an abrupt voltage change by detection of the bus voltage level, the ratio of bus voltage change is detected to stop deceleration if the bus voltage is less than *Pr. 883 Regeneration avoidance operation level*.
  Set that detectable bus voltage change ratio to *Pr. 884* as detection sensitivity.
  Increasing the setting raises the detection sensitivity

CAUTION

Too small setting (low detection sensitivity) will disable detection, and too large setting will turn on the regeneration avoidance function if the bus voltage is varied by an input power change, etc.

(3) Limit regeneration avoidance operation frequency *(Pr. 885)*



You can limit the output frequency compensated for (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 regeneration avoidance frequency has reached *Pr. 1 Maximum frequency*, it is limited to the maximum frequency.
- *Pr. 885* is set to "9999", the frequency setting is invalid.

(4) Regeneration avoidance function adjustment *(Pr. 665, Pr. 886)*

- If the frequency becomes unstable 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 Regeneration avoidance voltage gain* setting, set a smaller value in *Pr. 665 Regeneration avoidance frequency gain*.

CAUTION

- When regeneration avoidance operation is performed, oL (overvoltage stall) is displayed and the OL signal is output.
- 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 capability. When shortening the deceleration time, consider using the regeneration unit (FR-BU, MT-BU5, MT-HC). When using the regeneration unit with capacities of 55kW or less, another explosion-proof test is necessary.
- When using the regeneration unit (FR-BU, MT-BU5, MT-HC), set *Pr. 882* to "0 (initial value)" (regeneration avoidance function invalid). When using the regeneration unit with capacities of 55kW or less, another explosion-proof test is necessary.
- When regeneration avoidance operation is performed, the OL signal output item of *Pr. 156* also becomes the target of oL (overvoltage stall). *Pr. 157 OL signal output timer* also becomes the target of oL (overvoltage stall).

♦ Parameters referred to ♦

Pr. 1 Maximum frequency ☞ *Refer to page 79*
Pr. 8 Deceleration time ☞ *Refer to page 88*
Pr. 22 Stall prevention operation level ☞ *Refer to page 74*

4.21 Useful functions

Purpose	Parameter that must be Set		Refer to Page
Increase cooling fan life	**Cooling fan operation selection**	**Pr. 244**	246
To determine the maintenance time of parts.	**Inverter part life display**	**Pr. 255 to Pr. 259**	247
	Maintenance output function	**Pr. 503, Pr. 504**	249
	Current average value monitor signal	**Pr. 555 to Pr. 557**	250
Freely available parameter	**Free parameter**	**Pr. 888, Pr. 889**	252

4.21.1 Cooling fan operation selection (Pr. 244)

You can control the operation of the cooling fan (200V class:1500 or more, 400V class:2200 or more) built in the inverter.

Parameter Number	Name	Initial Value	Setting Range	Description
244	**Cooling fan operation selection**	1	0	A cooling fan operates at power on 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.

- In either of the following cases, fan operation is regarded as faulty, [FN] is shown on the operation panel, and the fan fault (FAN) and minor fault (LF) signals are output.
  ·*Pr. 244* = "0"
   When the fan comes to a stop with power on
  ·*Pr. 244* = "1"
   When the fan stops during the fan ON command while the inverter is running
- For the terminal used for FAN signal output, set "25" (positive logic) or "125" (negative logic) in any of *Pr. 190 to Pr. 196 (output terminal function selection)*, and for the LF signal, set "98" (positive logic) or "198" (negative logic).

CAUTION

- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 125*

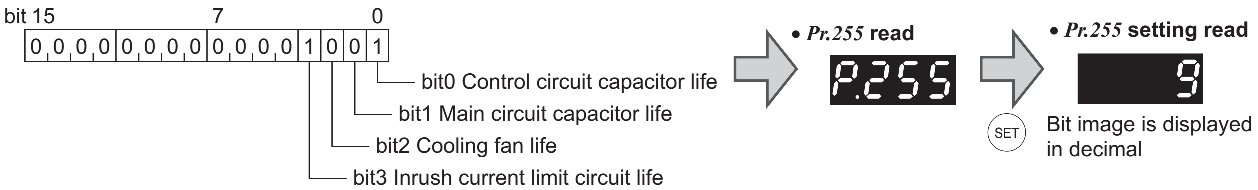
4.21.2 Display of the life of the inverter parts (Pr. 255 to Pr. 259)

Degrees of deterioration of main circuit capacitor, control circuit capacitor, cooling fan and inrush current limit circuit can be diagnosed by monitor.
When any part has approached 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)	Display whether the control circuit capacitor, main circuit capacitor, cooling fan, and each parts of the inrush current limit circuit has reached the life alarm output level or not. Reading only
256	**Inrush current limit circuit life display**	100%	(0 to 100%)	Display the deterioration degree of the inrush current limit circuit. Reading only
257	**Control circuit capacitor life display**	100%	(0 to 100%)	Display the deterioration degree of the control circuit capacitor. Reading only
258	**Main circuit capacitor life display**	100%	(0 to 100%)	Display 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 switching 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. Read the deterioration degree in *Pr. 258*.

(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 Limit Circuit Life	Cooling Fan Life	Main Circuit Capacitor Life	Control Circuit Capacitor Life
15	1111	○	○	○	○
14	1110	○	○	○	×
13	1101	○	○	×	○
12	1100	○	○	×	×
11	1011	○	×	○	○
10	1010	○	×	○	×
9	1001	○	×	×	○
8	1000	○	×	×	×
7	0111	×	○	○	○
6	0110	×	○	○	×
5	0101	×	○	×	○
4	0100	×	○	×	×
3	0011	×	×	○	○
2	0010	×	×	○	×
1	0001	×	×	×	○
0	0000	×	×	×	×

○: With warnings, ×: Without warnings

4

PARAMETERS

- 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 any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

REMARKS

- The digital output option (FR-A7AY) allows the control circuit capacitor life signal (Y86), main circuit capacitor life signal (Y87), cooling fan life signal (Y88) and inrush current limit circuit life signal (Y89) to be output individually.

CAUTION

- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.

(2) Life display of the inrush current limit circuit *(Pr. 256)*

- The life of the inrush current limit circuit (relay, contactor and inrush resistor) is displayed in *Pr. 256*.
- The number of contact (relay, contactor, thyristor) ON times is counted, and it is counted down from 100% (1 million times) every 1%/10,000 times. 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.

(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 main 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 while the inverter is off.
4) After making sure that the power lamp is off, switch on the power supply 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 See (c), (g), (h), (i) below.	
9	Measurement error See (d), (e), (f) below.	

REMARKS

- The life of the main circuit capacitor can not be measured in the following conditions.
  (a) The MT-HC, FR-BU, MT-BU5 or BU is connected
  (b) Terminals R1/L11, S1/L21 or DC power supply is connected to the terminal P/+ and N/-.
  (c) Switch power on during measuring.
  (d) The motor is not connected to the inverter.
  (e) The motor is running. (The motor is coasting.)
  (f) The inverter is at an alarm stop or an alarm occurred while power is off.
  (g) The inverter output is shut off with the MRS signal.
  (h) The start command is given while measuring.
- Operating environment: Ambient Temperature (annual average 40°C (free from corrosive gas, flammable gas, oil mist, dust and dirt))
  Output current (80% of the rated current of Mitsubishi explosion-proof 4P motor)

(5) Cooling fan life display

- The cooling fan speed of 40% or less is detected and "FN" is displayed on the operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07). As an alarm display, *Pr. 255* bit 2 is turned on and also an alarm is output to the Y90 signal.

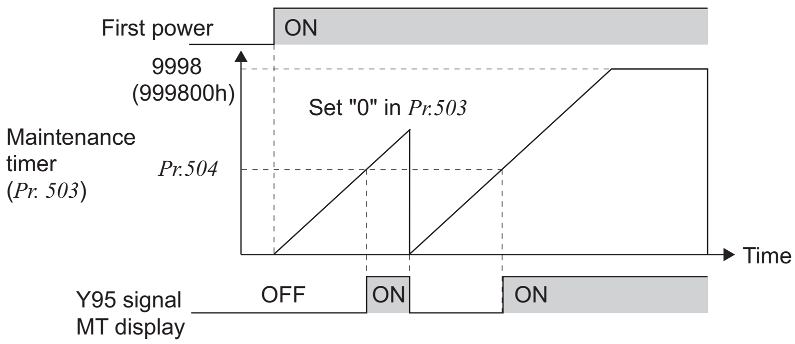
REMARKS
- When the inverter is mounted with two or more cooling fans, the life of even one cooling fan is diagnosed.

CAUTION
- For replacement of each part, contact the nearest Mitsubishi FA center.

4.21.3 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 (FR-DU07).
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)	Display the cumulative energization time of the inverter in 100h increments. Reading only Writing the setting of "0" clears the cumulative energization time.
504	**Maintenance timer alarm output set time**	9999	0 to 9998	Set the time taken until when the maintenance timer alarm output signal (Y95) is output.
			9999	No function



- The cumulative energization time of the inverter is stored into the EEPROM every hour and indicated in *Pr. 503 Maintenance timer* in 100h increments. *Pr. 503* is clamped at 9998 (999800h).
- When the *Pr. 503* value reaches the time set in *Pr. 504 Maintenance timer alarm output set time* (100h increments), the maintenance timer alarm output 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 any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

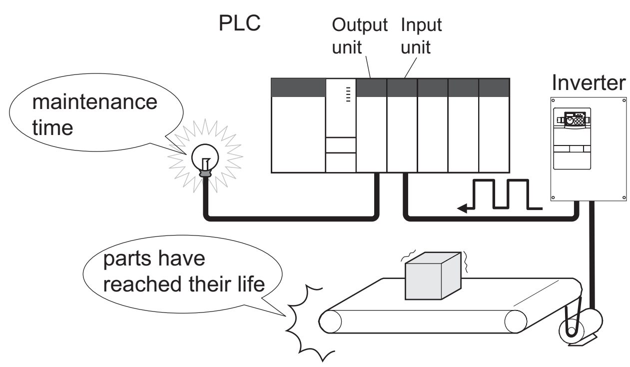
CAUTION
- The cumulative energization time is counted every hour. The energization time of less than 1h is not counted.
- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196(output terminal function selection) ☞ *Refer to page 125*

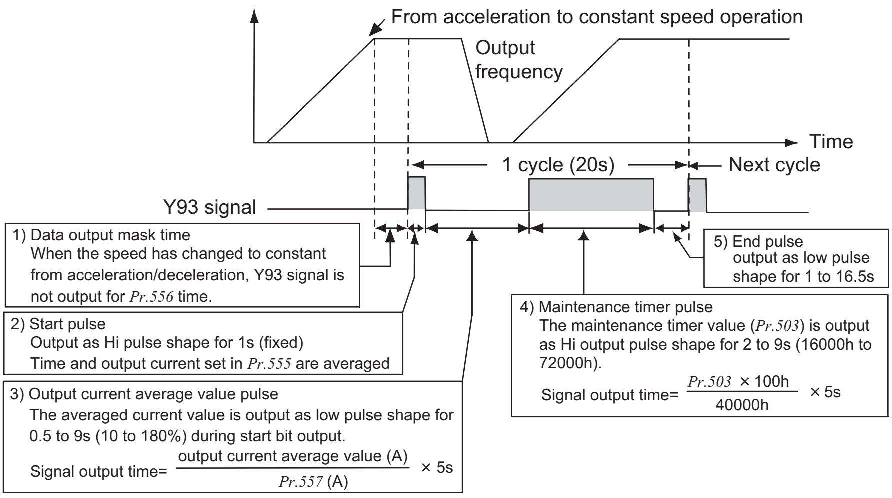
4.21.4 Current average value monitor signal (Pr. 555 to Pr. 557)

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 PLC etc. can be used as a guideline due to abrasion of machines and elongation of belt and for aged deterioration of devices to know the maintenance time.
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 1.0s		Set the time taken to average the current during start pulse output (1s).
556	**Data output mask time**	0s	0.0 to 20.0s		Set the time for not obtaining (mask) transient state data.
557	**Current average value monitor signal output reference current**	Rated inverter current	55K or less	0 to 500A	Set the reference (100%) for outputting the signal of the current average value.
			75K or more	0 to 3600A	

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



- The 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 any of *Pr. 190 to Pr. 194 (output terminal function selection)*. (The function can not be assigned to *Pr. 195 ABC1 terminal function selection* and *Pr. 196 ABC2 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*.

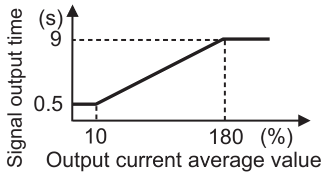
(2) Setting of the *Pr. 555 Current average time*
The average output current is calculated during Hi output of start bit (1s). Set the time taken to average the current during start bit output in *Pr. 555*.

(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 formula.

$$\frac{\textbf{Output current average value}}{\textbf{\textit{Pr. 557} setting}} \times \textbf{5s} \quad \textbf{(output current average value 100\%/5s)}$$

Note that the output time range is 0.5 to 9s, and it is 0.5s when the output current average value is less than 10% of the setting value of *Pr. 557* and 9s when exceeds 180%.

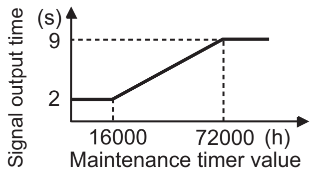
Example)When *Pr. 557* = 10A and the average value of output current is 15A
As 15A/10A × 5s = 7.5, the current average value monitor signal is output as low pulse shape for 7.5s.



(4) Output 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 formula.

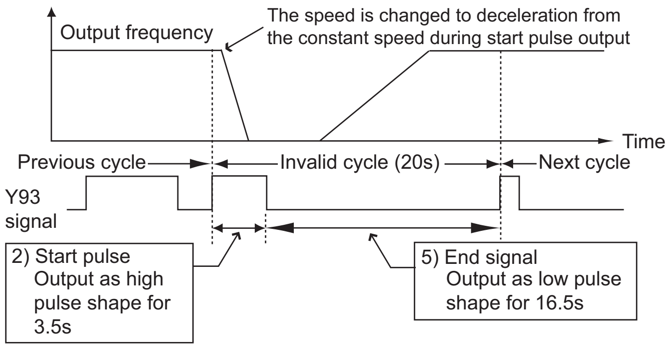
$$\frac{\textbf{\textit{Pr. 503}}}{\textbf{40000h}} \times \textbf{5s} \quad \textbf{(maintenance timer value 100\%/5s)}$$

Note that the output time range is 2 to 9s, and it is 2s when *Pr. 503* 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 condition.
  (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 automatic restart operation was being performed with automatic restart after instantaneous power failure selected (*Pr. 57* ≠ "9999") on completion of the data output mask

CAUTION

- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196(output terminal function selection) ☞ *Refer to page 125*
Pr. 503 Maintenance timer ☞ *Refer to page 249*
Pr. 57 Restart coasting time ☞ *Refer to page 148*

4.21.5 Free parameter (Pr. 888, Pr. 889)

You can input any number within the setting range 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	
889	**Free parameter 2**	9999	0 to 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*.

REMARKS

- The set value is stored in EEPROM as same as other parameter, the setting value is saved even after power off.
- *Pr. 888* and *Pr. 889* do not influence the inverter operation.

4.22 Setting of the parameter unit and operation panel

Purpose	Parameter that must be Set		Refer to Page
Switch the display language of the parameter unit	**PU display language selection**	**Pr. 145**	253
Use the setting dial of the operation panel like a volume for frequency setting. Key lock of operation panel	**Operation panel operation selection**	**Pr. 161**	253
Control of the parameter unit, operation panel buzzer	**PU buzzer control**	**Pr. 990**	255
Adjust the LCD contrast of the parameter unit	**PU contrast adjustment**	**Pr. 991**	255

4.22.1 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	Germany
			3	French
			4	Spanish
			5	Italian
			6	Swedish
			7	Finnish

4.22.2 Operation panel frequency setting/key lock operation selection (Pr. 161)

The setting dial of the operation panel (FR-DU07) can be used like a volume to perform operation.
The key operation of the operation panel can be disabled.

<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 rowspan="4">161</td><td rowspan="4">Frequency setting/key lock operation selection</td><td rowspan="4">0</td><td>0</td><td>Setting dial frequency setting mode</td><td rowspan="2">Key lock mode invalid</td></tr>
<tr><td>1</td><td>Setting dial volume mode</td></tr>
<tr><td>10</td><td>Setting dial frequency setting mode</td><td rowspan="2">Key lock mode valid</td></tr>
<tr><td>11</td><td>Setting dial volume mode</td></tr>
</table>

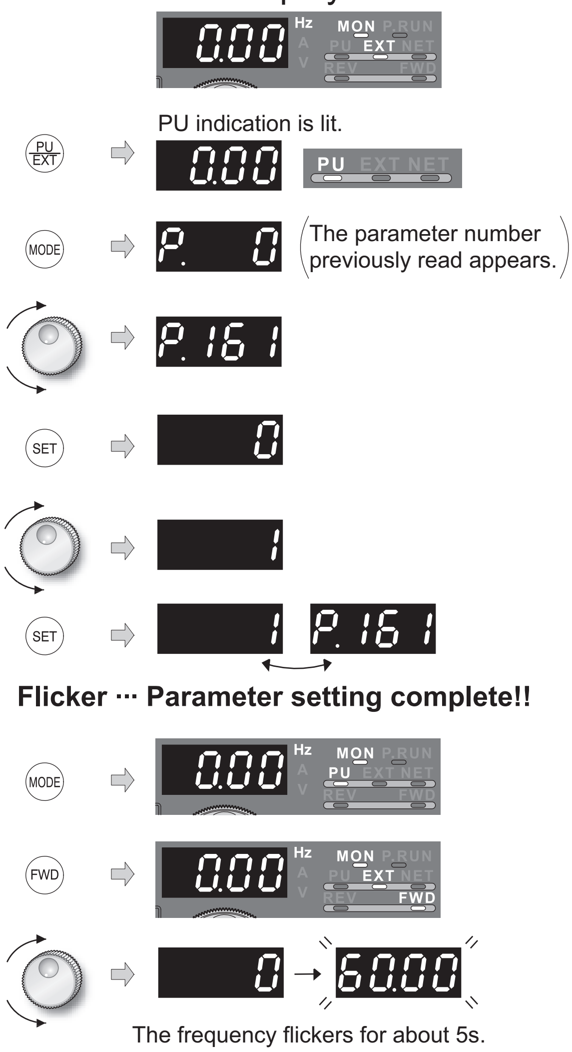
(1) Using the setting dial like a volume to set the frequency.

Operation example Changing the frequency from 0Hz to 60Hz during operation

Operation

1. Screen at powering 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 P. 161 (*Pr. 161*) appears.
5. Press SET to read the currently set value.
   "0" (initial value) appears.
6. Turn (dial) to change it to the setting value "1".
7. Press SET to set.
8. Mode/monitor check
   Press MODE twice to choose monitor/frequency monitor.
9. Press FWD (or REV) to start the inverter.
10. Turn (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.

(2) 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 made invalid to prevent parameter change and unexpected start and stop.

· 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 is made invalid, HOLd appears on the operation panel. When the setting dial and key operation is invalid, HOLd appears if the setting dial or key operation is performed. (When the setting dial or key operation is not performed for 2s, the 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 STOP RESET is valid.

CAUTION

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

4.22.3 Buzzer control (Pr. 990)

You can make the buzzer "beep" when you press key of the operation panel (FR-DU07) and 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 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*.

4.22.4 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 parameters are displayed as simple mode parameters only when the parameter unit (FR-PU04/FR-PU07) is connected.

4

PARAMETERS

4.23 Parameter clear

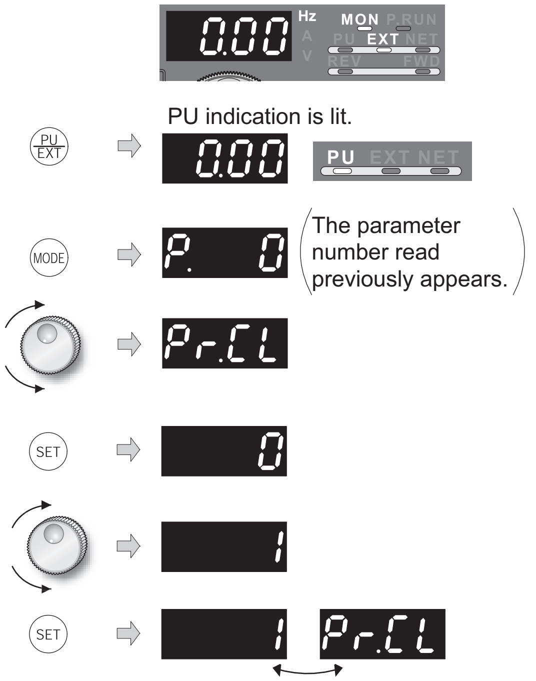
POINT

· Set "1" in *Pr. CL parameter clear* to initialize all parameters. (Parameters are not cleared when "1" is set in *Pr. 77 Parameter write selection*. In addition, calibration parameters are not cleared.)

Operation

1. Screen at powering 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.r.CL" appears.
5. Press (SET) to read the currently set value.
   "0"(initial value) appears.
6. Turn the setting dial to change it to the setting value "1".
7. Press (SET) to set.

Display



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.

Setting	Description
0	Not executed.
1	Returns all parameters except *calibration parameters C0 (Pr. 900) to C7 (Pr. 905)* to the initial values.

REMARKS

Refer to the list of parameters on *page 310* for availability of parameter clear.

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

☞ The inverter is not in the PU operation mode.

1. Press (PU/EXT).

   PU is lit and the monitor (4 digit LED) displays "0" (*Pr. 79* = "0" (initial value)).
2. Carry out operation from step 6 again.

