MITSUBISHI ELECTRIC

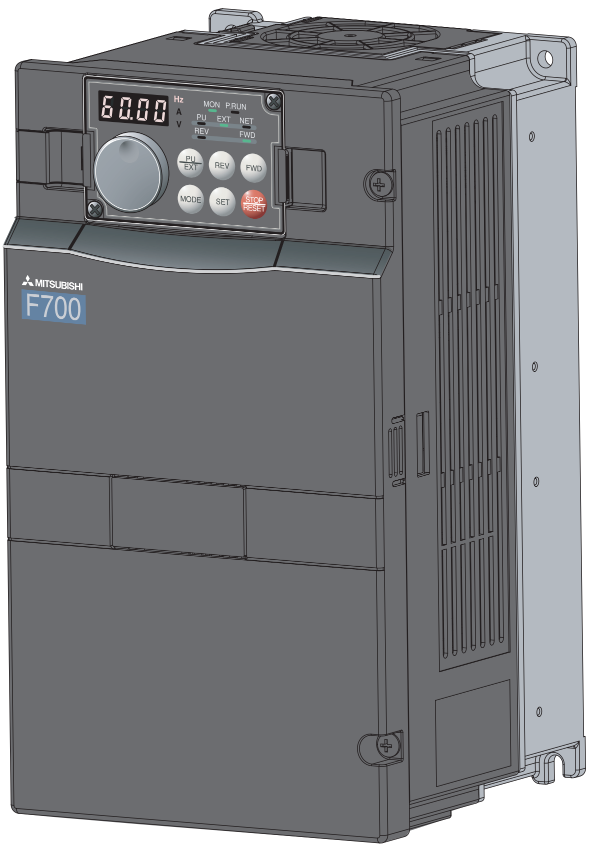
700 series

INVERTER

F700

INSTRUCTION MANUAL (Applied)

FR-F740-00023 to 12120-EC



Thank you for choosing this Mitsubishi Inverter.
This Instruction Manual (applied) provides instructions for advanced use of the FR-F700 series inverters.
Incorrect handling might cause an unexpected fault. Before using the inverter, always read this instruction manual and the instruction manual (basic) [IB-0600192ENG] 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.m
- 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, inspection or switching EMC filter on/off connector, switch off the inverter power, check to make sure that the operation panel indicator is off, wait for at least 10 minutes after the power supply has been switched off, and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power off and it is dangerous.
- This inverter must be earthed. Earthing must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)
- 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.
- 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

- When carrying products, use correct lifting gear to prevent injury.
- 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	LD	-10°C to +50°C (non-freezing)
		SLD (initial setting)	-10°C to +40°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. After that derate by 3% for every extra 500m up to 2500m (92%) 5.9m/s^2 or less *2

*1 Temperature applicable for a short time, e.g. in transit.
*2 2.9m/s^2 or less for the 04320 or more.

(2) Wiring ⚠CAUTION

- Do not install a power factor correction capacitor, surge suppressor or radio noise 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

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

(4) Operation ⚠WARNING

- 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 149)* 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 a 400V class motor is inverter-driven, please use an insulation-enhanced motor or measures taken to suppress surge voltages. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all 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

MEMO

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 inverter FR-F700 series
FR-F700 ....Mitsubishi inverter FR-F700 series
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.
Mitsubishi standard motor ......SF-JR
Mitsubishi constant-torque motor.SF-HRCA

<Trademarks>

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- DeviceNetTM is a registered trademark of ODVA (Open DeviceNet Vender Association, Inc.).
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1.1 Product checking and parts identification