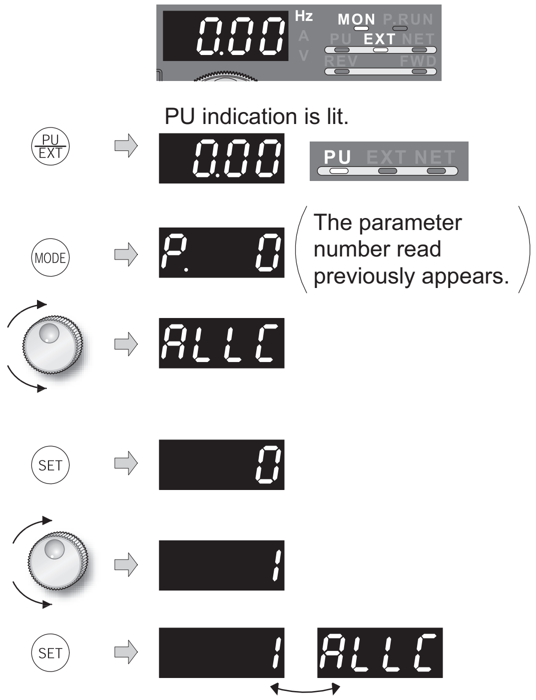
4.24 All parameter clear

POINT

· Set "1" in *ALLC parameter clear* to initialize all parameters. (Parameters are not cleared when "1" is set in *Pr. 77 Parameter write selection*. In addition, calibration parameters are not cleared.)

Operation — **Display**

1. Screen at powering 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 ALLC (all parameter clear) appears.
5. Press (SET) to read the currently set value.
"0"(initial value) appears.
6. Turn (dial) to change it to the setting value "1".
7. Press (SET) to set.



Flicker ··· Parameter setting complete!!

· Press (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	All parameters return to the initial values.

REMARKS

Refer to the list of parameters on *page 310* for availability of all parameter clear.

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

☞ The inverter is not in the PU operation mode.

1. Press (PU/EXT) .

   PU is lit and the monitor (4 digit LED) displays "0" (*Pr. 79* = "0" (initial value)).
2. Carry out operation from step 6 again.

4

PARAMETERS

4.25 Parameter copy and parameter verification

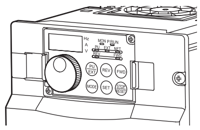
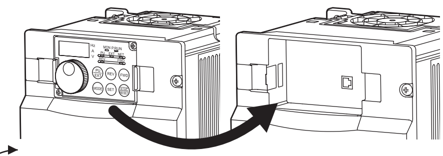
PCPY Setting	Description
0	Cancel
1	Copy the source parameters to the operation panel.
2	Write the parameters copied to the operation panel into the destination inverter.
3	Verify parameters in the inverter and operation panel. *(Refer to page 259.)*

REMARKS

· When the copy destination inverter is not the FR-B,B3 series (A700 specifications) or parameter copy write is performed after parameter read is stopped, "model error (rE4)" is displayed.
· Refer to the parameter list on *page 310* and later for availability of parameter copy.
· When the power is turned off or an operation panel is disconnected, etc. during parameter copy write, perform write again or check the values by parameter verification.

4.25.1 Parameter copy

Multiple inverters and parameter settings can be copied.

Operation	Display
1. Connect the operation panel to the copy source inverter. • **Connect it during a stop.**	
2. Press (MODE) to choose the parameter setting mode.	(MODE) ⇨ P. 0 (The parameter number previously read appears.)
3. Turn the setting dial until PCPY (parameter copy) appears.	⇨ PCPY
4. Press (SET) to read the currently set value. "0" (initial value) appears.	(SET) ⇨ 0
5. Turn the setting dial to change it to the setting value "1".	⇨ 1
6. Press (SET) to copy the source parameters to the operation panel.	(SET) ⇨ 1 Flickers for about 30s
	About 30s later ⇨ 1 ↔ PCPY **Flicker ··· Parameter copy complete!!**
7. Connect the operation panel to the copy source inverter.	
8. After performing steps 2 to 5, turn the setting dial to change it to "2".	⇨ 2
9. Press (SET) to write the parameters copied to the operation panel to the destination inverter.	(SET) ⇨ 2 The frequency flickers for about 30s
10. When copy is completed, "2" and "PCPY" flicker.	⇨ 2 ↔ PCPY **Flicker ··· Parameter copy complete!!**
11. After writing the parameter values to the copy destination inverter, always reset the inverter, e.g. switch power off once, before starting operation.	

? rE1 appears...Why? ☞ Parameter read error. Perform operation from step 3 again.
? rE2 appears...Why? ☞ Parameter write error. Perform operation from step 8 again.

? CP and 0.00 flicker alternately

☞ Appears when parameters are copied between the inverter of 55K or less and 75K or more.

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

	55K or less	75K or more
Pr. 989 Setting	10	100

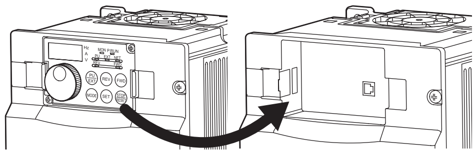
3. Reset *Pr. 9, Pr. 30, Pr. 52, Pr. 54, Pr. 56, Pr. 57, Pr. 61, Pr. 70, Pr. 80, Pr. 82, Pr. 90 to Pr. 94 , Pr. 158, Pr. 557, Pr. 859, Pr. 893*.

4.25.2 Parameter verification

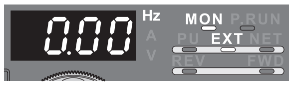
Whether same parameter values are set in other inverters or not can be checked.

Operation — **Display**

1. Replace the operation panel on the inverter to be verified.
   • **Replace it during a stop.**



2. Screen at powering on
   The monitor display appears.



3. Press (MODE) to choose the parameter setting mode.

   (MODE) ⇨ P. 0 — The parameter number read previously appears.

4. Turn ◯ until PCPY (parameter copy) appears.

   ⇨ PCPY

5. Press (SET) to read the currently set value.
   "0"(initial value) appears.

   (SET) ⇨ 0

6. Turn ◯ to change it to the set value "3"(parameter copy verification mode).

   ⇨ 3

7. Press (SET) to read the parameter setting of the verified inverter to the operation panel.

   (SET) ⇨ 3 — Flickers for about 30s

   • If different parameters exist, different parameter numbers and rE3 flicker.

   P 1 ⟷ rE3

   • Hold down (SET) to verify.

   (SET) ⇨ 3 — Flickering

8. It there is no difference, PCPY and 3 flicker to complete verification.

   3 ⟷ PCPY

Flicker ··· Parameter verification complete!!

REMARKS

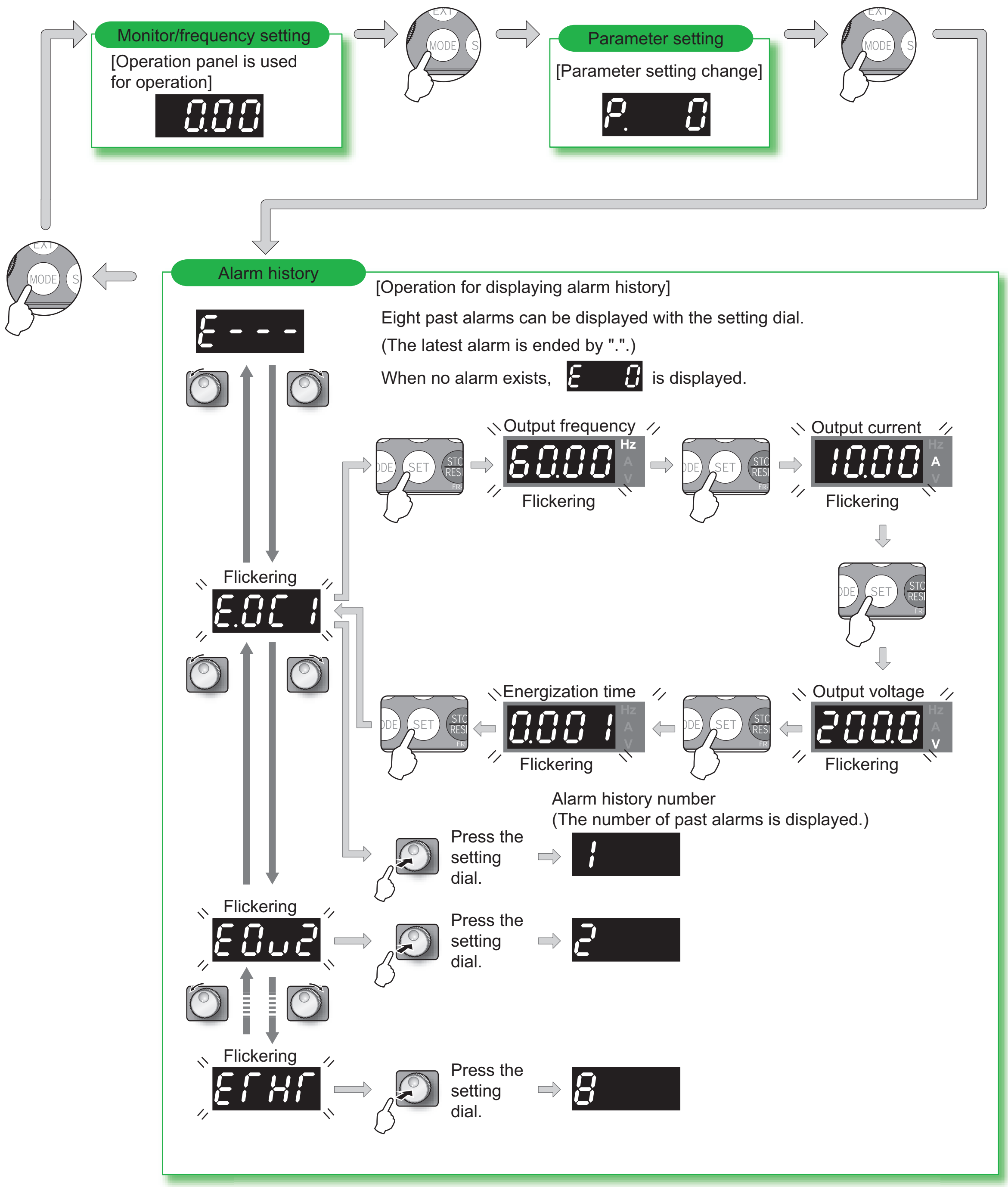
When the copy destination inverter is not the FR-B, B3 series (A700 specifications), "model error (rE4)" is displayed.

? rE3 flickers ... Why?

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

4.26 Check and clear of the alarm history

(1) Check for the alarm (major fault) history



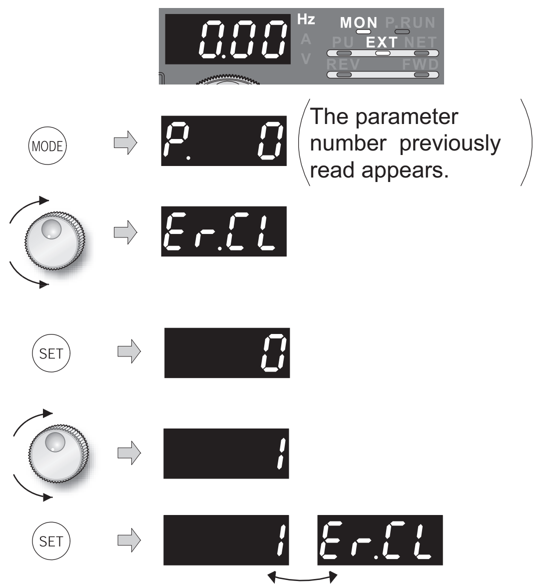
(2) Clearing procedure

POINT

· The alarm history can be cleared by setting "1" in *Er.CL Alarm history clear*. (The alarm history is not cleared when "1" is set in *Pr. 77 Parameter write selection*)

Operation | Display

1. Screen at powering on
   The monitor display appears.
2. Press (MODE) to choose the parameter setting mode.
3. Turn (dial) until Er.CL (alarm history clear) appears.
4. Press (SET) to read the currently set value.
   "0"(initial value) appears.
5. Turn (dial) to change it to the setting value "1".
6. Press (SET) to set.



Flicker ··· Alarm history clear complete!!

· Press (dial) to read another parameter.

· Press (SET) to show the setting again.

· Press (SET) twice to show the next parameter.

4

PARAMETERS

MEMO

5 PROTECTIVE FUNCTIONS

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

When an alarm (major failures) occurs in the inverter, the protective function is activated bringing the inverter to an alarm stop and the PU display automatically changes to any of the following error (alarm) indications.
If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

- Retention of alarm output signal......... When the magnetic contactor (MC) provided on the input side of the inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.
- Alarm display...................................... When the protective function is activated, the operation panel display automatically switches to the above indication.
- Resetting method .... When the protective function is activated, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart. *(Refer to page 264.)*
- When the protective function is activated, take the corresponding corrective action, then reset the inverter, and resume operation.
  Not doing so may lead to the inverter fault and damage.

Inverter alarm displays are roughly divided as below.

(1) Error Message
A message regarding operational fault and setting fault by the operation panel (FR-DU07) and parameter unit (FR-PU04 /FR-PU07) is displayed.
The inverter does not shut off output.

(2) Warnings
The inverter does not shut off output even when a warning is displayed. However, failure to take appropriate measures will lead to a major fault.

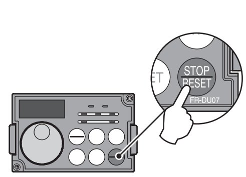
(3) Minor fault
The inverter does not shut off output.You can also output a minor fault signal by making parameter setting.

(4) Major fault
When the protective function is activated, the inverter output is shut off and an alarm is output.

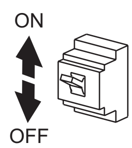
5.1 Reset method of protective function

(1) Resetting the inverter
The inverter can be reset by performing any of the following operations. Note that the internal thermal integrated value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the inverter.
Recover about 1s after reset is cancelled.

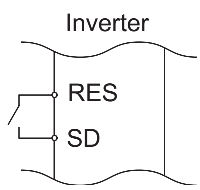
Operation 1: ..... Using the operation panel, press STOP RESET to reset the inverter.
(Enabled only when the inverter protective function is activated (major fault) (Refer to *page 270* for major fault.))



Operation 2:...... Switch power off once, then switch it on again.



Operation 3: ..... Turn on the reset signal (RES) for more than 0.1s. (If the RES signal is kept on, "Err." appears (flickers) to indicate that the inverter is in a reset status.)



5.2 List of alarm display

	Operation Panel Indication		Name	Refer to
Error message	E - - -	E - - -	Alarm history	260
	HOLd	HOLD	Operation panel lock	266
	Er1 to Er4	Er1 to 4	Parameter write error	266
	rE1 to rE4	rE1 to 4	Copy operation error	267
	Err.	Err.	Error	267
Warnings	OL	OL	Stall prevention (overcurrent)	268
	oL	oL	Stall prevention (overvoltage)	268
	rb	RB	Regenerative brake pre-alarm	269
	TH	TH	Electronic thermal relay function pre-alarm	269
	PS	PS	PU stop	268
	MT	MT	Maintenance signal output	269
	CP	CP	Parameter copy	269
Minor fault	Fn	FN	Fan fault	269
Major fault	E.OC1	E.OC1	Overcurrent shut-off during acceleration	270
	E.OC2	E.OC2	Overcurrent shut-off during constant speed	270
	E.OC3	E.OC3	Overcurrent shut-off during deceleration or stop	270
	E.Ov1	E.OV1	Regenerative overvoltage shut-off during acceleration	270
	E.Ov2	E.OV2	Regenerative overvoltage shut-off during constant speed	271
	E.Ov3	E.OV3	Regenerative overvoltage shut-off during deceleration or stop	271
	E.THT	E.THT	Inverter overload shut-off (electronic thermal relay function)	271
	E.THM	E.THM	Motor overload shut-off (electronic thermal relay function)	271
	E.FIn	E.FIN	Fin overheat	271
	E.IPF	E.IPF	Instantaneous power failure	272
	E. bE	E.BE	Brake transistor alarm detection	272
	E.UvT	E.UVT	Undervoltage	272
	E.ILF	E.ILF*1	Input phase failure	272
	E.OLT	E.OLT	Stall prevention	272

	Operation Panel Indication		Name	Refer to
Major fault	E. GF	E.GF	Output side earth (ground) fault overcurrent	273
	E. LF	E.LF	Output phase failure	273
	E.OHT	E.OHT	External thermal relay operation *2	273
	E.PTC	E.PTC*1	PTC thermistor operation	273
	E.OPT	E.OPT	Option alarm	273
	E.OP3	E.OP3	Communication option alarm	273
	E. 1 to E. 3	E. 1 to E. 3	Option alarm	274
	E. PE	E.PE	Parameter storage device alarm	274
	E.PUE	E.PUE	PU disconnection	274
	E.rET	E.RET	Retry count excess	274
	E.PE2	E.PE2*1	Parameter storage device alarm	274
	E. 6 / E. 7 / E.CPU	E. 6 / E. 7 / E.CPU	CPU error	275
	E.CTE	E.CTE	Operation panel power supply short circuit, RS-485 terminal power supply short circuit	275
	E.P24	E.P24	24VDC power output short circuit	276
	E.CdO	E.CDO*1	Output current detection value exceeded	276
	E.IOH	E.IOH*1	Inrush current limit circuit alarm	276
	E.SEr	E.SER*1	Communication error (inverter)	277
	E.AIE	E.AIE*1	Analog input error	277
	E.EP	E.EP*2	Encoder phase error	276
	E.Mb1 to E.Mb7	E.MB1 to E.MB7	Brake sequence error	275
	E.OS	E.OS	Overspeed occurence	275
	E.ECT	E.ECT	Signal loss detection	276
	E. 13	E.13	Internal circuit error	277

*1 If an error occurs when using the FR-PU04, "Fault 14" is displayed on the FR-PU04.
*2 Appears only for the FR-B3 series.

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 made invalid. *(Refer to page 255.)*	
Check point	—	
Corrective action	Press MODE for 2s to release lock.	

Operation Panel Indication	**Er1**	Er 1
Name	Write disable error	
Description	1. You attempted to make parameter setting when *Pr. 77 Parameter write selection* has been set to disable parameter write. 2. Frequency jump setting range overlapped. 3. Adjustable 5 points V/F settings overlapped 4. The PU and inverter cannot make normal communication	
Check point	1. Check the setting of *Pr. 77 Parameter write selection (Refer to page 179.)* 2. Check the settings of *Pr. 31 to 36 (frequency jump). (Refer to page 80.)* 3. Check the connection of the PU and inverter.	

Operation Panel Indication	**Er2**	Er2
Name	Write error during operation	
Description	When parameter write was performed during operation with a value other than "2" (writing is enabled independently of operating status in any operation mode) is set in *Pr. 77* and the STF (STR) is on.	
Check point	1. Check the *Pr. 77* setting. *(Refer to page 179.)* 2. Check that the inverter is not operating.	
Corrective action	1. Set "2" in *Pr. 77*. 2. After stopping operation, make parameter setting.	

Operation Panel Indication	**Er3**	Er3
Name	Calibration error	
Description	Analog input bias and gain calibration values are too close.	
Check point	Check the settings of C3, C4, C6 and C7 (calibration functions). *(Refer to page 172.)*	

Operation Panel Indication	**Er4**	Er4
Name	Mode designation error	
Description	You attempted to make parameter setting in the NET operation mode when *Pr. 77* is not "2".	
Check point	1. Check that operation mode is "PU operation mode". 2. Check the *Pr. 77* setting. *(Refer to page 179.)*	
Corrective action	1. After setting the operation mode to the "PU operation mode", make parameter setting. *(Refer to page 179.)* 2. After setting "2" in *Pr. 77*, make parameter setting.	

Operation Panel Indication	rE1	rE 1
Name	Parameter read error	
Description	An error occurred in the EEPROM on the operation panel side during parameter copy reading.	
Check point	——	
Corrective action	· Make parameter copy again. *(Refer to page 258.)* · Check for an operation panel (FR-DU07) failure. Please contact your sales representative.	

Operation Panel Indication	rE2	rE2
Name	Parameter write error	
Description	1. You attempted to perform parameter copy write during operation. 2. An error occurred in the EEPROM on the operation panel side during parameter copy writing.	
Check point	Is the FWD or REV LED of the operation panel (FR-DU07) lit or flickering?	
Corrective action	1. After stopping operation, make parameter copy again. *(Refer to page 258.)* 2. Check for an operation panel (FR-DU07) failure. Please contact your sales representative.	

Operation Panel Indication	rE3	rE3
Name	Parameter verification error	
Description	1. Data on the operation panel side and inverter side are different. 2. An error occurred in the EEPROM on the operation panel side during parameter verification.	
Check point	Check for the parameter setting of the source inverter and inverter to be verified.	
Corrective action	1. Press SET to continue verification. Make parameter verification again. *(Refer to page 259.)* 2. Check for an operation panel (FR-DU07) failure. Please contact your sales representative.	

Operation Panel Indication	rE4	rE4
Name	Model error	
Description	1. A different model was used for parameter write and verification during parameter copy. 2. When parameter copy write is stopped after parameter copy read is stopped	
Check point	1. Check that the verified inverter is the same model. 2. Check that the power is not turned off or an operation panel is not disconnected, etc. during parameter copy read.	
Corrective action	1. Use the same model (FR-B, B3 series(A700 specifications)) for parameter copy and verification. 2. Perform parameter copy read again.	

Operation Panel Indication	Err.	Err.
Description	1. The RES signal is on 2. The PU and inverter cannot make normal communication (contact fault of the connector) 3. When the control circuit power (R1/L11, S1/L21) and the main circuit power (R/L1, S/L2, T/L3) are connected to a separate power, it may appear at turning on of the main circuit. It is not a fault.	
Corrective action	1. Turn off the RES signal. 2. Check the connection of the PU and inverter.	

(2) Warnings

When the protective function is activated, the output is not shut off.

<table>
<tr><td>Operation Panel Indication</td><td>OL</td><td>OL</td><td>FR-PU04
FR-PU07</td><td>OL</td></tr>
<tr><td>Name</td><td colspan="4">Stall prevention (overcurrent)</td></tr>
<tr><td rowspan="3">Description</td><td>During acceleration</td><td colspan="3">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 shut-off. When the overload current has decreased below stall prevention operation level, this function increases the frequency again.</td></tr>
<tr><td>During constant-speed operation</td><td colspan="3">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 shut-off. When the overload current has decreased below stall prevention operation level, this function increases the frequency up to the set value.</td></tr>
<tr><td>During deceleration</td><td colspan="3">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 shut-off. When the overload current has decreased below stall prevention operation level, this function decreases the frequency again.</td></tr>
<tr><td>Check point</td><td colspan="4">1. Check that the Pr. 7 Acceleration time and Pr. 8 Deceleration time settings are not too small.
2. Check that the load is not too heavy.
3. Are there any failure in peripheral devices?
4. Check that the Pr. 13 Starting frequency is not too large.
· Check the motor for use under overload.</td></tr>
<tr><td>Corrective action</td><td colspan="4">1. Set a larger value in Pr. 7 Acceleration time and Pr. 8 Deceleration time. (Refer to page 88.)
2. Reduce the load weight.
3. Set stall prevention operation current in Pr. 22 Stall prevention operation level. (The initial value is 150%.) The acceleration/deceleration time may change. Increase the stall prevention operation level with Pr. 22 Stall prevention operation level, or disable stall prevention with Pr. 156 Stall prevention operation selection. (Use Pr. 156 to set either operation continued or not at OL operation.)</td></tr>
</table>

<table>
<tr><td>Operation Panel Indication</td><td>oL</td><td>oL</td><td>FR-PU04
FR-PU07</td><td>oL</td></tr>
<tr><td>Name</td><td colspan="4">Stall prevention (overvoltage)</td></tr>
<tr><td>Description</td><td>During deceleration</td><td colspan="3">· If the regenerative energy of the motor becomes excessive and exceeds the regenerative energy consumption capability, this function stops the decrease in frequency to prevent overvoltage shut-off. As soon as the regenerative energy has decreased, 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 shut-off. (Refer to page 244.)</td></tr>
<tr><td>Check point</td><td colspan="4">· Check for sudden speed reduction.
· Regeneration avoidance function (Pr. 882 to Pr. 886) is being used? (Refer to page 244.)</td></tr>
<tr><td>Corrective action</td><td colspan="4">The deceleration time may change.
Increase the deceleration time using Pr. 8 Deceleration time.</td></tr>
</table>

<table>
<tr><td>Operation Panel Indication</td><td>PS</td><td>PS</td><td>FR-PU04
FR-PU07</td><td>PS</td></tr>
<tr><td>Name</td><td colspan="4">PU stop</td></tr>
<tr><td>Description</td><td colspan="4">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 177.)</td></tr>
<tr><td>Check point</td><td colspan="4">Check for a stop made by pressing STOP/RESET of the operation panel.</td></tr>
<tr><td>Corrective action</td><td colspan="4">Turn the start signal off and release with PU/EXT.</td></tr>
</table>

Operation Panel Indication	RB	rb	FR-PU04 FR-PU07	RB
Name	Regenerative brake pre-alarm			
Description	Appears if the regenerative brake duty reaches or exceeds 85% of the *Pr. 70 Special regenerative brake duty* value. 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 any of *Pr. 190 to Pr. 196 (output terminal function selection)*. *(Refer to page 125)* Appears only for the 75K or more.			
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* values are correct.			
Corrective action	• Increase the deceleration time. • Check the *Pr. 30 Regenerative function selection* and *Pr. 70 Special regenerative brake duty* values.			

Operation Panel Indication	TH	rH	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 shut-off (E. THM) occurs. The THP signal can be simultaneously output with the [TH] display. For the terminal used for the THP signal output, assign the function by setting "8" (positive logic) or "108" (negative logic) in any of *Pr. 190 to Pr. 196 (output terminal function selection)*. *(Refer to page 125)*			
Check point	1. Check for large load or sudden acceleration. 2. Is the *Pr. 9 Electronic thermal O/L relay* setting is appropriate? *(Refer to page 96.)*			
Corrective action	1. Reduce the load weight or the number of operation times. 2. Set an appropriate value in *Pr. 9 Electronic thermal O/L relay*. *(Refer to page 96.)*			

Operation Panel Indication	MT	nr	FR-PU04	——
			FR-PU07	MT
Name	Maintenance signal output			
Description	Indicates that the cumulative energization time of the inverter has reached a given time.			
Check point	The *Pr. 503 Maintenance timer* setting is larger than the *Pr. 504 Maintenance timer alarm output set time* setting. *(Refer to page 249.)*			
Corrective action	Setting "0" in *Pr. 503 Maintenance timer* erraces the signal.			

Operation Panel Indication	CP	CP	FR-PU04	——
			FR-PU07	CP
Name	Parameter copy			
Description	Appears when parameters are copied between models with capacities of 55K or less and 75K or more.			
Check point	Resetting of *Pr.9, Pr.30, Pr.52, Pr.54, Pr.56, Pr.57, Pr.61, Pr.70, Pr.80, Pr.82, Pr.90 to Pr.94, Pr.158, Pr.557, Pr.859* and *Pr.893* is necessary.			
Corrective action	Set the initial value in *Pr. 989 Parameter copy alarm release*.			

(3) Minor fault

When the protective function is activated, the output is not shut off. You can also output a minor fault signal by making parameter setting. (Set "98" in any of *Pr. 190 to Pr. 196 (output terminal function selection)*. *(Refer to page 125.)*)

Operation Panel Indication	FN	Fn	FR-PU04 FR-PU07	FN
Name	Fan fault			
Description	For the inverter that contains a cooling fan, Fn appears on the operation panel when the cooling fan stops due to a fault or different operation from the setting of *Pr. 244 Cooling fan operation selection*.			
Check point	Check the cooling fan for a fault.			
Corrective action	Check for fan fault. Please contact your sales representative.			

(4) Major fault
When the protective function is activated, the inverter output is shut off and an alarm is output.

Operation Panel Indication	E.OC1	E.OC 1	FR-PU04 FR-PU07	OC During Accs
Name	Overcurrent shut-off during acceleration			
Description	When the inverter output current reaches or exceeds approximately 220% of the rated current during acceleration, the protective circuit is activated to stop the inverter output.			
Check point	1. Check for sudden acceleration. 2. Check that the downward acceleration time is not long in vertical lift application. 3. Check for output short circuit. 4. Check that stall prevention operation is correct. 5. Check that the regeneration is not performed frequently. (Check that the output voltage becomes larger than the V/F reference voltage at regeneration and overcurrent due to increase in motor current occurs.)			
Corrective action	1. Increase the acceleration time. (Shorten the downward acceleration time in vertical lift application.) 2. 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. 3. Check the wiring to make sure that output short circuit does not occur. 4. Perform a correct stall prevention operation. *(Refer to page 74.)*			

Operation Panel Indication	E.OC2	E.OC 2	FR-PU04 FR-PU07	Stedy Spd OC
Name	Overcurrent shut-off during constant speed			
Description	When the inverter output current reaches or exceeds approximately 220% of the rated current during constant speed operation, the protective circuit is activated to stop the inverter output.			
Check point	1. Check for sudden load change. 2. Check for output short circuit. 3. Check that stall prevention operation is correct			
Corrective action	1. Keep load stable. 2. Check the wiring to avoid output short circuit. 3. Check that stall prevention operation setting is correct. *(Refer to page 74.)*			

Operation Panel Indication	E.OC3	E.OC 3	FR-PU04 FR-PU07	OC During Dec
Name	Overcurrent shut-off during deceleration or stop			
Description	When the inverter output current reaches or exceeds approximately 220% of the rated inverter current during deceleration (other than acceleration or constant speed), the protective circuit is activated to stop the inverter output.			
Check point	1. Check for sudden speed reduction. 2. Check for output short circuit. 3. Check for too fast operation of the motor's mechanical brake. 4. Check that stall prevention operation setting is correct.			
Corrective action	1. Increase the deceleration time. 2. Check the wiring to avoid output short circuit. 3. Check the mechanical brake operation. 4. Check that stall prevention operation setting is correct.*(Refer to page 74.)*			

Operation Panel Indication	E.OV1	E.Ou 1	FR-PU04 FR-PU07	OV During Acc
Name	Regenerative overvoltage shut-off during acceleration			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	Check for too slow acceleration. (e.g. during descending acceleration with lifting load)			
Corrective action	· Decrease the acceleration time. · Use regeneration avoidance function *(Pr. 882 to Pr. 886)*. *(Refer to page 244.)*			

Operation Panel Indication	E.OV2		FR-PU04 FR-PU07	Stedy Spd OV
Name	Regenerative overvoltage shut-off 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.			
Corrective action	· Keep load stable. · Use regeneration avoidance function *(Pr. 882 to Pr. 886)*. *(Refer to page 244.)* · Use the regeneration unit as required. When using the regeneration unit with 55kW or less, another explosion-proof test is necessary.			

Operation Panel Indication	E.OV3		FR-PU04 FR-PU07	OV During Dec
Name	Regenerative overvoltage shut-off 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.			
Corrective action	· Increase the deceleration time. (Set the deceleration time which matches the moment of inertia of the load) · Decrease the braking duty. · Use regeneration avoidance function *(Pr. 882 to Pr. 886)*. *(Refer to page 244.)* · Use the regeneration unit as required. When using the regeneration unit with 55kW or less, another explosion-proof test is necessary.			

Operation Panel Indication	E.THT		FR-PU04 FR-PU07	Inv. Overload
Name	Inverter overload shut-off (electronic thermal relay function) *1			
Description	If a current not less than 150% of the rated output current flows and overcurrent shut-off does not occur (220% or less), inverse-time characteristics cause the electronic thermal relay to be activated to stop the inverter output in order to protect the output transistors. (overload immunity 150% 60s)			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			

Operation Panel Indication	E.THM		FR-PU04 FR-PU07	Motor Overload
Name	Motor overload shut-off (electronic thermal 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 temperature 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 temperature reaches the specified value. When running a special motor such as a multi-pole motor, provide a thermal relay on the inverter output side since such motor(s) cannot be protected by the electronic thermal relay function.			
Check point	1. Check the motor for use under overload. 2. Check that stall prevention operation setting is correct.			
Corrective action	1. Reduce the load weight. 2. For a constant-torque motor, set the constant-torque motor in *Pr. 71 Applied motor*. 3. Check that stall prevention operation setting is correct. *(Refer to page 74.)*			

*1 Resetting the inverter initializes the internal thermal integrated data of the electronic thermal relay function.

Operation Panel Indication	E.FIN		FR-PU04 FR-PU07	H/Sink O/Temp
Name	Fin overheat			
Description	If the heatsink overheats, the temperature sensor is actuated to stop the inverter output. 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 to Pr. 196 (output terminal function selection)*. *(Refer to page 125)*			
Check point	1. Check for too high ambient temperature. 2. Check for heatsink clogging. 3. Check that the cooling fan is stopped. (Check that Fn is displayed on the operation panel.)			
Corrective action	1. Set the ambient temperature to within the specifications. 2. Clean the heatsink. 3. Replace the cooling fan.			

PROTECTIVE FUNCTIONS

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Operation Panel Indication	E.IPF	E.I PF	FR-PU04 FR-PU07	Inst. Pwr. Loss
Name	Instantaneous power failure			
Description	If a power failure occurs for longer than 15ms (this also applies to inverter input shut-off), the instantaneous power failure protective function is activated to stop the inverter output in order to prevent the control circuit from malfunctioning. If a power failure persists for longer than 100ms, the alarm warning output is not provided, and the inverter restarts if the start signal is on upon power restoration. (The inverter continues operating if an instantaneous power failure is within 15ms.) In some operating status (load magnitude, acceleration/ deceleration time setting, etc.), overcurrent or other protection may be activated upon power restoration. When instantaneous power failure protection is activated, the IPF signal is output. *(Refer to page 148)*			
Check point	Find the cause of instantaneous power failure occurrence.			
Corrective action	· Remedy the instantaneous power failure. · Prepare a backup power supply for instantaneous power failure. · Set the function of automatic restart after instantaneous power failure (*Pr. 57*). *(Refer to page 148.)*			

Operation Panel Indication	E.BE	E. bE	FR-PU04 FR-PU07	Br. Cct. Fault
Name	Brake transistor alarm detection Appears only for the 75K or more.			
Description	This function stops the inverter output if an alarm occurs in the brake circuit, e.g. damaged brake transistors. In this case, the inverter must be powered off immediately.			
Check point	· Reduce the load inertia. · Check that the frequency of using the brake is proper.			
Corrective action	Replace the inverter.			

Operation Panel Indication	E.UVT	E.UvT	FR-PU04 FR-PU07	Under Voltage
Name	Undervoltage			
Description	If the power supply voltage of the inverter decreases, the control circuit will not perform normal functions. In addition, the motor torque wiil be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage decreases below about 150VAC (300VAC for the 400V class), this function stops the inverter output. When a jumper is not connected across P/+-P1, the undervoltage protective function is activated. When undervoltage protection is activated, the IPF signal is output. *(Refer to page 148)*			
Check point	1. Check for start of large-capacity motor. 2. Check that a jumper or DC reactor is connected across terminals P/+-P1.			
Corrective action	1. Check the power supply system equipment such as the power supply. 2. Connect a jumper or DC reactor across terminals P/+-P1. If the problem still persists after taking the above measure, please contact your sales representative.			

Operation Panel Indication	E.ILF	E.I LF	FR-PU04 FR-PU07	Fault 14 Input phase loss
Name	Input phase failure			
Description	This alarm is output when function valid setting (=1) is set in *Pr. 872 Input phase failure protection selection* and one phase of the three phase power input opens. *(Refer to page 158.)*			
Check point	Check for a break in the cable for the three-phase power supply input.			
Corrective action	· Wire the cables properly. · Repair a brake portion in the cable. · Check the *Pr. 872 Input phase failure protection selection* setting.			

Operation Panel Indication	E.OLT	E.OLT	FR-PU04 FR-PU07	Stll Prev STP (OL shown during stall prevention operation)
Name	Stall prevention			
Description	If the frequency has fallen to 0.5Hz by stall prevention operation and remains for 3s, an alarm (E.OLT) appears to shutoff the inverter output. OL appears while stall prevention is being activated.			
Check point	· Check the motor for use under overload. *(Refer to page 75.)* · Check that the *Pr. 865 Low speed detection* values are correct. (Check the *Pr. 22 Stall prevention operation level* setting if V/F control is exercised.)			
Corrective action	· Reduce the load weight. · Change the *Pr. 22 Stall prevention operation level*, *Pr. 865 Low speed detection* values. (Check the *Pr. 22 Stall prevention operation level* setting if V/F control is exercised.)			

Operation Panel Indication	E.GF		FR-PU04 FR-PU07	Ground Fault
Name	Output side earth (ground) fault overcurrent			
Description	This function stops the inverter output if an earth (ground) fault overcurrent flows due to an earth (ground) fault that occurred on the inverter's output (load) side.			
Check point	Check for an earth (ground) fault in the motor and connection cable.			
Corrective action	Remedy the earth (ground) fault portion.			

Operation Panel Indication	E.LF		FR-PU04 FR-PU07	——
Name	Output phase failure			
Description	This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) opens.			
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.			
Corrective action	· Wire the cables properly. · Check the *Pr. 251 Output phase failure protection selection* setting.			

Operation Panel Indication	E.OHT		FR-PU04 FR-PU07	OH Fault
Name	External thermal relay operation *2			
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.			
Check point	· Check for motor overheating. · Check that the value of 7 (OH signal) is set correctly in any of *Pr. 178 to Pr. 189 (input terminal function selection)*.			
Corrective action	· Reduce the load and operating duty. · Even if the relay contacts are reset automatically, the inverter will not restart unless it is reset.			

*2 Functions only when any of *Pr. 178 to Pr. 189 (input terminal function selection)* is set to OH.

Operation Panel Indication	E.PTC		FR-PU04	Fault 14
			FR-PU07	PTC activated
Name	PTC thermistor operation			
Description	Appears when the motor overheat status is detected for 10s or more by the external PTC thermistor input connected to the terminal AU.			
Check point	· Check the connection between the PTC thermistor switch and thermal protector. · Check the motor for operation under overload. · Is valid setting (= 63) selected in *Pr. 184 AU terminal function selection* ? *(Refer to page 98, 118.)*			
Corrective action	Reduce the load weight.			

Operation Panel Indication	E.OPT		FR-PU04 FR-PU07	Option Fault
Name	Option alarm			
Description	Appears when the AC power supply is connected to the terminal R/L1, S/L2, T/L3 accidentally when a high power factor converter is connected. Appears when the switch for the manufacturer setting of the plug-in option is changed.			
Check point	· Check that the AC power supply is not connected to the terminal R/L1, S/L2, T/L3 when a high power factor converter (MT-HC) is connected.			
Corrective action	· Check the parameter (*Pr. 30*) setting and wiring. · The inverter may be damaged if the AC power supply is connected to the terminal R/L1, S/L2, T/L3 when a high power factor converter is connected. Please contact your sales representative. · Check for connection of the plug-in option. · Return the switch for the manufacturer setting of the plug-in option to the initial status. *(Refer to instruction manual of each option)*			

Operation Panel Indication	E.OP3		FR-PU04 FR-PU07	Option slot alarm 3
Name	Communication option alarm			
Description	Stops the inverter output when a communication line error occurs in the communication option.			
Check point	· Check for a wrong option function setting and operation. · Check that the plug-in option is plugged into the connector securely. · Check for a brake in the communication cable. · Check that the terminating resistor is fitted properly.			
Corrective action	· Check the option function setting, etc. · Connect the plug-in option securely. · Check the connection of communication cable.			

PROTECTIVE FUNCTIONS

5

Operation Panel Indication	E. 1 to E. 3	E. 1 to E. 3	FR-PU04 FR-PU07	Fault 1 to Fault 3
Name	Option alarm			
Description	Stops the inverter output if a contact faullt or the like of the connector between the inverter and communication option occurs or if a communication option is fitted to the connector 1 or 2. Appears when the switch for the manufacturer setting of the plug-in option is changed.			
Check point	1. Check that the plug-in option is plugged into the connector securely. (1 to 3 indicate the option connector numbers.) 2. Check for excess electrical noises around the inverter. 3. Check that the communication option is not fitted to the connector 1 or 2.			
Corrective action	1. Connect the plug-in option securely. 2. Take measures against noises if there are devices producing excess electrical noises around the inverter. If the problem still persists after taking the above measure, please contact your sales representative or distributor. 3. Fit the communication option to the connector 3. 4. Return the switch for the manufacturer setting of the plug-in option to the initial status. *(Refer to instruction manual of each option)*			

Operation Panel Indication	E.PE	E. PE	FR-PU04 FR-PU07	Corrupt Memry
Name	Parameter storage device alarm (control circuit board)			
Description	A fault occurred in parameters stored (EEPROM failure)			
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.PE2	E.PE2	FR-PU04	Fault 14
			FR-PU07	PR storage alarm
Name	Parameter storage device alarm (main circuit board)			
Description	A fault occurred in parameters stored (EEPROM failure)			
Check point	——————			
Corrective action	Please contact your sales representative.			

Operation Panel Indication	E.PUE	E.PUE	FR-PU04 FR-PU07	PU Leave Out
Name	PU disconnection			
Description	This function stops the inverter output if communication between the inverter and PU is suspended, e.g. the operation panel and parameter unit is disconnected, when "2", "3", "16" or "17" was set in *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*. 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. This function also stops the inverter output if communication is broken for the period of time set in *Pr. 122 PU communication check time interval*.			
Check point	· Check that the FR-DU07 or parameter unit (FR-PU04/FR-PU07) is fitted tightly. · Check the *Pr. 75* setting.			
Corrective action	Fit the FR-DU07 or parameter unit (FR-PU04/FR-PU07) securely.			

Operation Panel Indication	E.RET	E.rET	FR-PU04 FR-PU07	Retry No Over
Name	Retry count excess			
Description	If operation cannot be resumed properly within the number of retries set, this function stops the inverter output.			
Check point	Find the cause of alarm occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

Operation Panel Indication	E. 6	E. 6	FR-PU04 FR-PU07	Fault 6
	E. 7	E. 7		Fault 7
	E.CPU	E.CPU		CPU Fault
Name	CPU error			
Description	Stops the inverter output if the communication error of the built-in CPU occurs.			
Check point	Check for devices producing excess electrical noises around the inverter.			
Corrective action	· Take measures against noises if there are devices producing excess electrical noises around the inverter. · Please contact your sales representative.			

Operation Panel Indication	E.CTE	E.CTE	FR-PU04	——
			FR-PU07	E.CTE
Name	Operation panel power supply short circuit, RS-485 terminal power supply short circuit			
Description	When the operation panel power supply (PU connector) is shorted, this function shuts off the power output. At this time, the operation panel (parameter unit) cannot be used and RS-485 communication from the PU connector cannot be made. When the power supply for the RS-485 terminals are shorted, this function shuts off the power output. At this time, communication from the RS-485 terminals cannot be made. To reset, enter the RES signal or switch power off, then on again.			
Check point	1. Check for a short circuit in the PU connector cable. 2. Check that the RS-485 terminals are connected correctly.			
Corrective action	1. Check the PU and cable. 2. Check the connection of the RS-485 terminals			

Operation Panel Indication	E.MB1 to 7	E.MB1 to E.MB7	FR-PU04	——
			FR-PU07	E.MB1 Fault to E.MB7 Fault
Name	Brake sequence error			
Description	The inverter output is stopped when a sequence error occurs during use of the brake sequence function (*Pr. 278* to *Pr. 285*).			
Check point	Find the cause of alarm occurrence.			
Corrective action	Check the set parameters and perform wiring properly.			

Operation Panel Indication	E.OS	E.OS	FR-PU04 FR-PU07	Overspeed occurrence
Name	Overspeed occurence			
Description	Appears when the motor speed reaches and exceedes the overspeed setting level under encoder feedback control.			
Check point	· Check that the *Pr. 374 Overspeed detection level* value is correct. · Check that the number of encoder pulses does not differ from the actual number of encoder pulses.			
Corrective action	· Set the *Pr. 374 Overspeed detection level* value correctly. · Set the correct number of encoder pulses in *Pr. 369 Number of encoder pulses*.			

Operation Panel Indication	E.ECT		FR-PU04 FR-PU07	No encoder signal
Name	Signal loss detection			
Description	Stops the inverter output when the encoder signal is shut off under orientation control, encoder feedback control.			
Check point	· Check for the encoder signal loss. · Check that the encoder specifications are correct. · Check for a loose connector. · Check that the switch setting of the FR-A7AP is correct. · Check that the power is supplied to the encoder. Or, check that the power is not supplied to the encoder later than the inverter.			
Corrective action	· Remedy the signal loss. · Use an encoder that meets the specifications. · Make connection securely. · Make a switch setting of the FR-A7AP correctly. · Supply the power to the encoder. Or supply the power to the encoder at the same time when the power is supplied to the inverter. If the power is supplied to the encoder after the inverter, check that the encoder signal is securely sent and set "0" in *Pr. 376*.			