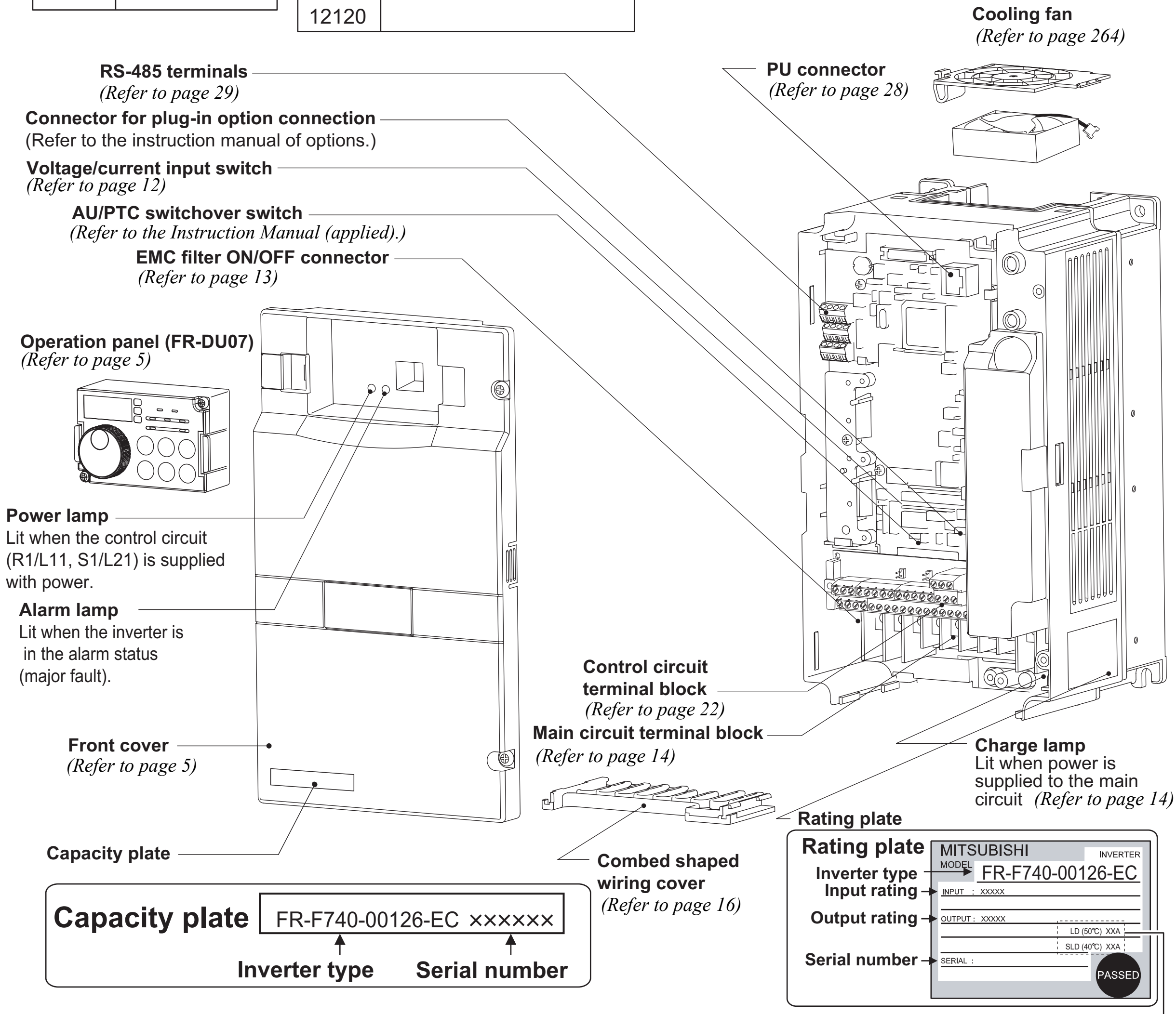
Unpack the inverter and check the capacity plate on the front cover and the rating plate on the inverter side face to ensure that the product agrees with your order and the inverter is intact.