Operation Panel Indication	E.EP		FR-PU04	Fault 14
			FR-PU07	E.EP
Name	Encoder phase error *			
Description	The rotation command of the inverter differs from the actual motor rotation direction detected from the encoder during offline auto tuning.			
Check point	· Check for mis-wiring of the encoder cable. · Check for wrong setting of *Pr. 359 Encoder rotation direction*.			
Corrective action	· Perform connection and wiring securely. · Change the *Pr. 359 Encoder rotation direction* value.			

* Appears only for the FR-B3 series.

Operation Panel Indication	E.P24		FR-PU04 FR-PU07	E.P24
Name	24VDC power output short circuit			
Description	When the 24VDC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch off. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel or switch power off, then on again.			
Check point	· Check for a short circuit in the PC terminal output.			
Corrective action	· Remedy the earth (ground) fault portion.			

Operation Panel Indication	E.CDO		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 132.)*			

Operation Panel Indication	E.IOH		FR-PU04	Fault 14
			FR-PU07	Inrush overheat
Name	Inrush current limit circuit alarm			
Description	This function is activated when the resistor of the inrush current limit circuit overheats. The inrush current limit circuit failure			
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.SER**	E.SEr	**FR-PU04**	**Fault 14**
			FR-PU07	**VFD Comm error**
Name	Communication error (inverter)			
Description	This function stops the inverter output when communication error occurs consecutively for more than permissible retry count when a value other than "9999" is set in *Pr. 335 RS-485 communication retry count* during RS-485 communication from the RS-485 terminals. This function also stops the inverter output if communication is broken for the period of time set in *Pr. 336 RS-485 communication check time interval*.			
Check point	Check the RS-485 terminal wiring.			
Corrective action	Perform wiring of the RS-485 terminals properly.			

Operation Panel Indication	**E.AIE**	E.AI E	**FR-PU04**	**Fault 14**
			FR-PU07	**Analog in error**
Name	Analog input error			
Description	Appears when 30mA or more is input or a voltage (7.5V or more) is input with the terminal 2/4 set to current input.			
Check point	Check the setting of *Pr. 73 Analog input selection* and *Pr. 267 Terminal 4 input selection*. *(Refer to page 166.)*			
Corrective action	Either give a frequency command by current input or set *Pr. 73 Analog input selection* or *Pr. 267 Terminal 4 input selection* to voltage input.			

Operation Panel Indication	**E.13**	E. 13	**FR-PU04** **FR-PU07**	**Fault 13**
Name	Internal circuit error			
Description	Appears when an internal circuit error occurred.			
Corrective action	Please contact your sales representative.			

CAUTION

- If protective functions of E.ILF, E.PTC, E.PE2, E.EP, E.OD, E.CDO, E.IOH, E.SER, E.AIE are activated when using the FR-PU04, "Fault 14" appears.
  Also when the alarm history is checked on the FR-PU04, the display is "E.14".
- If alarms other than the above appear, contact your sales representative.

5.4 Correspondences between digital and actual characters

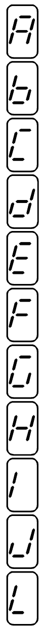
There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel.

Actual
0
1
2
3
4
5
6
7
8
9

Digital

Actual
A
B
C
D
E
F
G
H
I
J
L

Digital



Actual
M
N
O
o
P
S
T
U
V
r
-

Digital

5.5 Check first when you have troubles

POINT

If the cause is still unknown after every check, it is recommended to initialize the parameters (initial value) then reset the required parameter values and check again.

5.5.1 Motor does not start

1) Check the main circuit
- Check that a proper power supply voltage is applied (operation panel display is provided).
- Check that the motor is connected properly.
- Check that the jumper across P/+-P1 is connected.

2) Check the input signals
- Check that start signal is input.
- Check that both the forward and reverse rotation start signals are not input simultaneously.
- Check that the frequency setting signal is not zero. (When the frequency command is 0Hz and the start command is entered, FWD or REV LED on the operation panel flickers.)
- Check that the AU signal is on when terminal 4 is used for frequency setting signal.
- Check that the output stop signal (MRS) or reset signal (RES) is not on.
- Check that the CS signal is not OFF with automatic restart after instantaneous power failure function is selected (*Pr. 57* ≠ "9999").
- Check that the sink or source jumper connector is fitted securely. *(Refer to page 29)*
- Check that the voltage/current input switch is correctly set for analog input signal (0 to 5V/0 to 10V, 4 to 20mA).

3) Check the parameter settings
- Check that *Pr. 78 Reverse rotation prevention selection* is not selected.
- Check that the *Pr. 79 Operation mode selection* setting is correct.
- Check that the bias and gain *(calibration parameter C2 to C7)* settings are correct.
- Check that the *Pr. 13 Starting frequency* setting is not greater than the running frequency.
- Check that frequency settings of each running frequency (such as multi-speed operation) are not zero. Check that especially the *Pr. 1 Maximum frequency* setting is not zero.
- Check that the *Pr. 15 Jog frequency* setting is not lower than the *Pr. 13 Starting frequency* setting.
- Check that the *Pr.359 Encoder rotation direction* setting is correct during the encoder feedback control. When "REV" is lit on the operation panel under the forward rotation command, set "1" in *Pr.359*.

4) Inspection of load
- Check that the load is not too heavy.
- Check that the shaft is not locked.

5.5.2 Motor generates abnormal noise

- Check for any mechanical looseness.
- Contact the customer support of the motor manufacturer.

5.5.3 Motor generates heat abnormally

- Is the fan for the motor is running? (Check for accumulated dust.)
- Check that the load is not too heavy. Lighten the load.
- Check that the inverter output voltages (U, V, W) balanced.
- Was the motor type set? Check the setting of *Pr. 71 Applied motor*.
- When using any FR-B3 series, perform offline auto tuning. *(Refer to page 70.)*

5.5.4 Motor rotates in opposite direction

- Check that the phase sequence of output terminals U, V and W is correct.
- Check that the start signals (forward rotation, reverse rotation) are connected properly. *(Refer to page 26)*

5.5.5 Speed greatly differs from the setting

- Check that the frequency setting signal is correct. (Measure the input signal level.)
- Check that the *Pr. 1, Pr. 2, Calibration parameter C2 to C7* settings are correct
- Check that the input signal lines are not affected by external noise. (Use shielded cables)
- Check that the load is not too heavy.
- Check that the *Pr. 31* to *Pr. 36* (frequency jump) settings are correct.

5.5.6 Acceleration/deceleration is not smooth

- Check that the acceleration and deceleration time settings are not too short.
- Check that the load is not too heavy.

5.5.7 Motor current is large

- Check that the load is not too heavy.

5.5.8 Speed does not increase

- Check that the *Pr. 1 Maximum frequency* setting is correct.
- Check that the load is not too heavy. (In agitators, etc., load may become heavier in winter.)

5.5.9 Speed varies during operation

When the FR-B3 series, encoder feedback control is exercised, the output frequency varies with load fluctuation between 0 and 2Hz. This is a normal operation and is not a fault.

1) Inspection of load

- Check that the load is not varying.

2) Check the input signals

- Check that the frequency setting signal is not varying.
- Check that the frequency setting signal is not affected by noise. Input filter to the analog input terminal using *Pr. 74 Input filter time constant*.
- Check for a malfunction due to undesirable currents when the transistor output unit is connected. *(Refer to page 30)*

3) Others

- Check that the settings of *Pr. 80 Motor capacity* and *Pr. 81 Number of motor poles* are correct to the inverter capacity and motor capacity under FR-B3 series.
- For the FR-B3 series, perform offline auto tuning. *(Refer to pege 70)*
- Check that the wiring length is not too long for V/F control.(FR-B series only)

5.5.10 Operation mode is not changed properly

If the operation mode does not change correctly, check the following:

1) Inspection of load

- Check that the STF or STR signal is off.
  When it is on, the operation mode cannot be changed.

2) Parameter setting

- Check the *Pr. 79* setting.
  When the *Pr. 79 Operation mode selection* setting is "0" (initial value), the inverter is placed in the external operation mode at input power-on. At this time, press PU/EXT on the operation panel (press PU when the parameter unit (FR-PU04/FR-PU07) is used) to switch to the PU operation mode.
  For the other values (1 to 4, 6, 7), the operation mode is limited accordingly.

5.5.11 Operation panel (FR-DU07) display is not operating

└─Check that the operation panel is connected to the inverter securely.

5.5.12 POWER lamp is not lit

└─Check that wiring is securely performed and installation is correct.

5.5.13 Parameter write cannot be performed

├─Make sure that operation is not being performed (signal STF or STR is not ON).
├─Make sure that you are not attempting to set the parameter in the external operation mode.
├─Check *Pr. 77 Parameter write selection.*
└─Check *Pr. 161 Frequency setting/key lock operation selection*.

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

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/+-N/– of the inverter is not more than 30VDC using a tester, etc.

6.1 Inspection item

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) Unusual vibration and noise
(5) Unusual overheat and discoloration
During operation, check the inverter input voltages using a tester.

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.
Tighten them according to the specified tightening torque. *(Refer to page 20)*
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 ambient temperature, humidity, dirt, corrosive gas, oil mist , etc	○		Improve emvironment	
	Overall unit		Check for unusual vibration and noise	○		Check alarm location and retighten	
	Power supply voltage		Check that the main circuit voltages and control 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	
	Transformer/reactor		Check for unusual odor and abnormal increase in whining sound.	○		Stop the device and contact the manufacturer.	
	Terminal block		Check for damage.		○	Stop the device and contact the manufacturer.	
	Smoothing aluminum electrolytic capacitor		(1) Check for liquid leakage.		○	Contact the manufacturer	
			(2) Check for safety valve projection and bulge.		○	Contact the manufacturer	
			(3) Visual check and judge by the life check of the main circuit capacitor *(Refer to page 286)*		○		
	Relay/contactor		Check that the operation is normal and no chatter is heard.		○	Contact the manufacturer	
	Resistor		(1) Check for crack in resistor insulation.		○	Contact the manufacturer	
			(2) Check for a break in the cable.		○	Contact the manufacturer	
Control circuit protective circuit	Operation check		(1) Check that the output voltages across phases with the inverter operated alone is balanced		○	Contact the manufacturer	
			(2) Check that no fault is found in protective and display circuits in a sequence protective operation test.		○	Contact the manufacturer	
	Parts check	Overall	(1) Check for unusual odor and discoloration.		○	Stop the device and contact the manufacturer.	
			(2) Check for serious rust development		○	Contact the manufacturer	
		Aluminum electrolytic capacitor	(1) Check for liquid leakage in a capacitor and deformation trance		○	Contact the manufacturer	
			(2) Visual check and judge by the life check of the control circuit capacitor. *(Refer to page 286.)*		○		
Cooling system	Cooling fan		(1) Check for unusual vibration and noise.	○		Replace the fan	
			(2) Check for loose screws and bolts		○	Retighten	
			(3) Check for stain		○	Clean	
	Heatsink		(1) Check for clogging		○	Clean	
			(2) Check for stain		○	Clean	
	Air filter, etc.		(1) Check for clogging		○	Clean or replace	
			(2) Check for stain		○	Clean or replace	
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, each parts of the inrush current limit circuit is near to give an indication of replacement time .

The life alarm output can be used as a guideline for life judgement.

Parts	Judgement Level
Main circuit capacitor	85% of the initial capacity
Control circuit capacitor	Estimated 10% life remaining
Inrush current limit circuit	Estimated 10% life remaining (Power on: 100,000 times left)
Cooling fan	Less than 40% of the predetermined speed

Refer to page 247 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>

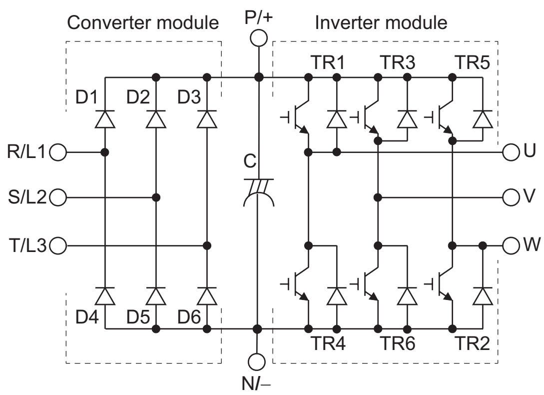
Change the polarity of the tester alternately at the inverter terminals R/L1, S/L2, T/L3, U, V, W, P/+ and N/–, and check for continuity.

CAUTION

1. Before measurement, check that the smoothing capacitor is discharged.
2. At the time of discontinuity, due to the smothing capacitor, the tester may not indicate ∞. At the time of continuity, the measured value is several to several ten's-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 ⊕	Tester Polarity ⊖	Measured Value		Tester Polarity ⊕	Tester Polarity ⊖	Measured Value
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.

CAUTION

Do not use solvent, such as acetone, benzene, toluene and alcohol, as they will cause the inverter surface paint to peel off.
The display, etc. of the operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07) are vulnerable to detergent and alcohol. Therefore, avoid using them for cleaning.

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	Standard Replacement Interval *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	Replace the board (as required)
Relays	–	as required

*1 Replacement years for when the yearly average ambient temperature is 40°C
(without corrosive gas, flammable gas, oil mist, dust and dirt etc)
*2 Output current : equivalent to rating current of the Mitsubishi explosion-proof motor (4 poles)

CAUTION

For parts replacement, consult the nearest Mitsubishi FA Center.

(1) Cooling fan

The replacement interval of the cooling fan used for cooling the parts generating heat such as the main circuit semiconductor is greatly affected by the ambient temperature. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be replaced immediately.

CAUTION

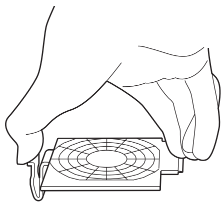
For parts replacement, consult the nearest Mitsubishi FA Center.

Inverter Type			Fan Type	Units
	FR-B	FR-B3		
200V	1500 to 3700	(N)1500 to (N)3700	MMF-06F24ES-RP1 BKO-CA1638H01	1
	5.5K to 11K	(N)5.5K to (N)11K	MMF-08D24ES-RP1 BKO-CA1639H01	2
	15K	(N)15K to 18.5K	MMF-12D24DS-RP1 BKO-CA1619H01	1
	22K	(N)22K	MMF-06F24ES-RP1 BKO-CA1638H01	1
			MMF-12D24DS-RP1 BKO-CA1619H01	1
	30K to 55K	(N)30K, (N)37K	MMF-12D24DS-RP1 BKO-CA1619H01	2
	75K	-	MMF-12D24DS-RP1 BKO-CA1619H01	3
400V	2200, 3700	(N)H2200, (N)H3700	MMF-06F24ES-RP1 BKO-CA1638H01	1
	7.5K, 15K	(N)H5.5K to (N)H15K	MMF-08D24ES-RP1 BKO-CA1639H01	2
	22K	(N)H18.5K, (N)H22K	MMF-12D24DS-RP1 BKO-CA1619H01	1
	-	(N)H30K	MMF-09D24TS-RP1 BKO-CA1640H01	2
	37K, 55K	(N)H37K	MMF-12D24DS-RP1 BKO-CA1619H01	2
	75K, 110K	-		3

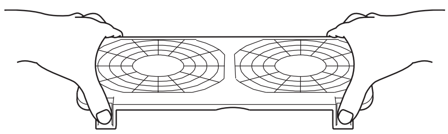
FR-B-750, FR-B3-(N)400, 750, FR-B3-(N)H400 to 1500

- Removal (FR-B-1500 to 75K(200V), FR-B-2200 to 110K(400V), FR-B3-(N)1500 to 37K, FR-B3-(N)H2200 to 37K)

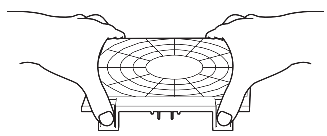
1) Push the hooks from above and remove the fan cover.



FR-B-1500 to 3700(200V)
FR-B-2200, 3700(400V)
FR-B3-(N)1500 to 3700
FR-B3-(N)H2200, 3700

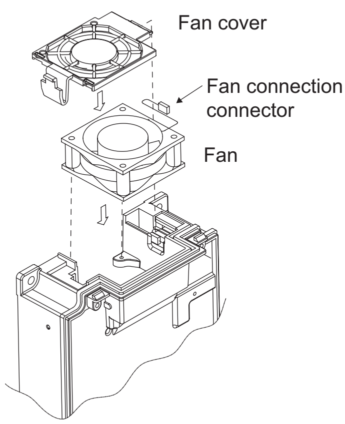


FR-B-5.5K to 22K(200V)
FR-B-7.5K to 22K(400V)
FR-B3-(N)(H)5.5K to 22K

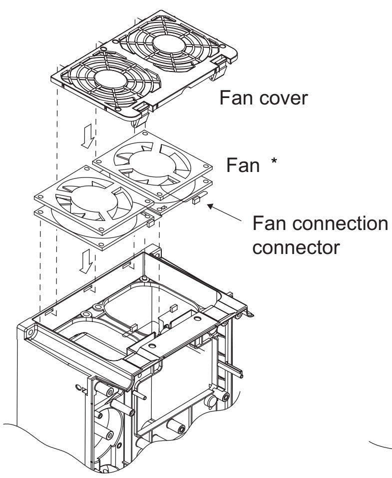


FR-B-30K or more(200V/400V)
FR-B3-(N)(H)30K or more

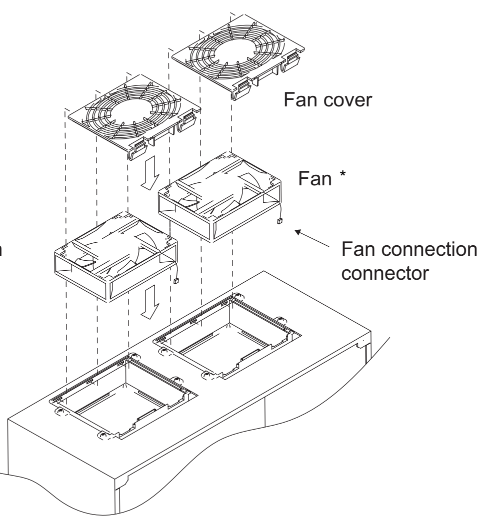
2) Disconnect the fan connectors.
3) Remove the fan.



FR-B-1500 to 3700(200V)
FR-B-2200, 3700(400V)
FR-B3-(N)1500 to 3700
FR-B3-(N)H2200, 3700



FR-B-5.5K to 22K(200V)
FR-B-7.5K to 22K(400V)
FR-B3-(N)(H)5.5K to 22K

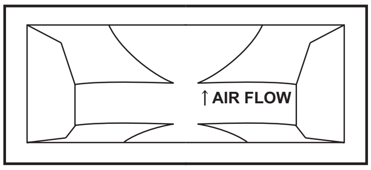


FR-B-30K or more(200V/400V)
FR-B3-(N)(H)30K or more

* The number of cooling fans differs according to the inverter capacity. (Refer to the table above)

- Reinstallation (FR-B-1500 to 75K(200V), FR-B3-(N)1500 to 37K, FR-B-2200 to 110K(400V), FR-B3-(N)H2200 to 37K)

1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.

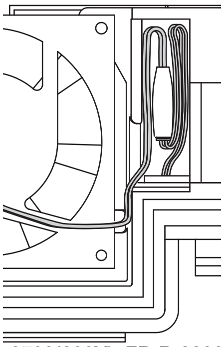


<Fan side face>

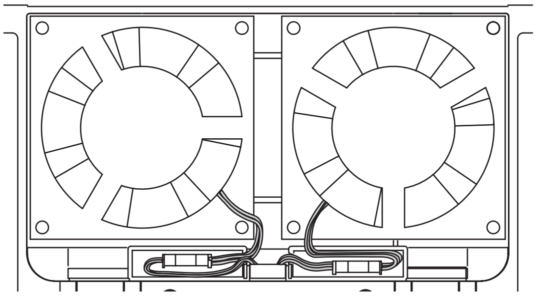
CAUTION

Installing the fan in the opposite air flow direction can cause the inverter life to be shorter.

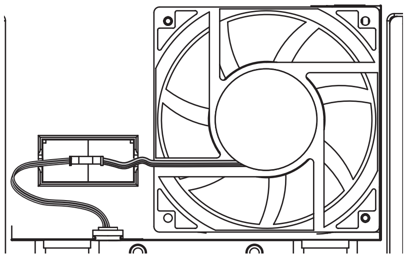
2) Reconnect the fan connectors.
When wiring, use care to avoid the cables being caught by the fan.



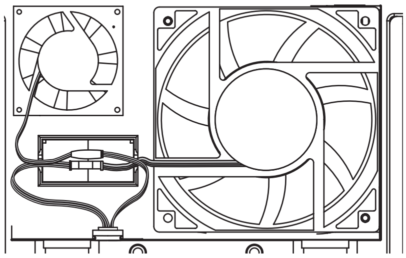
FR-B-1500 to 3700(200V), FR-B-2200, 3700(400V)
FR-B3-(N)1500 to 3700, FR-B3-(N)H2200, 3700



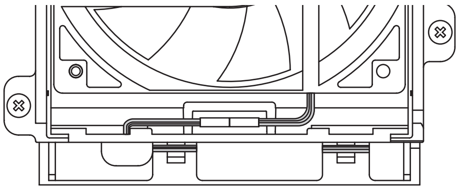
FR-B-5.5 to 11K(200V), FR-B-5.5K to 15K(400V)
FR-B3-(N)5.5K to 11K, FR-B3-(N)H5.5K to 15K



FR-B-15K(200V), FR-B-22K(400V)
FR-B3-(N)15K, 18.5K, FR-B3-(N)H18.5K, 22K

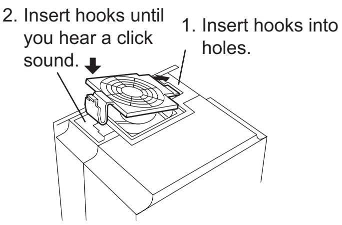


FR-B-22K(200V)
FR-B3-(N)22K

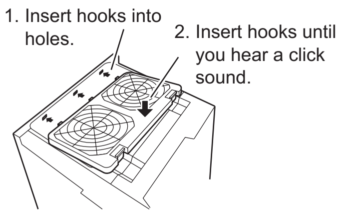


FR-B-30K(200V), FR-B-30K(400V)
FR-B3-(N)30K or more, FR-B3-(N)H30K or more

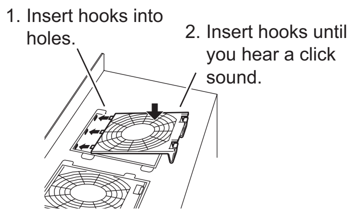
3) Reinstall the fan cover.



FR-B-1500 to 3700(200V),
FR-B-2200, 3700(400V)
FR-B3-(N)1500 to 3700, FR-B3-(N)H2200, 3700



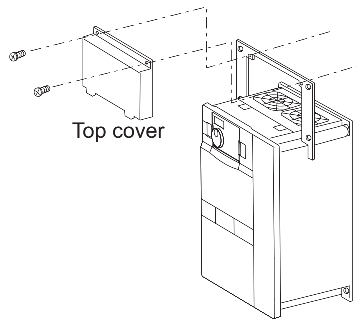
FR-B-5.5K to 22K(200V),
FR-B-7.5K to 22K(400V)
FR-B3-(N)(H)5.5K to 22K



FR-B-30K(200V),
FR-B-30K(400V)
FR-B3-(N)(H)30K or more

(2) Replacement procedure of the cooling fan when using a heatsink protrusion attachment (FR-A7CN)

When replacing a cooling fan, remove a top cover of the heatsink protrusion attachment and perform replacement.
After replacing the cooling fan, replace the top cover in the original position.



(3) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc.
The replacement intervals greatly vary with the ambient temperature and operating conditions. When the inverter is operated in air-conditioned, normal environment conditions, replace the capacitors about every 10 years.
The appearance criteria for inspection are as follows:
1) Case: Check the side and bottom faces for expansion
2) Sealing plate: Check for remarkable warp and extreme crack.
3) Check for external crack, discoloration, fluid leakage, etc. Judge that the capacitor has reached its life when the measured capacitance of the capacitor reduced below 80% of the rating.

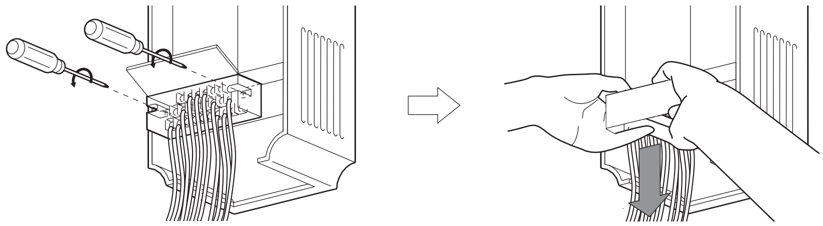
Refer to page 247 to perform the life check of the main circuit capacitor.

(4) Relays

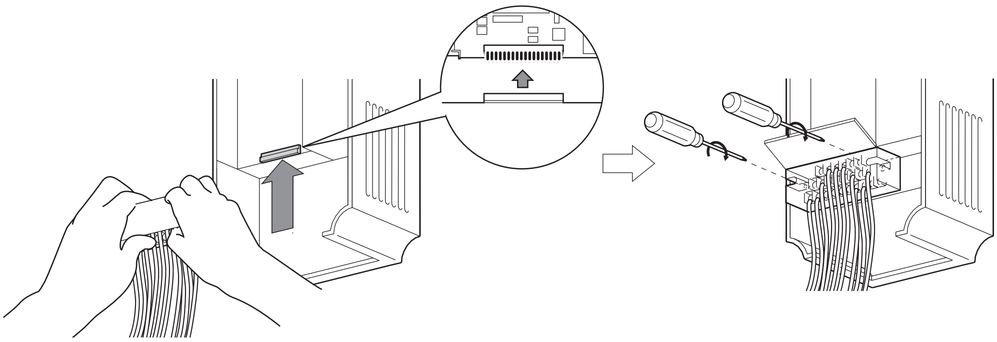
To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

6.1.8 Inverter replacement

The inverter can be replaced with the control circuit wiring kept connected. Before replacement, remove the wiring cover of the inverter.
1) Loosen the two installation screws in both ends of the control circuit terminal block. (These screws cannot be removed.) Pull down the terminal block from behind the control circuit terminals.



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



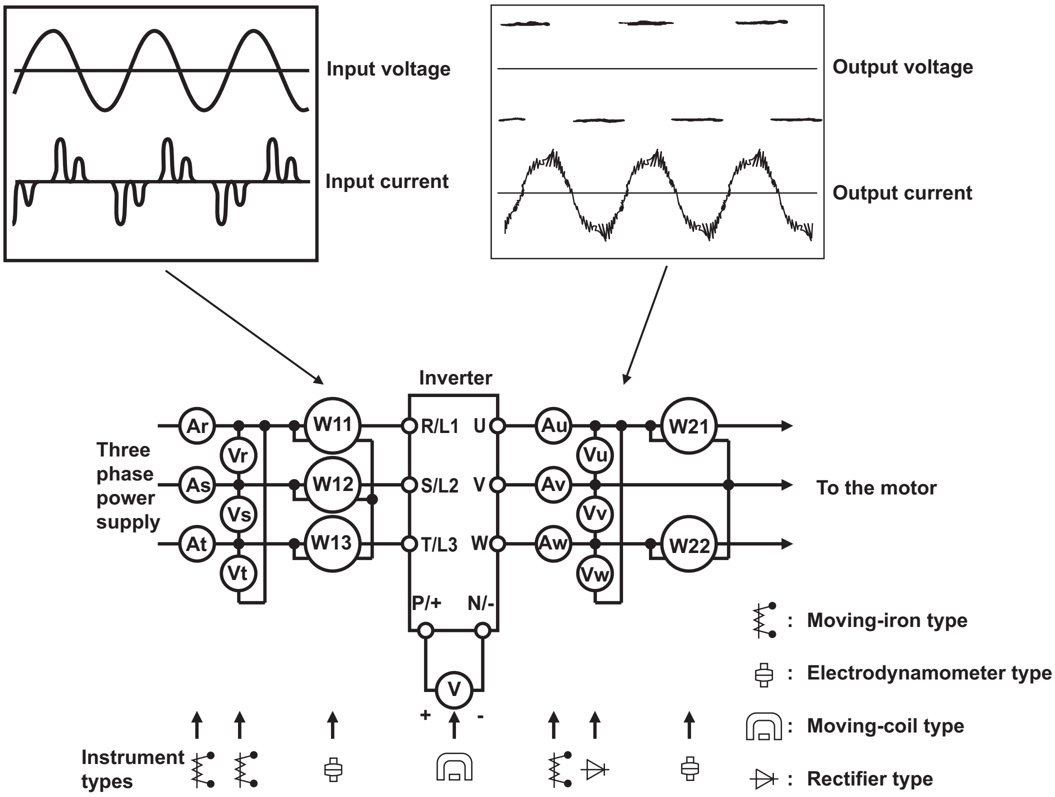
CAUTION

Before starting inverter replacement, switch power off, wait for at least 10 minutes, and then check the voltage with a tester and such to ensure safety.

6.2 Measurement of main circuit voltages, currents and powers

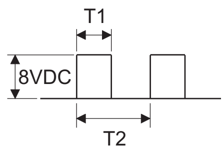
Since the voltages and currents on the inverter power supply and output sides include harmonics, measurement data depends on the instruments used and circuits measured.
When instruments for commercial frequency are used for measurement, measure the following circuits with the instruments given on the 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.
  When measuring and indicating the output voltage and output current of the inverter, it is recommended to utilize the AM-5 and FM-SD terminal output function of the inverter.



Examples of Measuring Points and Instruments

Measuring points and instruments

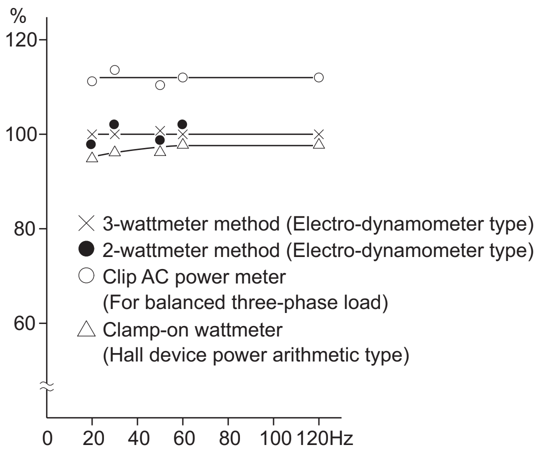
<table>
<tr><th>Item</th><th>Measuring Point</th><th>Measuring Instrument</th><th colspan="2">Remarks (Reference Measured Value)</th></tr>
<tr><td>Power supply voltage
V_1</td><td>Across R/L1-S/L2, S/L2-T/L3, T/L3-R/L1</td><td>Moving-iron type AC voltmeter</td><td colspan="2">Commercial power supply
Within permissible AC voltage fluctuation
(Refer to page 298)</td></tr>
<tr><td>Power supply side current
I_1</td><td>R/L1, S/L2, and T/L3 line currents</td><td>Moving-iron type AC ammeter</td><td colspan="2"></td></tr>
<tr><td>Power supply side power
P_1</td><td>R/L1, S/L2, T/L3 and R/L1-S/L2, S/L2-T/L3, T/L3-R/L1</td><td>Electrodynamic type single-phase wattmeter</td><td colspan="2">$P_1=W_{11}+W_{12}+W_{13}$ (3-wattmeter method)</td></tr>
<tr><td>Power supply side power factor
Pf_1</td><td colspan="4">Calculate after measuring power supply voltage, power supply side current and power supply side power.
$Pf_1 = \frac{P_1}{\sqrt{3} V_1 \times I_1} \times 100\%$</td></tr>
<tr><td>Output side voltage
V_2</td><td>Across U-V, V-W and W-U</td><td>Rectifier type AC voltage meter *1 (Moving-iron type cannot measure)</td><td colspan="2">Difference between the phases is within ±1% of the maximum output voltage.</td></tr>
<tr><td>Output side current
I_2</td><td>U, V and W line currents</td><td>Moving-iron type AC ammeter *2</td><td colspan="2">Difference between the phases is 10% or lower of the rated inverter current.</td></tr>
<tr><td>Output side power
P_2</td><td>U, V, W and U-V, V-W</td><td>Electrodynamic type single-phase wattmeter</td><td colspan="2">$P_2 = W_{21} + W_{22}$
2-wattmeter method (or 3-wattmeter method)</td></tr>
<tr><td>Output side power factor
Pf_2</td><td colspan="4">Calculate in similar manner to power supply side power factor.
$Pf_2 = \frac{P_2}{\sqrt{3} V_2 \times I_2} \times 100\%$</td></tr>
<tr><td>Converter output</td><td>Across P/+-N/–</td><td>Moving-coil type (such as tester)</td><td colspan="2">Inverter LED display is lit. 1.35 × V1</td></tr>
<tr><td rowspan="2">Frequency setting signal</td><td>Across 2, 4(+)-5</td><td rowspan="10">Moving-coil type
(Tester and such may be used)
(Internal resistance: 50kΩ or larger)</td><td>0 to 10VDC, 4 to 20mA</td><td rowspan="5">"5" is common</td></tr>
<tr><td>Across 1(+)-5</td><td>0 to ±5VDC, 0 to ±10VDC</td></tr>
<tr><td rowspan="2">Frequency setting power supply</td><td>Across 10 (+) -5</td><td>5.2VDC</td></tr>
<tr><td>Across 10E(+)-5</td><td>10VDC</td></tr>
<tr><td rowspan="2">Frequency meter signal</td><td>Across AM(+)-5</td><td>Approximately 10VDC at maximum frequency
(without frequency meter)</td></tr>
<tr><td>Across FM(+)-SD</td><td>Approximately 5VDC at maximum frequency
(without frequency meter)

Pulse width T1:
Adjusted by C0 (Pr. 900)
Pulse cycle T2: Set by Pr. 55
(Valid for frequency monitoring only)</td><td rowspan="4">"SD" is common</td></tr>
<tr><td>Start signal
Select signal</td><td>Across STF, STR, RH, RM, RL, JOG, RT, AU, STOP, CS (+) -SD</td><td rowspan="3">When open
20 to 30VDC
ON voltage: 1V or less</td></tr>
<tr><td>Reset</td><td>Across RES (+) -SD</td></tr>
<tr><td>Output stop</td><td>Across MRS (+) -SD</td></tr>
<tr><td>Alarm signal</td><td>Across A1-C1
Across B1-C1</td><td>Moving-coil type
(such as tester)</td><td colspan="2">Continuity check*3
<Normal> <Abnormal>
Across A1-C1 Discontinuity Continuity
Across B1-C1 Continuity Discontinuity</td></tr>
</table>

*1 Use an FFT to measure the output voltage accurately. A tester or general measuring instrument cannot measure accurately.
*2 For the low acoustic noise FR-B3 series, do not use this instrument since using it may increase eddy-current losses produced in metal parts inside the instrument, leading to burnout. If the wiring length between the inverter and motor is long, the instrument and CT may generate heat due to line-to-line leakage current.
*3 When the setting of *Pr. 195 ABC1 terminal function selection* is positive logic

6.2.1 Measurement of powers

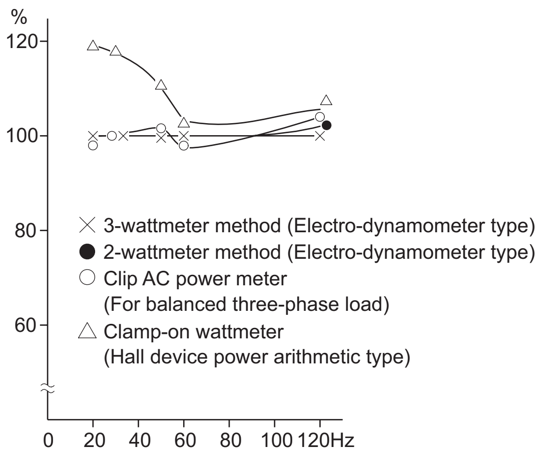
Using an electro-dynamometer type meter, measure the power in both the input and output sides of the inverter using the two- or three-wattmeter method. As the current is liable to be imbalanced especially in the input side, it is recommended to use the three-wattmeter method.
Examples of measured value 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, constant-power at 60Hz or more.
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, constant-power at 60Hz or more.
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 can not 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 (provide analog output) using the operation panel.

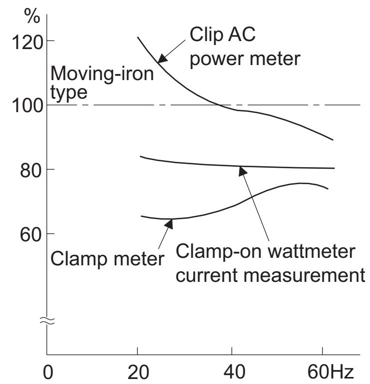
(3) PT

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

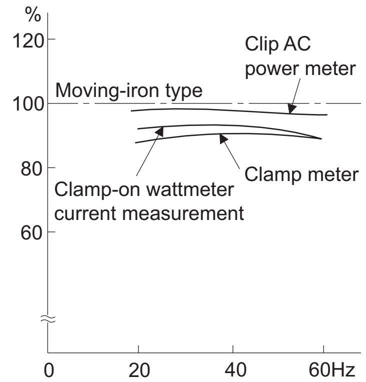
Use a moving-iron type meter on both the input and output sides of the inverter. However, when using the FR-B3 series low noise type, do not use that meter since an eddy-current losses produced in the internal metal parts of the meter will increase and the meter may burn out. In this case, use an approximate-effective value type.
As the inverter input side current is easily imbalanced, measurement of currents in all three phases is recommended. Correct values can not be measured in one or two phases. On the other hand, the phase imbalanced ratio of the output side current must be within 10%.
When using a clamp ammeter, 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.
An example of the measured value difference produced by different measuring meters is 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

Use the effective power and apparent power to calculate the inverter input power factor. A power-factor meter can not indicate an exact value.

$$\text{Total power factor of the inverter} = \frac{\text{Effective power}}{\text{Apparent power}}$$

$$= \frac{\text{Three-phase input power found by 3-wattmeter method}}{\sqrt{3} \times \text{V (power supply voltage)} \times \text{I (input current effective value)}}$$

6.2.6 Measurement of converter output voltage (across terminals P/+ - N/-)

The output voltage of the converter is developed across terminals P/+ - N/- and can be measured with a moving-coil type meter (tester). Although the voltage varies according to the power supply voltage, approximately 270V to 300V (approximately 540V to 600V for the 400V class) is output when no load is connected and voltage decreases when a load is connected.
When regenerative energy is returned from the motor during deceleration, for example, the converter output voltage rises to nearly 400V to 450V (800V to 900V for the 400V class) maximum.

6.2.7 Measurement of inverter output frequency

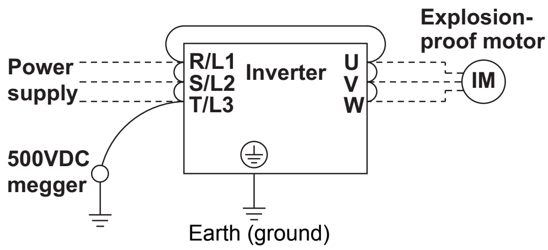
A pulse train proportional to the output frequency is output across the frequency meter signal output terminal FM-SD of the inverter. This pulse train output can be counted by a frequency counter, or a meter (moving-coil type voltmeter) can be used to read the mean value of the pulse train output voltage. 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 145*.

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.)

CAUTION

- Before performing the insulation resistance test on the external circuit, disconnect the cables from all terminals of the inverter 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.

MEMO

7 SPECIFICATIONS

This chapter provides the "SPECIFICATIONS" of this product.
Always read the instructions before using the equipment

7.1 FR-B Series Specifications

7.1.1 FR-B series ratings

FR-B series (suitable for inverter drive reduced-torque explosion-proof type motor)

●200V class

Type FR-B-□□□□			750			1500	2200	3700	5.5K	7.5K	11K	15K	22K	30K		37K	45K	55K	75K
Applicable motor capacity (kW) *1		60Hz standard reduced-torque	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	22	30		37	45	55	75
		50Hz standard reduced-torque	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	75
		60Hz standard constant torque	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55
		60Hz standard constant torque	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45
Output	Rated capacity (kVA) *2		1.9			3.1	4.2	6.7	9.2	12.6	17.6	23.3	34	44		55	67	82	110
	Rated current (A)		5			8	11	17.5	24	33	46	61	90	115		145	175	215	288
	Overload current rating *3		150% 60s, 200% 3s (inverse time characteristics)																
	Voltage *4		Three-phase 200V																
	Regenerative braking torque	Maximum value/ permissible duty	150% torque/ 3%ED				100% torque/ 3%ED		100% torque/ 2%ED		20% torque/continuous								10% torque/ continuous
Power supply	Rated input AC voltage/frequency		Three-phase 200V 50Hz, 200/220V 60Hz																
	Permissible AC voltage fluctuation		180 to 220V 50Hz, 180 to 242V 60Hz																
	Permissible frequency fluctuation		±5%																
	Power supply capacity (kVA) *5	Reduced torque type	0.8	1.5	2.5	4.5	5.5	9	12	17	20	28	41	52		66	80	100	110
		Constant torque type	-	1.5	-	2.2	4.5	5.5	9	12	17	20	28	34	41	52	66	80	100
Protective structure (JEM 1030) *7			Enclosed type (IP20) *6											Open type (IP00)					
Cooling system			Self-cooling			Forced air cooling													
Approx. mass (kg)			2.3			3.8	3.8	3.8	7.1	7.1	7.5	13.0	14.0	23.0		35.0	35.0	58.0	70.0

●400V class

Type FR-B-□□□□			750			1500	2200	3700	7.5K		15K		22K	37K			55K		75K	90K	110K
Applicable motor capacity (kW) *1		60Hz standard reduced-torque	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	22	30		37	45	55	75	90	110
		50Hz standard reduced-torque	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	90	110
		60Hz standard constant torque	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	75	90
		60Hz standard constant torque	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	55	75
Output	Rated capacity (kVA) *2		1.9			3	4.6	6.9	13		23.6		32.8	54			84		110	137	165
	Rated current (A)		2.5			4	6	9	17		31		44	71			110		144	180	216
	Overload current rating *3		150% 60s, 200% 3s (inverse time characteristics)																		
	Voltage *4		Three-phase 380V to 440V																		
	Regenerative braking torque	Maximum value/ permissible duty	100% torque/ 2%ED								20% torque/continuous								10% torque/ continuous		
Power supply	Rated input AC voltage/frequency		Three-phase 400V 50Hz, 400/440V 60Hz																		
	Permissible AC voltage fluctuation		360 to 440V 50Hz, 360 to 484V 60Hz																		
	Permissible frequency fluctuation		±5%																		
	Power supply capacity (kVA) *5	Reduced torque type	0.8	1.5	2.5	4.5	5.5	9	12	17	20	28	41	52		66	100		144	180	216
		Constant torque type	-	1.5	-	4.5	5.5	-	9	12	17	20	28	34	41	52	66		100	144	180
Protective structure (JEM 1030) *7			Enclosed typ (IP20) *6											Open type (IP00)							
Cooling system			Self-cooling				Forced air cooling														
Approx. mass (kg)			3.5			3.5	3.5	3.5	6.5		7.5		13.0	35.0			37.0		50.0	57.0	72.0

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi Pressure-resistant, explosion-Proof motor. The motors are XF-(N)E and TH series.
*2 The rated output capacity indicated assumes that the output voltage is 220V for 200V class and 440V for 400V class.
*3 The % value of the overload current rating indicates 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 When the hook of the inverter front cover is cut off for installation of the plug-in option, the inverter changes to an open type (IP00).
*7 FR-DU07:IP40 (except for the PU connector)