- **Inverter Type**

FR - F740 - 00126 - EC

Symbol	Voltage Class
F740	Three-phase 400V class

Symbol	Type Number
00023 to 12120	Displays the rated current

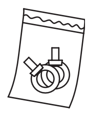


	Overload Current Rating	Ambient Temperature
LD	120% 60s, 150% 3s	50℃
SLD	110% 60s, 120% 3s	40℃

- **Accessory**
  - **Fan cover fixing screws (00620 or less)**
    (Refer to page 135)

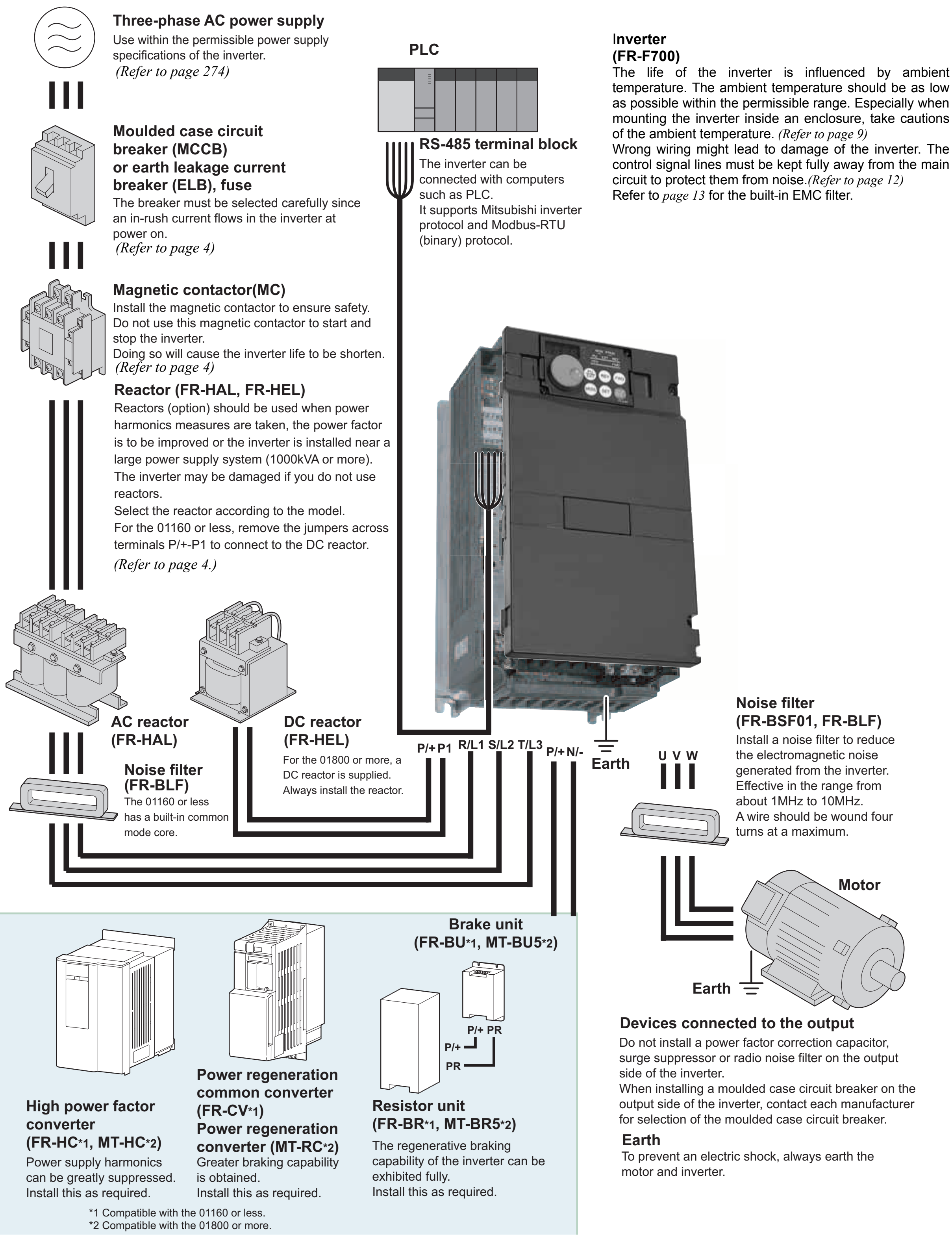
Capacity	Screw Size (mm)	Number
00083, 00126	M3 × 35	1
00170 to 00380	M4 × 40	2
00470, 00620	M4 × 50	1