7.1.2 FR-B series common specifications

Control specifications	Control method		Sine wave PWN control (V/F constant control)
Control specifications	Output frequency range		0.2 to 120Hz (22K or less), 0.2 to 60Hz (30K or more)
Control specifications	Frequency setting resolution	Analog input	0.015Hz/0 to 60Hz (terminal 2, 4: 0 to 10V/12bit) 0.03Hz/0 to 60Hz (terminal 2, 4: 0 to 5V/11bit, 0 to 20mA/about 11bit, terminal 1: 0 to ±10V/12bit) 0.06Hz/0 to 60Hz (terminal 1: 0 to ±5V/11bit)
Control specifications	Frequency setting resolution	Digital input	0.01Hz
Control specifications	Frequency accuracy	Analog input	Within ±0.2% of the max. output frequency (25°C±10°C)
Control specifications	Frequency accuracy	Digital input	Within 0.01% of the set output frequency
Control specifications	Voltage/frequency characteristics		Base frequency is always 50Hz
Control specifications	Acceleration/deceleration time setting		0 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode, backlash measures acceleration/deceleration can be selected.
Control specifications	DC injection brake		Operation at 3Hz (fixed) is selectable
Control specifications	Stall prevention operation level		Operation current level can be set (0 to 200% adjustable), whether to use the function or not can be selected
Operation specifications	Frequency setting signal	Analog input	• Terminal 2, 4: 0 to 10V, 0 to 5V, 4 to 20mA can be selected • Terminal 1: -10 to +10V, -5 to +5V can be selected
Operation specifications	Frequency setting signal	Digital input	Input using the setting dial of the operation panel or parameter unit Four-digit BCD or 16 bit binary (when used with option FR-A7AX)
Operation specifications	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
Operation specifications	Input signals		You can select any twelve signals using *Pr. 178 to Pr. 189 (input terminal function selection)* from among multi speed selection, remote setting, stop-on-contact, second function selection, third function selection, terminal 4 input selection, JOG operation selection, selection of automatic restart after instantaneous power failure, flying start, external thermal relay input, inverter operation enable signal (MT-HC connection), MT-HC connection (instantaneous power failure detection), PU operation/external inter lock signal, PID control enable terminal, PU operation/external operation switchover, load torque high-speed frequency, S-pattern acceleration/deceleration C switchover, pre-excitation, output stop, start self-holding selection, forward rotation command, reverse rotation command, inverter reset, PTC thermistor input, PID forward reverse operation switchover, PU-NET operation switchover, NET-external operation switchover, command source switchover, DC feeding operation permission, and DC feeding operation cancel.
Operation specifications	Input signals	Pulse train input	100kpps
Operation specifications	Operational functions		Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, polarity reversible operation, automatic restart after instantaneous power failure operation, electronic bypass operation, forward/reverse rotation prevention, remote setting, second function, third function, multi-speed operation, original operation continuation at instantaneous power failure, stop-on-contact control, load torque high speed frequency control, regeneration avoidance, operation mode selection, PID control, computer link operation (RS-485), speed feed forward.
Operation specifications	Output signals	Operating status	You can select any signals using *Pr. 190 to Pr. 196 (output terminal function selection)* from among inverter running, up-to-frequency, instantaneous power failure/undervoltage, overload warning, output frequency (speed) detection, second output frequency (speed) detection, third output frequency (speed) detection, regenerative brake pre-alarm, electronic thermal relay function pre-alarm, PU operation mode, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward rotation reverse rotation output, orientation completion*1, fan fault output, heatsink overheat pre-alarm , inverter running/start command on, deceleration at an instantaneous power failure, PID control activated, during retry, PID output interruption, life alarm, alarm output 1, 2, 3 (power-off signal), power savings average value update timing, current average value monitor, maintenance timer alarm, remote output, forward rotation output*1, reverse rotation output*1, low speed output, minor failure output and alarm output. Open collector output (5 points), relay output (2 points) and alarm code of the inverter can be output (4 bit) from the open collector.
Operation specifications	Output signals	When used with the FR-A7AY, FR-A7AR (option)	In addition to the above, you can select any signals using *Pr. 313 to Pr. 319 (extension output terminal function selection)* from among control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life. (only positive logic can be set for extension terminals of the FR-A7AR)
Operation specifications	Output signals	Pulse train output	50kpps
Operation specifications	Output signals	Pulse/analog output	You can select any signals using *Pr. 54 FM terminal function selection (pulse train output)* and *Pr. 158 AM terminal function selection (analog output)* from among output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, reference voltage output, motor load factor, power saving effect, regenerative brake duty ,PID set point, PID measured value, motor output.
Indication	PU (FR-DU07/ FR-PU07/ FR-PU04)	Operating status	Output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed,motor torque, overload, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, cumlative energization time, actual operation time, motor load factor, cumulative power, energy saving effect, cumulative saving power, regenerative brake duty, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, input terminal option monitor*2, output terminal option monitor*2, option fitting status*3, terminal assignment status*3, feed back pulse*1.
Indication	PU (FR-DU07/ FR-PU07/ FR-PU04)	Alarm definition	Alarm definition is displayed during the protective function is activated, the output voltage/current/frequency/cumulative energization time right before the protection function was activated and past 8 alarm definitions are stored.
Indication	PU (FR-DU07/ FR-PU07/ FR-PU04)	Interactive guidance	Operation guide/trouble shooting with a help function*3
Protective/warning function			Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, instantaneous power failure occurrence, undervoltage, input phase failure, motor overload, output side earth (ground) fault overcurrent, output short circuit, main circuit element overheat, output phase failure, external thermal relay operation, PTC thermistor operation, option alarm, parameter error, PU disconnection, retry count excess, CPU alarm, operation panel power supply short circuit, 24VDC power output short circuit, output current detection value excess, inrush current limit circuit alarm, communication alarm (inverter), error, analog input error, fan fault, overcurrent stall prevention, overvoltage stall prevention, regenerative brake pre-alarm, electronic thermal relay function pre-alarm, PU stop, maintenance timer alarm*2, brake transistor alarm, parameter write error, copy operation error, operation panel lock, parameter copy alarm.
Environment	Ambient temperature		-10°C to +50°C (non-freezing)
Environment	Ambient humidity		90%RH maximum (non-condensing)
Environment	Storage temperature*4		-20°C to +65°C
Environment	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
Environment	Altitude/vibration		Maximum 1000m above sea level, 5.9m/s^2 or less. (conforms to JIS C 60068-2-6)

*1 Available only when the option (FR-A7AP) is mounted
*2 Can be displayed only on the operation panel (FR-DU07).
*3 Can be displayed only on the parameter unit (FR-PU07/FR-PU04).
*4 Temperature applicable for a short period in transit, etc.

7.2 FR-B3 Series Specifications

7.2.1 FR-B3 series ratings

FR-B3 series (suitable for inverter drive constant-torque explosion-proof type motor)

●200V class

Type FR-B3-(N)-□□□□		400	750	1500	2200	3700	5.5	7.5	11	15	18.5	22	30	37
Applicable motor capacity (kW) *1		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
Output	Rated capacity (kVA) *2	1.1	1.9	3.1	4.2	6.7	9.2	12.6	17.6	23.3	29	34	44	55
Output	Rated current (A)	3	5	8	11	17.5	24	33	46	61	76	90	115	145
Output	Overload current rating *3	150% 60s, 200% 3s (inverse time characteristics)												
Output	Voltage *4	Output according to a pressure-resistant, explosion-proof motor												
Output	Regenerative braking torque: Maximum value/ permissible duty	150% torque/ 3%ED			100% torque/ 3%ED		100% torque/ 2%ED		20% torque/continuous					
Power supply	Rated input AC voltage/frequency	Three-phase 200V 50Hz, 200/220V 60Hz												
Power supply	Permissible AC voltage fluctuation	180 to 220V 50Hz, 180 to 242V 60Hz												
Power supply	Permissible frequency fluctuation	±5%												
Power supply	Power supply capacity (kVA) *5	1.5	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66
Protective structure (JEM 1030) *7		Enclosed type (IP20)*6											Open type (IP00)	
Cooling system		Self-cooling		Forced air cooling										
Approx. mass (kg)		1.9	2.3	3.8	3.8	3.8	7.1	7.1	7.5	13.0	13.0	14.0	23.0	35.0

●400V class

Type FR-B3-(N)H-□□□□		400	750	1500	2200	3700	5.5	7.5	11	15	18.5	22	30	37
Applicable motor capacity (kW) *1		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
Output	Rated capacity (kVA) *2	1.1	1.9	3	4.6	6.9	9.1	13	17.5	23.6	29	32.8	43.4	54
Output	Rated current (A)	1.5	2.5	4	6	9	12	17	23	31	38	44	57	71
Output	Overload current rating *3	150% 60s, 200% 3s (inverse time characteristics)												
Output	Voltage *4	Output according to a pressure-resistant, explosion-proof motor												
Output	Regenerative braking torque: Maximum value/ permissible duty	100% torque/2%ED							20% torque/continuous					
Power supply	Rated input AC voltage/frequency	Three-phase 400V 50Hz,400/440V 60Hz												
Power supply	Permissible AC voltage fluctuation	360 to 440V 50Hz, 360 to 484V 60Hz												
Power supply	Permissible frequency fluctuation	±5%												
Power supply	Power supply capacity (kVA) *5	1.5	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66
Protective structure (JEM 1030) *7		Enclosed type (IP20)*6											Open type (IP00)	
Cooling system		Self-cooling			Forced air cooling									
Approx. mass (kg)		3.5	3.5	3.5	3.5	3.5	6.5	6.5	7.5	7.5	13.0	13.0	23.0	35.0

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi Pressure-resistant, explosion-Proof motor.
For FR-B3-(H)400 to 37K, the motors are XF-(N)ECA-2 series. For FR-B3-N(H)400 to 37K, the motors are XF-(N)ECA-1 series.
*2 The rated output capacity indicated assumes that the output voltage is 220V for 200V class and 440V for 400V class.
*3 The % value of the overload current rating indicates 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 When the hook of the inverter front cover is cut off for installation of the plug-in option, the inverter changes to an open type (IP00).
*7 FR-DU07:IP40 (except for the PU connector)

7.2.2 FR-B3 series common specifications

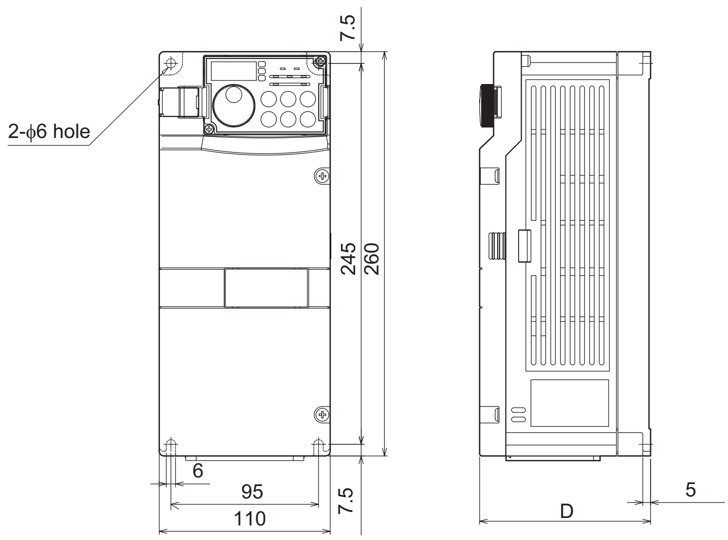
Control specifications	Control method		Soft-PWM control/high carrier frequency PWM control (selectable from among, advanced magnetic flux vector control).
	Output frequency range		0.2 to 120Hz
	Frequency setting resolution	Analog input	0.015Hz/0 to 60Hz (terminal 2, 4: 0 to 10V/12bit) 0.03Hz/0 to 60Hz (terminal 2, 4: 0 to 5V/11bit, 0 to 20mA/about 11bit, terminal 1: 0 to ±10V/12bit) 0.06Hz/0 to 60Hz (terminal 1: 0 to ±5V/11bit)
		Digital input	0.01Hz
	Frequency accuracy	Analog input	Within ±0.2% of the max. output frequency (25°C±10°C)
		Digital input	Within 0.01% of the set output frequency
	Voltage/frequency characteristics		Constant torque up to 60Hz, constant output from 60Hz to the maximum frequency (When the rated motor frequency is set to 60Hz)
	Starting torque		200% 0.3Hz (0.4K to 3.7K), 150% 0.3Hz (5.5K or more)
	Acceleration/deceleration time setting		0 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode, backlash measures acceleration/deceleration can be selected.
	DC injection brake		Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) variable
	Stall prevention operation level		Operation current level can be set (0 to 400% adjustable), whether to use the function or not can be selected
Operation specifications	Frequency setting signal	Analog input	• Terminal 2, 4: 0 to 10V, 0 to 5V, 4 to 20mA can be selected • Terminal 1: -10 to +10V, -5 to +5V can be selected
		Digital input	Input using the setting dial of the operation panel or parameter unit Four-digit BCD or 16 bit binary (when used with option FR-A7AX)
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
	Input signals		You can select any twelve signals using *Pr. 178 to Pr. 189 (input terminal function selection)* from among multi speed selection, remote setting, stop-on-contact, second function selection, third function selection, terminal 4 input selection, JOG operation selection, selection of automatic restart after instantaneous power failure, flying start, external thermal relay input, inverter operation enable signal (FR-HC/FR-CV connection), FR-HC connection (instantaneous power failure detection), PU operation/external inter lock signal , external DC injection brake operation start, PID control enable terminal, brake opening completion signal, PU operation/external operation switchover, load torque high-speed frequency, S-pattern acceleration/deceleration C switchover, output stop, start self-holding selection, forward rotation command, reverse rotation command, inverter reset, PID forward reverse operation switchover, PU-NET operation switchover, NET-external operation switchover, command source switchover, DC feeding operation permission, and DC feeding operation cancel.
		Pulse train input	100kpps
	Operational functions		Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, polarity reversible operation, automatic restart after instantaneous power failure operation, forward/reverse rotation prevention, remote setting, brake sequence, second function, third function, multi-speed operation, original operation continuation at instantaneous power failure, stop-on-contact control, load torque high speed frequency control, droop control, regeneration avoidance, slip compensation, operation mode selection, offline auto tuning function, PID control, computer link operation (RS-485), pre-excitation.
	Output signals	Operating status	You can select any signals using *Pr. 190 to Pr. 196 (output terminal function selection)* from among inverter running, up-to-frequency, instantaneous power failure/undervoltage, overload warning, output frequency (speed) detection, second output frequency (speed) detection, third output frequency (speed) detection, regenerative brake pre-alarm, electronic thermal relay function pre-alarm, PU operation mode, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward rotation reverse rotation output, brake opening request, fan fault output, heatsink overheat pre-alarm , inverter running/start command on, deceleration at an instantaneous power failure, PID control activated, during retry, PID output interruption, life alarm, alarm output 1, 2, 3 (power-off signal), power savings average value update timing, current average value monitor, maintenance timer alarm, remote output, forward rotation output*1, reverse rotation output*1, low speed output, torque detection, minor failure output and alarm output. Open collector output (5 points), relay output (2 points) and alarm code of the inverter can be output (4 bit) from the open collector.
		When used with the FR-A7AY, FR-A7AR (option)	In addition to the above, you can select any signals using *Pr. 313 to Pr. 319 (extension output terminal function selection)* from among control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life. (only positive logic can be set for extension terminals of the FR-A7AR)
		Pulse train output	50kpps
		Pulse/analog output	You can select any signals using *Pr. 54 FM terminal function selection (pulse train output)* and *Pr. 158 AM terminal function selection (analog output)* from among output frequency, motor current (steady or peak value), output voltage, frequency setting, operation speed, motor torque, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, reference voltage output, motor load factor, power saving effect, regenerative brake duty ,PID set point, PID measured value, motor output, torque command, torque current command, and torque monitor.
Indication	PU (FR-DU07/ FR-PU07/ FR-PU04)	Operating status	Output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, overload, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, cumlative energization time, actual operation time, motor load factor, cumulative power, energy saving effect, cumulative saving power, regenerative brake duty, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, input terminal option monitor*2, output terminal option monitor*2, option fitting status*3, terminal assignment status*3, motor output
		Alarm definition	Alarm definition is displayed during the protective function is activated, the output voltage/current/frequency/cumulative energization time right before the protection function was activated and past 8 alarm definitions are stored.
		Interactive guidance	Operation guide/trouble shooting with a help function*3
Protective/warning function			Overcurrent during acceleration, overcurrent during constant speed, overcurrent during deceleration, overvoltage during acceleration, overvoltage during constant speed, overvoltage during deceleration, inverter protection thermal operation, motor protection thermal operation, heatsink overheat, instantaneous power failure occurrence, undervoltage, input phase failure, motor overload, output side earth (ground) fault overcurrent, output short circuit, main circuit element overheat, output phase failure, external thermal relay operation, PTC thermistor operation, option alarm, parameter error, PU disconnection, retry count excess, CPU alarm, operation panel power supply short circuit, 24VDC power output short circuit, output current detection value excess, inrush current limit circuit alarm, communication alarm (inverter), opposite rotation deceleration error, analog input error, fan fault, overcurrent stall prevention, overvoltage stall prevention, regenerative brake pre-alarm, electronic thermal relay function pre-alarm, PU stop, maintenance timer alarm*2, brake transistor alarm, parameter write error, copy operation error, operation panel lock, parameter copy alarm.
Environment	Ambient temperature		-10°C to +50°C (non-freezing)
	Ambient humidity		90%RH maximum (non-condensing)
	Storage temperature*4		-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. (conforms to JIS C 60068-2-6)

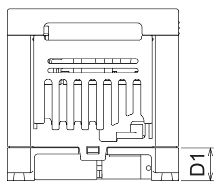
*1 Available only when the option (FR-A7AP) is mounted
*2 Can be displayed only on the operation panel (FR-DU07).
*3 Can be displayed only on the parameter unit (FR-PU07/FR-PU04).
*4 Temperature applicable for a short period in transit, etc.

7.3 Outline dimension drawings

7.3.1 Inverter outline dimension drawings

● FR-B-750 (200V class), FR-B3-(N)400, 750

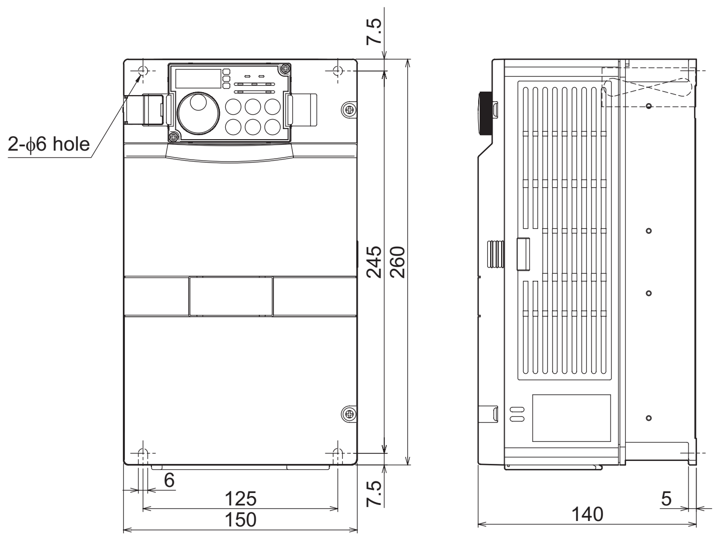


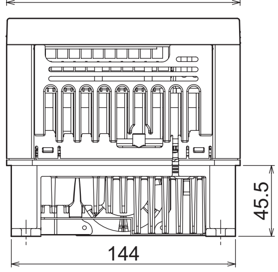


Inverter Type	D	D1
FR-B3-(N)400	110	21
FR-B-750, FR-B3-(N)750	125	36

(Unit: mm)

●FR-B-1500 to 3700 (200V class), FR-B3-(N)1500 to 3700
●FR-B-750 to 3700 (400V class), FR-B3-(N)H400 to 3700

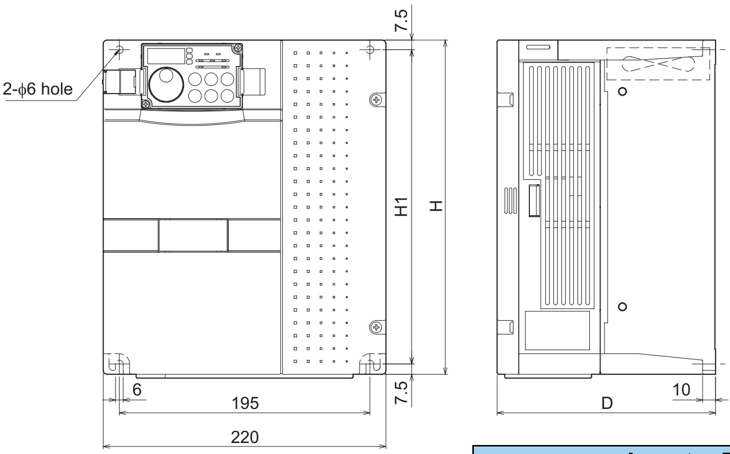


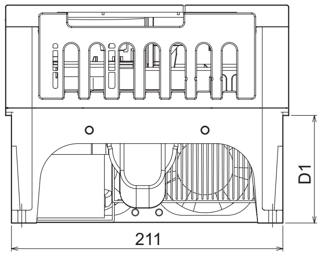


* The FR-B-750,1500, FR-B3-(N)H 400 to 1500 are not provided with a cooling fan.

(Unit: mm)

●FR-B-5.5K to 11K(200V class), FR-B3-(N)5.5K to 11K
●FR-B-7.5K,15K(400V class), FR-B3-(N)H5.5K to 15K

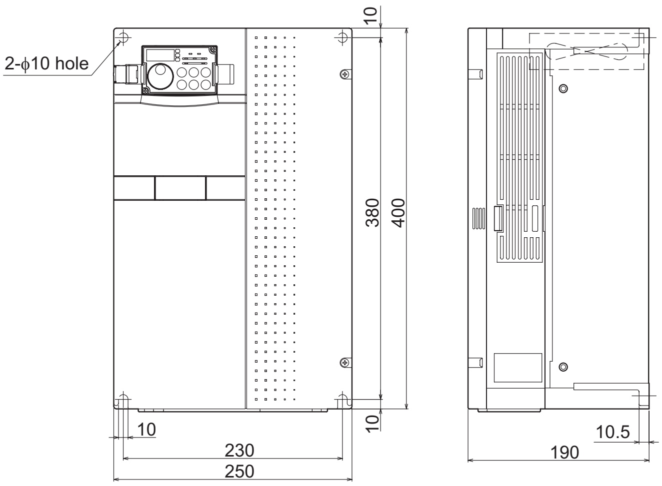


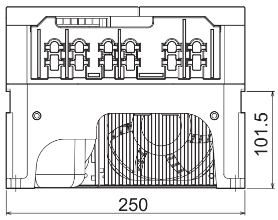


Inverter Type	H	H1	D	D1
FR-B-5.5K, 7.5K (200V), FR-B-7.5K (400V) FR-B3-(N)(H)5.5K, 7.5K	260	245	170	84
FR-B-11K(200V), FR-B-15K(400V) FR-B3-(N)(H)11K, 15K	300	285	190	101.5

(Unit: mm)

●FR-B-15K,22K(200V class), FR-B3-(N)15K to 22K
●FR-B-22K(400V class), FR-B3-(N)H18.5K, 22K





(Unit: mm)

SPECIFICATIONS

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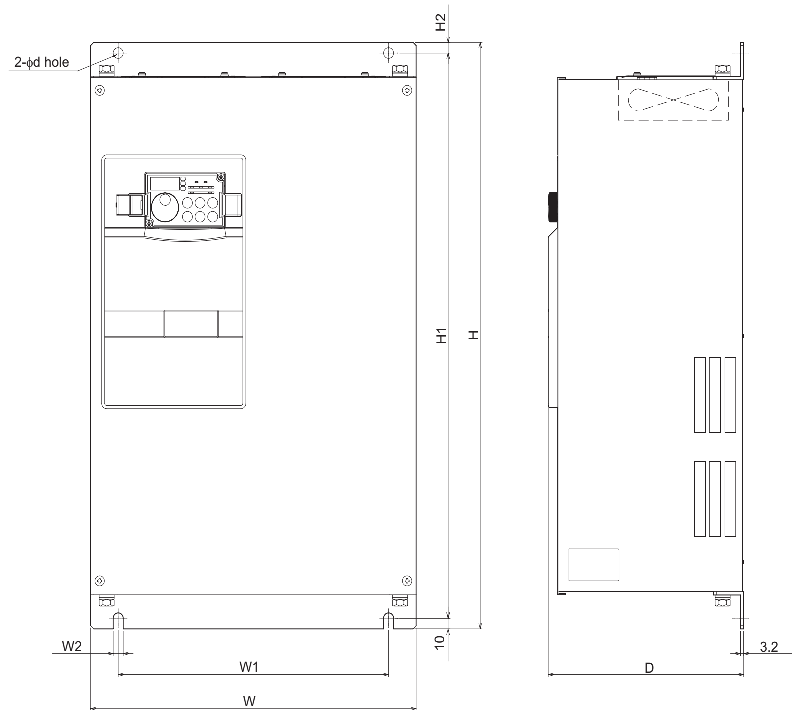
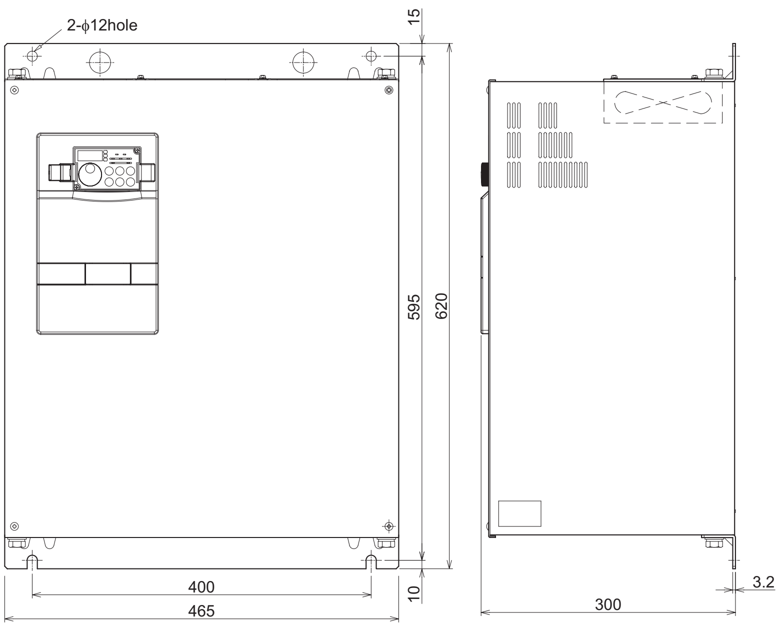
●FR-B-30K to 55K (200V class), FR-B3-(N)30K, 37K
●FR-B-37K, 55K (400V class), FR-B3-(N)H30K, 37K



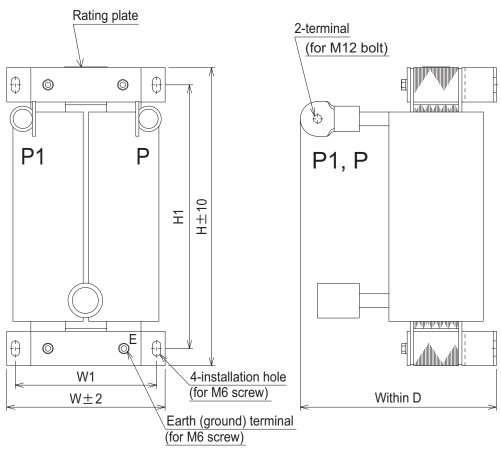
Inverter Type	W	W1	W2	H	H1	H2	d	D
FR-B-30K (200V/400V) FR-B3-(N)(H)30K	325	270	10	550	530	10	10	195
FR-B-37K, 45K (200V), FR-B-37K, 55K (400V) FR-B3-(N)(H)37K	435	380	12	550	525	15	12	250
FR-B-55K (200V)	465	410	12	700	675	15	12	250

(Unit: mm)

●FR-B-75K, 90K (400V class)



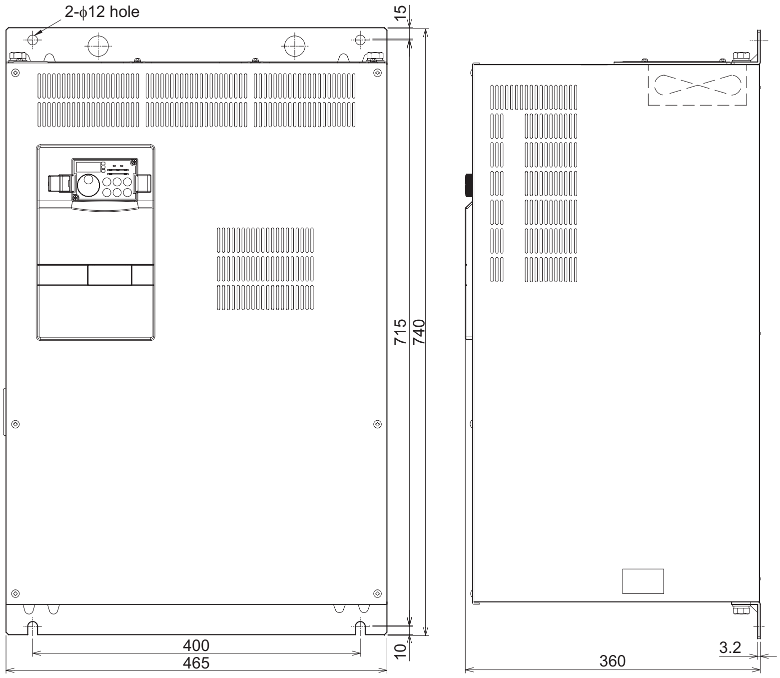
●DC reactor supplied



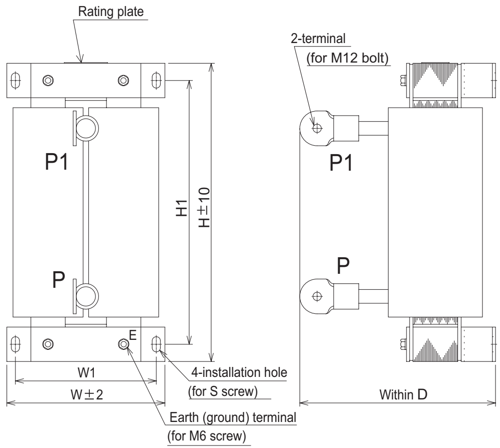
DC Reactor Type	W	W1	H	H1	D	Mass (Kg)
FR-HEL-H75K (FR-B-75K)	140	120	320	295	185	16
FR-HEL-H90K (FR-B-90K)	150	130	340	310	190	20

(Unit: mm)

●FR-B-75K (200V class)
●FR-B-110K (400V class)



●DC reactor supplied

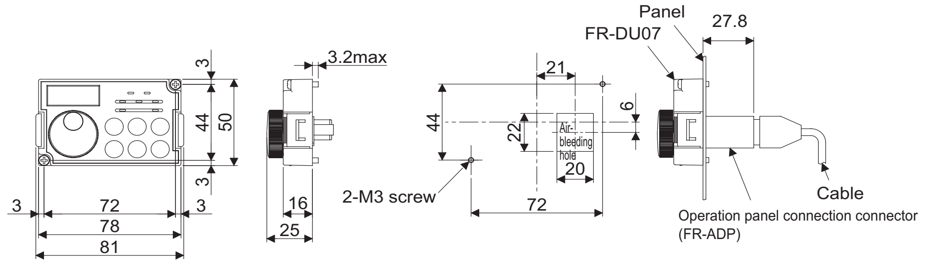


DC Reactor Type	W	W1	H	H1	D	S	Mass (kg)
FR-HEL-75K (FR-B-75K)	150	130	340	310	190	M6	17
FR-HEL-H110K (FR-B-110K)	150	130	340	310	195	M6	22

(Unit: mm)

● Operation panel (FR-DU07)

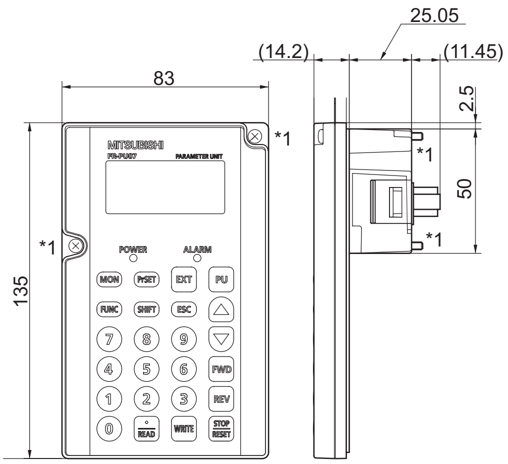
<Outline drawing> <Panel cutting dimension drawing>

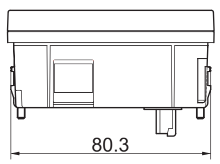


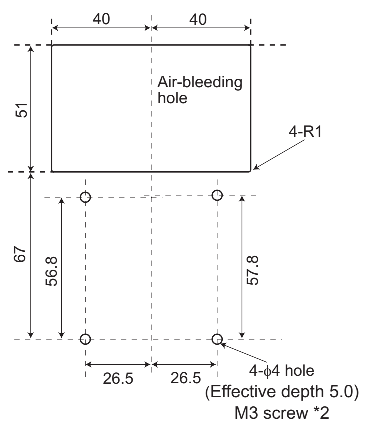
(Unit: mm)

● Parameter unit (option) (FR-PU07)

<Outline drawing> <Panel cutting dimension drawing>







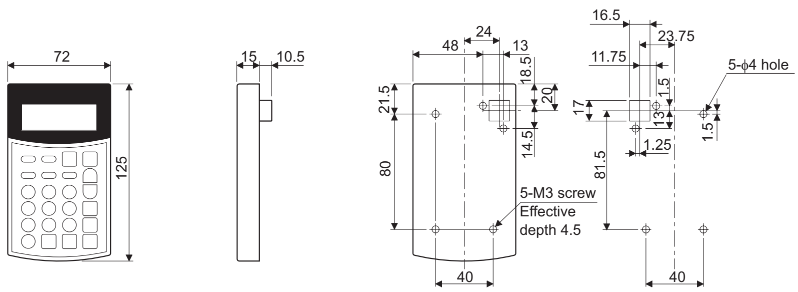
*1 When installing the FR-PU07 on the enclosure, etc., remove screws for fixing the FR-PU07 to the inverter or fix the screws to the FR-PU07 with M3 nuts.

*2 Select the installation screws whose length will not exceed the effective depth of the installation screws threads.

(Unit: mm)

● Parameter unit (option) (FR-PU04)

<Outline drawing> <Panel cutting dimension drawing>



Select the installation screws whose length will not exceed the effective depth of the installation screws threads.

(Unit: mm)

7 APPENDICES

This chapter provides the "APPENDICES" of this product.
Always read the instructions before using the equipment.

Appendix 1 For customers who have replaced the older model with this inverter

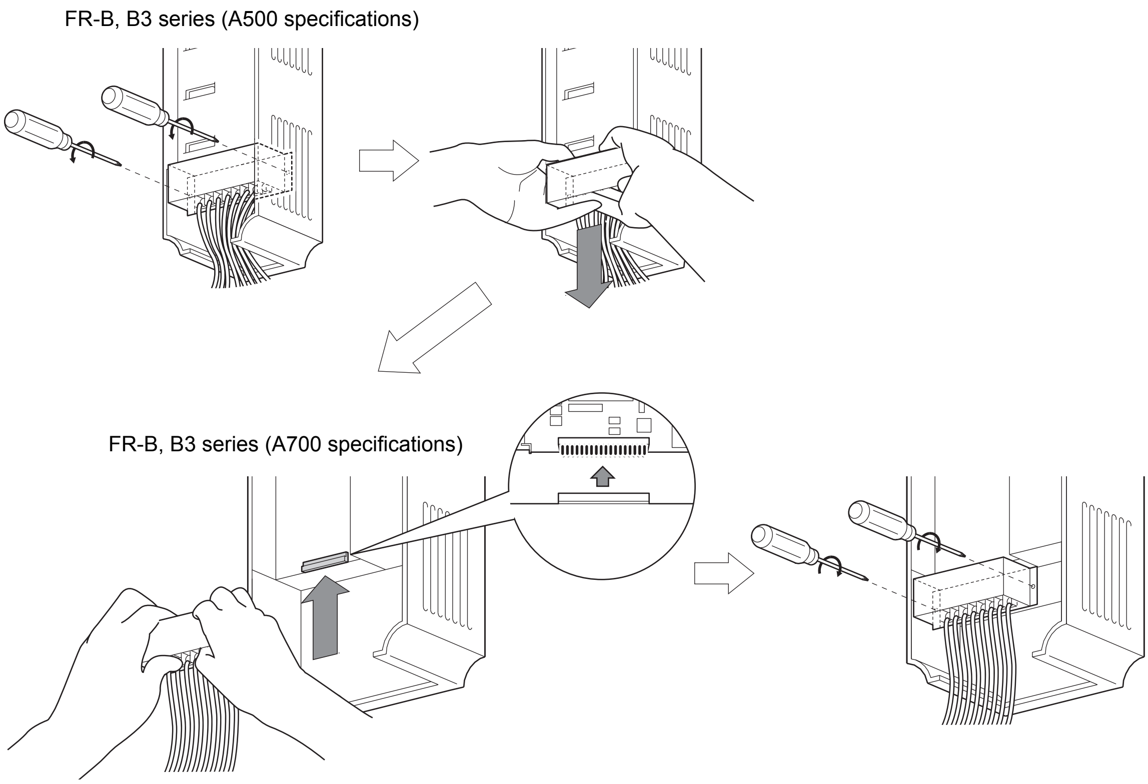
Appendix 1-1 Replacement of the FR-B,B3 series (A500 specifications)

(1) Instructions for installation

1)Removal procedure of the front cover was changed. (with screws) Please note. *(Refer to page 6.)*
2)Removal procedure of the operation panel was changed. (with screws) Please note. *(Refer to page 6.)*
3)Plug-in options of the B,B3 series (A500 specifications) are not compatible
4)Operation panel (FR-DU04) can not be used.
5)Setup software (FR-SW0-SETUP/FR-SW1-SETUP) can not be used.

(2) Wiring instructions

1)The control circuit terminal block can be used for the FR-B, B3 series (A700 specifications) without removing wiring.
Note that the wiring cover (400 to 22K) is not compatible.



(Note that the relay output 2 (A2, B2, C2) specific for the FR-B, B3 series (A700 specifications) can not be used with the FR-B, B3 series (A500 specifications) terminals.)

(3) Instructions for continuous use of the FR-PU04 (parameter unit)

1) For the FR-B, B3 series (A700 specifications), 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-B, B3 series (A700 specifications), many protective functions have been added. These functions activate, but all alarms are displayed as "Fault 14". When the alarm history has been checked, "E.14" appears. Added alarm display will not appear on the parameter unit.
3) User initial value setting can not be used.
4) User registration/clear (user group 2) can not be used.
5) Parameter copy/verification function can not be used.

(4) Main differences between the explosion proof inverter and standard inverter

Specifications		FR-B3-(N) (FR-A700 specifications)	FR-A700
Power supply voltage	200V class	200V 50Hz 200/220V 60Hz	200V to 220V 50Hz 200V to 240V 60Hz
	400V class	400V 50Hz 400/440V 60Hz	380 to 480V 50/60Hz
Maximum output frequency		Limit according to the maximum operating frequency of the motor	400Hz
Advanced magnetic flux vector control		Available (Advanced magnetic flux vector control operation is required)	Available
Real sensorless vector control		Not available	Available
DC brake operation		Variable	Available
Energy saving control selection		Not available (due to advanced magnetic flux vector control)	Available
PWM frequency		Two types, standard(2kHz)/law noise (14.5kHz), are available	Law noise(Variable)

Appendix 2 Control mode-based parameter (function) correspondence table and instruction code list

*1 These instruction codes are used for parameter read and write by using Mitsubishi inverter protocol with the RS-485 communication. (Refer to *page 201* for RS-485 communication)
*2 Validity and invalidity according to operation mode are as follows:
○:Usable parameter
×:Unusable parameter
"○" indicates valid and "×" indicates invalid of "parameter copy", "parameter clear", and "all parameter clear".
Symbols in the table indicate parameters which function when an option is mounted.
AX .... FR-A7AX, AY .... FR-A7AY, AR .... FR-A7AR, AP .... FR-A7AP, NC .... FR-A7NC, ND FR-A7ND,
NL .... FR-A7NL, NP FR-A7NP

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B V/F Control	FR-B3 Advanced magnetic flux vector control			
1	Maximum frequency	01	81	0	○	○	○	○	○
2	Minimum frequency	02	82	0	○	○	○	○	○
4	Multi-speed setting (high speed)	04	84	0	○	○	○	○	○
5	Multi-speed setting (middle speed)	05	85	0	○	○	○	○	○
6	Multi-speed setting (low speed)	06	86	0	○	○	○	○	○
7	Acceleration time	07	87	0	○	○	○	○	○
8	Deceleration time	08	88	0	○	○	○	○	○
9	Electronic thermal O/L relay	09	89	0	○	○	○	○	○
10	DC injection brake operation frequency	0A	8A	0	×	○	○	○	○
11	DC injection brake operation time	0B	8B	0	○	○	○	○	○
12	DC injection brake operation voltage	0C	8C	0	×	○	○	○	○
13	Starting frequency	0D	8D	0	○	○	○	○	○
15	Jog frequency	0F	8F	0	○	○	○	○	○
16	Jog acceleration/deceleration time	10	90	0	○	○	○	○	○
17	MRS input selection	11	91	0	○	○	○	○	○
20	Acceleration/deceleration reference frequency	14	94	0	○	○	○	○	○
21	Acceleration/deceleration time increments	15	95	0	○	○	○	○	○
22	Stall prevention operation level	16	96	0	○	○	○	○	○
23	Stall prevention operation level compensation factor at double speed	17	97	0	○	○	○	○	○
24	Multi-speed setting (speed4)	18	98	0	○	○	○	○	○
25	Multi-speed setting (speed 5)	19	99	0	○	○	○	○	○
26	Multi-speed setting (speed 6)	1A	9A	0	○	○	○	○	○
27	Multi-speed setting (speed 7)	1B	9B	0	○	○	○	○	○
28	Multi-speed input compensation selection	1C	9C	0	○	○	○	○	○
29	Acceleration/deceleration pattern selection	1D	9D	0	○	○	○	○	○
30	Regenerative function selection	1E	9E	0	○	×	○	○	○
31	Frequency jump 1A	1F	9F	0	○	○	○	○	○
32	Frequency jump 1B	20	A0	0	○	○	○	○	○
33	Frequency jump 2A	21	A1	0	○	○	○	○	○
34	Frequency jump 2B	22	A2	0	○	○	○	○	○
35	Frequency jump 3A	23	A3	0	○	○	○	○	○
36	Frequency jump 3B	24	A4	0	○	○	○	○	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B	FR-B3			
					V/F Control	Advanced magnetic flux vector control			
37	Speed display	25	A5	0	○	○	○	○	○
41	Up-to-frequency sensitivity	29	A9	0	○	○	○	○	○
42	Output frequency detection	2A	AA	0	○	○	○	○	○
43	Output frequency detection for reverse rotation	2B	AB	0	○	○	○	○	○
44	Second acceleration/ deceleration time	2C	AC	0	○	○	○	○	○
45	Second deceleration time	2D	AD	0	○	○	○	○	○
48	Second stall prevention operation current	30	B0	0	○	○	○	○	○
49	Second stall prevention operation frequency	31	B1	0	○	○	○	○	○
50	Second output frequency detection	32	B2	0	○	○	○	○	○
52	DU/PU main display data selection	34	B4	0	○	○	○	○	○
54	FM terminal function selection	36	B6	0	○	○	○	○	○
55	Frequency monitoring reference	37	B7	0	○	○	○	○	○
56	Current monitoring reference	38	B8	0	○	○	○	○	○
57	Restart coasting time	39	B9	0	○	○	○	○	○
58	Restart cushion time	3A	BA	0	○	○	○	○	○
59	Remote function selection	3B	BB	0	○	○	○	○	○
61	Reference current	3D	BD	0	×	○	○	○	○
62	Reference value at acceleration	3E	BE	0	×	○	○	○	○
63	Reference value at dcceleration	3F	BF	0	×	○	○	○	○
65	Retry selection	41	C1	0	○	○	○	○	○
66	Stall prevention operation reduction starting frequency	42	C2	0	○	○	○	○	○
67	Number of retries at alarm occurrence	43	C3	0	○	○	○	○	○
68	Retry waiting time	44	C4	0	○	○	○	○	○
69	Retry count display erase	45	C5	0	○	○	○	○	○
70	Special regenerative brake duty	46	C6	0	○	×	○	○	○
71	Applied motor	47	C7	0	○	×	○	○	○
73	Analog input selection	49	C9	0	○	○	○	×	○
74	Input filter time constant	4A	CA	0	○	○	○	○	○
75	Reset selection/disconnected PU detection/PU stop selection	4B	CB	0	○	○	○	×	×
76	Alarm code output selection	4C	CC	0	○	○	○	○	○
77 *	Parameter write selection	4D	CD	0	○	○	○	○	○
78	Reverse rotation prevention selection	4E	CE	0	○	○	○	○	○
79 *	Operation mode selection	4F	CF	0	○	○	○	○	○
80	Motor capacity	50	D0	0	×	○	×	×	×
81	Number of motor poles	51	D1	0	×	○	×	×	×
82	Motor excitation current	52	D2	0	×	○	○	×	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B	FR-B3			
					V/F Control	Advanced magnetic flux vector control			
83	Motor rated voltage	53	D3	0	×	○	○	○	○
84	Rated motor frequency	54	D4	0	×	○	○	○	○
89	Speed control gain (magnetic flux vector)	59	D9	0	×	○	○	×	○
90	Motor constant (R1)	5A	DA	0	×	○	○	×	○
91	Motor constant (R2)	5B	DB	0	×	○	○	×	○
92	Motor constant (L1)	5C	DC	0	×	○	○	×	○
93	Motor constant (L2)	5D	DD	0	×	○	○	×	○
94	Motor constant (X)	5E	DE	0	×	○	○	×	○
96	Auto tuning setting/status	60	E0	0	×	○	○	×	○
110	Third acceleration/deceleration time	0A	8A	1	○	○	○	○	○
111	Third deceleration time	0B	8B	1	○	○	○	○	○
114	Third stall prevention operation current	0E	8E	1	○	○	○	○	○
115	Thrid stall prevention operation frequency	0F	8F	1	○	○	○	○	○
116	Third output frequency detection	10	90	1	○	○	○	○	○
117	PU communication station number	11	91	1	○	○	○	○	○
118	PU communication speed	12	92	1	○	○	○	○	○
119	PU communication stop bit length	13	93	1	○	○	○	○	○
120	PU communication parity check	14	94	1	○	○	○	○	○
121	Number of PU communication retries	15	95	1	○	○	○	○	○
122	PU communication check time interval	16	96	1	○	○	○	○	○
123	PU communication waiting time setting	17	97	1	○	○	○	○	○
124	PU communication CR/LF selection	18	98	1	○	○	○	○	○
125	Terminal 2 frequency setting gain frequency	19	99	1	○	○	○	×	○
126	Terminal 4 frequency setting gain frequency	1A	9A	1	○	○	○	×	○
127	PID control automatic switchover freqeuncy	1B	9B	1	○	○	○	○	○
128	PID action selection	1C	9C	1	○	○	○	○	○
129	PID proportional band	1D	9D	1	○	○	○	○	○
130	PID integral time	1E	9E	1	○	○	○	○	○
131	PID upper limit	1F	9F	1	○	○	○	○	○
132	PID lower limit	20	A0	1	○	○	○	○	○
133	PID action set point	21	A1	1	○	○	○	○	○
134	PID differential time	22	A2	1	○	○	○	○	○
140	Backlash acceleration stopping frequency	28	A8	1	○	○	○	○	○
141	Backlash acceleration stopping time	29	A9	1	○	○	○	○	○
142	Backlash deceleration stopping frequency	2A	AA	1	○	○	○	○	○
143	Backlash deceleration stopping time	2B	AB	1	○	○	○	○	○

* Read and write from communication with PU connector only is enabled.

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
					FR-B	FR-B3			
		Read	Write	Extended	V/F Control	Advanced magnetic flux vector control			
144	Speed setting switchover	2C	AC	1	○	○	○	○	○
145	PU display language selection	2D	AD	1	○	○	○	×	×
148	Stall prevention level at 0V input	30	B0	1	○	○	○	○	○
149	Stall prevention level at 10V input	31	B1	1	○	○	○	○	○
150	Output current detection level	32	B2	1	○	○	○	○	○
151	Output current detection signal delay time	33	B3	1	○	○	○	○	○
152	Zero current detection level	34	B4	1	○	○	○	○	○
153	Zero current detection time	35	B5	1	○	○	○	○	○
154	Voltage reduction selection during stall prevention operation	36	B6	1	○	○	○	○	○
155	RT signal function validity condition selection	37	B7	1	○	○	○	○	○
156	Stall prevention operation selection	38	B8	1	○	○	○	○	○
157	OL signal output timer	39	B9	1	○	○	○	○	○
158	AM terminal function selection	3A	BA	1	○	○	○	○	○
160	User group read selection	00	80	2	○	○	○	○	○
161	Frequency setting/key lock operation selection	01	81	2	○	○	○	×	○
162	Automatic restart after instantaneous power failure selection	02	82	2	○	○	○	○	○
163	First cushion time for restart	03	83	2	○	○	○	○	○
164	First cushion voltage for restart	04	84	2	○	○	○	○	○
165	Stall prevention operation level for restart	05	85	2	○	○	○	○	○
166	Output current detection signal retention time	06	86	2	○	○	○	○	○
167	Output current detection operation selection	07	87	2	○	○	○	○	○
168	Parameter for manufacturer setting. Do not set.								
169									
170	Watt-hour meter clear	0A	8A	2	○	○	○	×	○
171	Operation hour meter clear	0B	8B	2	○	○	×	×	×
172	User group registered display/ batch clear	0C	8C	2	○	○	○	×	×
173	User group registration	0D	8D	2	○	○	×	×	×
174	User group clear	0E	8E	2	○	○	×	×	×
178	STF terminal function selection	12	92	2	○	○	○	×	○
179	STR terminal function selection	13	93	2	○	○	○	×	○
180	RL terminal function selection	14	94	2	○	○	○	×	○
181	RM terminal function selection	15	95	2	○	○	○	×	○
182	RH terminal function selection	16	96	2	○	○	○	×	○
183	RT terminal function selection	17	97	2	○	○	○	×	○
184	AU terminal function selection	18	98	2	○	○	○	×	○
185	JOG terminal function selection	19	99	2	○	○	○	×	○
186	CS terminal function selection	1A	9A	2	○	○	○	×	○
187	MRS terminal function selection	1B	9B	2	○	○	○	×	○
188	STOP terminal function selection	1C	9C	2	○	○	○	×	○
189	RES terminal function selection	1D	9D	2	○	○	○	×	○
190	RUN terminal function selection	1E	9E	2	○	○	○	×	○
191	SU terminal function selection	1F	9F	2	○	○	○	×	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B	FR-B3			
					V/F Control	Advanced magnetic flux vector control			
192	IPF terminal function selection	20	A0	2	○	○	○	×	○
193	OL terminal function selection	21	A1	2	○	○	○	×	○
194	FU terminal function selection	22	A2	2	○	○	○	×	○
195	ABC1 terminal function selection	23	A3	2	○	○	○	×	○
196	ABC2 terminal function selection	24	A4	2	○	○	○	×	○
232	Multi-speed setting (speed 8)	28	A8	2	○	○	○	○	○
233	Multi-speed setting (speed 9)	29	A9	2	○	○	○	○	○
234	Multi-speed setting (speed 10)	2A	AA	2	○	○	○	○	○
235	Multi-speed setting (speed 11)	2B	AB	2	○	○	○	○	○
236	Multi-speed setting (speed 12)	2C	AC	2	○	○	○	○	○
237	Multi-speed setting (speed 13)	2D	AD	2	○	○	○	○	○
238	Multi-speed setting (speed 14)	2E	AE	2	○	○	○	○	○
239	Multi-speed setting (speed 15)	2F	AF	2	○	○	○	○	○
241	Analog input display unit switchover	31	B1	2	○	○	○	○	○
242	Terminal 1 added compensation amount (terminal 2)	32	B2	2	○	○	○	○	○
243	Terminal 1 added compensation amount (terminal 4)	33	B3	2	○	○	○	○	○
244	Cooling fan operation selection	34	B4	2	○	○	○	○	○
250	Stop selection	3A	BA	2	○	○	○	○	○
251	Output phase failure protection selection	3B	BB	2	○	○	○	○	○
252	Override bias	3C	BC	2	○	○	○	○	○
253	Override gain	3D	BD	2	○	○	○	○	○
255	Life alarm status display	3F	BF	2	○	○	×	×	×
256	Inrush current limit circuit life display	40	C0	2	○	○	×	×	×
257	Control circuit capacitor life display	41	C1	2	○	○	×	×	×
258	Main circuit capacitor life display	42	C2	2	○	○	×	×	×
259	Main circuit capacitor life measuring	43	C3	2	○	○	○	○	○
261	Power failure stop selection	45	C5	2	○	○	○	○	○
262	Subtracted frequency at deceleration start	46	C6	2	○	○	○	○	○
263	Subtraction starting frequency	47	C7	2	○	○	○	○	○
264	Power-failure deceleration time 1	48	C8	2	○	○	○	○	○
265	Power-failure deceleration time 2	49	C9	2	○	○	○	○	○
266	Power failure deceleration time switchover frequency	4A	CA	2	○	○	○	○	○
267	Terminal 4 input selection	4B	CB	2	○	○	○	×	○
268	Monitor decimal digits selection	4C	CC	2	○	○	○	○	○
269	Parameter for manufacturer setting. Do not set.								
270	Stop-on contact/load torque high-speed frequency control selection	4E	CE	2	○	○	○	○	○
271	High-speed setting maximum current	4F	CF	2	○	○	○	○	○
272	Middle-speed setting minimum current	50	D0	2	○	○	○	○	○
273	Current averaging range	51	D1	2	○	○	○	○	○
274	Current averaging filter time constant	52	D2	2	○	○	○	○	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B	FR-B3			
					V/F Control	Advanced magnetic flux vector control			
275	Stop-on contact excitation current low-speed multiplying factor	53	D3	2	×	○	○	○	○
278	Brake opening frequency	56	D6	2	×	○	○	○	○
279	Brake opening current	57	D7	2	×	○	○	○	○
280	Brake opening current detection time	58	D8	2	×	○	○	○	○
281	Brake operation time at start	59	D9	2	×	○	○	○	○
282	Brake operation frequency	5A	DA	2	×	○	○	○	○
283	Brake operation time at stop	5B	DB	2	×	○	○	○	○
284	Deceleration detection function selection	5C	DC	2	×	○	○	○	○
285	Overspeed detection frequency	5D	DD	2	×	○	○	○	○
286	Droop gain	5E	DE	2	×	○	○	○	○
287	Droop filter time constant	5F	DF	2	×	○	○	○	○
291	Pulse train I/O selection	63	E3	2	○	○	○	×	○
292	Automatic acceleration/ deceleration	64	E4	2	×	○	○	○	○
293	Acceleration/deceleration time individual calculation selection	65	E5	2	×	○	○	○	○
294	UV avoidance voltage gain	66	E6	2	○	○	○	○	○
299	Rotation direction detection selection at restarting	6B	EB	2	○	○	○	○	○
300	BCD input bias AX	00	80	3	○	○	○	○	○
301	BCD input gain AX	01	81	3	○	○	○	○	○
302	BIN input bias AX	02	82	3	○	○	○	○	○
303	BIN input gain AX	03	83	3	○	○	○	○	○
304	Digital input and analog input compensation enable/disable selection AX	04	84	3	○	○	○	○	○
305	Read timing operation selection AX	05	85	3	○	○	○	○	○
306	Analog output signal selection AY	06	86	3	○	○	○	○	○
307	Setting for zero analog output AY	07	87	3	○	○	○	○	○
308	Setting for maximum analog output AY	08	88	3	○	○	○	○	○
309	Analog output signal voltage/ current switchover AY	09	89	3	○	○	○	○	○
310	Analog meter voltage output selection AY	0A	8A	3	○	○	○	○	○
311	Setting for zero analog meter voltage output AY	0B	8B	3	○	○	○	○	○
312	Setting for maximum analog meter voltage output AY	0C	8C	3	○	○	○	○	○
313	DO0 output selection AY NC	0D	8D	3	○	○	○	○	○
314	DO1 output selection AY NC	0E	8E	3	○	○	○	○	○
315	DO2 output selection AY NC	0F	8F	3	○	○	○	○	○
316	DO3 output selection AY	10	90	3	○	○	○	○	○
317	DO4 output selection AY	11	91	3	○	○	○	○	○
318	DO5 output selection AY	12	92	3	○	○	○	○	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B	FR-B3			
					V/F Control	Advanced magnetic flux vector control			
319	DO6 output selection AY	13	93	3	○	○	○	○	○
320	RA1 output selection AR	14	94	3	○	○	○	○	○
321	RA2 output selection AR	15	95	3	○	○	○	○	○
322	RA3 output selection AR	16	96	3	○	○	○	○	○
323	AM0 0V adjustment AY	17	97	3	○	○	○	×	○
324	AM1 0mA adjustment AY	18	98	3	○	○	○	×	○
329	Digital input unit selection AX	1D	9D	3	○	○	○	×	○
331	RS-485 communication station	1F	9F	3	○	○	○	○	○
332	RS-485 communication speed	20	A0	3	○	○	○	○	○
333	RS-485 communication stop bit length	21	A1	3	○	○	○	○	○
334	RS-485 communication parity check selection	22	A2	3	○	○	○	○	○
335	RS-485 communication retry count	23	A3	3	○	○	○	○	○
336	RS-485 communication check time interval	24	A4	3	○	○	○	○	○
337	RS-485 communication waiting time setting	25	A5	3	○	○	○	○	○
338	Communication operation command source	26	A6	3	○	○	○	○	○
339	Communication speed command source	27	A7	3	○	○	○	○	○
340	Communication startup mode selection	28	A8	3	○	○	○	○	○
341	RS-485 communication CR/LF selection	29	A9	3	○	○	○	○	○
342	Communication EEPROM write selection	2A	AA	3	○	○	○	○	○
343	Communication error count	2B	AB	3	○	○	×	×	×
345	DeviceNet address ND	2D	AD	3	○	○	○	○	○
346	DeviceNet baud rate ND	2E	AE	3	○	○	○	○	○
349	Communication reset selection NC ND NL NP	31	B1	3	○	○	○	○	○
350	Stop position command selection AP	32	B2	3	○	○	○	○	○
351	Orientation speed AP	33	B3	3	○	○	○	○	○
352	Creep speed AP	34	B4	3	○	○	○	○	○
353	Creep switchover position AP	35	B5	3	○	○	○	○	○
354	Position loop switchover position AP	36	B6	3	○	○	○	○	○
355	DC injection brake start position AP	37	B7	3	○	○	○	○	○
356	Internal stop position command AP	38	B8	3	○	○	○	○	○
357	Orientation in-position zone AP	39	B9	3	○	○	○	○	○
358	Servo torque selection AP	3A	BA	3	○	○	○	○	○
359	Encoder rotation direction AP	3B	BB	3	○	○	○	○	○
360	16 bit data selection AP	3C	BC	3	○	○	○	○	○
361	Position shift AP	3D	BD	3	○	○	○	○	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B	FR-B3			
					V/F Control	Advanced magnetic flux vector control			
362	Orientation position loop gain AP	3E	BE	3	○	○	○	○	○
363	Completion signal output delay time AP	3F	BF	3	○	○	○	○	○
364	Encoder stop check time AP	40	C0	3	○	○	○	○	○
365	Orientation limit AP	41	C1	3	○	○	○	○	○
366	Recheck time AP	42	C2	3	○	○	○	○	○
367	Speed feedback range AP	43	C3	3	○	○	○	○	○
368	Feedback gain AP	44	C4	3	○	○	○	○	○
369	Number of encoder pulses AP	45	C5	3	○	○	○	○	○
374	Overspeed detection level AP	4A	CA	3	○	○	○	○	○
376	Encoder signal loss detection enable/disable selection AP	4C	CC	3	○	○	○	○	○
380	Acceleration S-pattern 1	50	D0	3	○	○	○	○	○
381	Deceleration S-pattern 1	51	D1	3	○	○	○	○	○
382	Acceleration S-pattern 2	52	D2	3	○	○	○	○	○
383	Deceleration S-pattern 2	53	D3	3	○	○	○	○	○
384	Input pulse division scaling factor	54	D4	3	○	○	○	○	○
385	Frequency for 0 input pulse	55	D5	3	○	○	○	○	○
386	Frequency for maximum input pulse	56	D6	3	○	○	○	○	○
387	Initial communication delay time NL	57	D7	3	○	○	○	○	○
388	Send time interval at hart beat NL	58	D8	3	○	○	○	○	○
389	Minimum sending time at hart beat NL	59	D9	3	○	○	○	○	○
390	% setting reference frequency NL	5A	DA	3	○	○	○	○	○
391	Receive time interval at hart beat NL	5B	DB	3	○	○	○	○	○
392	Event driven detection width NL	5C	DC	3	○	○	○	○	○
495	Remote output selection	5F	DF	4	○	○	○	○	○
496	Remote output data 1	60	E0	4	○	○	×	×	×
497	Remote output data 2	61	E1	4	○	○	×	×	×
500	Communication error execution waiting time NC ND NL NP	00	80	5	○	○	○	○	○
501	Communication error occurrence count display NC ND NL NP	01	81	5	○	○	×	○	○
502	Stop mode selection at communication error NC ND NL NP	02	82	5	○	○	○	○	○
503	Maintenance timer	03	83	5	○	○	×	×	×
504	Maintenance timer alarm output set time	04	84	5	○	○	○	×	○
505	Speed setting reference	05	85	5	○	○	○	○	○
516	S-pattern time at a start of acceleration	10	90	5	○	○	○	○	○
517	S-pattern time at a completion of acceleration	11	91	5	○	○	○	○	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
					FR-B	FR-B3			
		Read	Write	Extended	V/F Control	Advanced magnetic flux vector control			
518	S-pattern time at a start of deceleraiton	12	92	5	○	○	○	○	○
519	S-pattern time at a completion of deceleraiton	13	93	5	○	○	○	○	○
539	Modbus-RTU commnunication check time interval	27	A7	5	○	○	○	○	○
541	Frequency command sign selection (CC-Link) NC	29	A9	5	○	○	○	○	○
542	Communication station number (CC-Link) NC	2A	AA	5	○	○	○	○	○
543	Baud rate (CC-Link) NC	2B	AB	5	○	○	○	○	○
544	CC-Link extended setting NC	2C	AC	5	○	○	○	○	○
549	Protocol selection	31	B1	5	○	○	○	○	○
550	NET mode operation command source selection	32	B2	5	○	○	○	○	○
551	PU mode operation command source selection	33	B3	5	○	○	○	○	○
555	Current average time	37	B7	5	○	○	○	○	○
556	Data output mask time	38	B8	5	○	○	○	○	○
557	Current average value monitor signal output reference current	39	B9	5	○	○	○	○	○
563	Energization time carrying-over times	3F	BF	5	○	○	×	×	×
564	Operating time carrying-over times	40	C0	5	○	○	×	×	×
571	Holding time at a start	47	C7	5	○	○	○	○	○
575	Output interruption detection time	4B	CB	5	○	○	○	○	○
576	Output interruption detection level	4C	CC	5	○	○	○	○	○
577	Output interruption cancel level	4D	CD	5	○	○	○	○	○
611	Acceleration time at a restart	0B	8B	6	○	○	○	○	○
665	Regeneration avoidance frequency gain	41	C1	6	○	○	○	○	○
684	Tuning data increments switchover	54	D4	6	×	○	○	○	○
811	Set resolution switchover	0B	8B	8	○	○	○	○	○
849	Analog input off set adjustment	31	B1	8	○	○	○	○	○
858	Terminal 4 function assignment	3A	BA	8	○	○	○	×	○
859	Torque current	3B	BB	8	×	○	○	×	○
864	Torque detection	40	C0	8	×	○	○	○	○
865	Low speed detection	41	C1	8	○	○	○	○	○
866	Torque monitoring reference	42	C2	8	×	○	○	○	○
867	AM output filter	43	C3	8	○	○	○	○	○
868	Terminal 1 function assignment	44	C4	8	○	○	○	×	○
872	Input phase failure protection selection	48	C8	8	○	○	○	○	○
875	Fault definition	4B	CB	8	○	○	○	○	○
882	Regeneration avoidance operation selection	52	D2	8	○	○	○	○	○
883	Regeneration avoidance operation level	53	D3	8	○	○	○	○	○
884	Regeneration avoidance at deceleration detection sensitivity	54	D4	8	○	○	○	○	○

Parameter	Name	Instruction Code *1			Model based Correspondence Table *2		Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended	FR-B	FR-B3			
					V/F Control	Advanced magnetic flux vector control			
885	Regeneration avoidance compensation frequency limit value	55	D5	8	○	○	○	○	○
886	Regeneration avoidance voltage gain	56	D6	8	○	○	○	○	○
888	Free parameter 1	58	D8	8	○	○	○	×	×
889	Free parameter 2	59	D9	8	○	○	○	×	×
891	Cumulative power monitor digit shifted times	5B	DB	8	○	○	○	○	○
892	Load factor	5C	DC	8	○	○	○	○	○
893	Energy saving monitor reference (motor capacity)	5D	DD	8	○	○	○	○	○
894	Control selection during commercial power-supply operation	5E	DE	8	○	○	○	○	○
895	Power saving rate reference value	5F	DF	8	○	○	○	○	○
896	Power unit cost	60	E0	8	○	○	○	○	○
897	Power saving monitor average time	61	E1	8	○	○	○	○	○
898	Power saving cumulative monitor clear	62	E2	8	○	○	○	×	○
899	Operation time rate (estimated value)	63	E3	8	○	○	○	○	○
C0 (900)	FM terminal calibration	5C	DC	1	○	○	○	×	○
C1 (901)	AM terminal calibration	5D	DD	1	○	○	○	×	○
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	○	○	○	×	○
989	Parameter copy alarm release	59	D9	9	○	○	○	×	○
990	PU buzzer control	5A	DA	9	○	○	○	○	○
991	PU contrast adjustment	5B	DB	9	○	○	○	×	○

REVISIONS

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

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For Maximum Safety

- Mitsubishi inverters are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.
- When considering this product for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest Mitsubishi sales representative.
- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to prevent serious accidents when it is used in facilities where breakdowns of the product are likely to cause a serious accident.
- Please do not use this product for loads other than three-phase induction motors.