- **DC reactor supplied (01800 or more)**
- **Eyebolt for hanging the inverter (00770 to 06830)**
  M8 × two pieces



REMARKS
For removal and reinstallation of covers, refer to *page 5*.

1.2 Inverter and peripheral devices



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 13.)
- Refer to the instruction manual of each option and peripheral devices for details of peripheral devices.

1.2.1 Peripheral devices

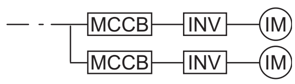
Check the motor capacity of the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the following list and prepare appropriate peripheral devices:

400V class

Motor Output (kW) *1	Applicable Inverter Type	Breaker Selection*2,4			Input Side Magnetic Contactor*3	
		Reactor connection		with commercial power-supply operation	Reactor connection	
		without	with		without	with
0.75	FR-F740-00023-EC	30AF 5A	30AF 5A	30AF 5A	S-N10	S-N10
1.5	FR-F740-00038-EC	30AF 10A	30AF 10A	30AF 10A	S-N10	S-N10
2.2	FR-F740-00052-EC	30AF 10A	30AF 10A	30AF 15A	S-N10	S-N10
3.7	FR-F740-00083-EC	30AF 20A	30AF 15A	30AF 20A	S-N10	S-N10
5.5	FR-F740-00126-EC	30AF 30A	30AF 20A	30AF 30A	S-N20	S-N11, N12
7.5	FR-F740-00170-EC	30AF 30A	30AF 30A	30AF 30A	S-N20	S-N20
11	FR-F740-00250-EC	50AF 50A	50AF 40A	50AF 50A	S-N20	S-N20
15	FR-F740-00310-EC	100AF 60A	50AF 50A	100AF 60A	S-N25	S-N20
18.5	FR-F740-00380-EC	100AF 75A	100AF 60A	100AF 75A	S-N25	S-N25
22	FR-F740-00470-EC	100AF 100A	100AF 75A	100AF 100A	S-N35	S-N25
30	FR-F740-00620-EC	225AF 125A	100AF 100A	225AF 125A	S-N50	S-N50
37	FR-F740-00770-EC	225AF 150A	225AF 125A	225AF 150A	S-N65	S-N50
45	FR-F740-00930-EC	225AF 175A	225AF 150A	225AF 175A	S-N80	S-N65
55	FR-F740-01160-EC	225AF 200A	225AF 175A	225AF 200A	S-N80	S-N80
75	FR-F740-01800-EC	—	225AF 225A	225AF 225A	—	S-N95
90	FR-F740-01800-EC	—	225AF 225A	400AF 300A	—	S-N150
110	FR-F740-02160-EC	—	225AF 225A	400AF 350A	—	S-N180
132	FR-F740-02600-EC	—	400AF 400A	400AF 400A	—	S-N220
160	FR-F740-03250-EC	—	400AF 400A	600AF 500A	—	S-N300
185	FR-F740-03610-EC	—	400AF 400A	600AF 500A	—	S-N300
220	FR-F740-04320-EC	—	600AF 500A	600AF 600A	—	S-N400
250	FR-F740-04810-EC	—	600AF 600A	600AF 600A	—	S-N600
280	FR-F740-05470-EC	—	600AF 600A	800AF 800A	—	S-N600
315	FR-F740-06100-EC	—	800AF 700A	800AF 800A	—	S-N600
355	FR-F740-06830-EC	—	800AF 800A	800AF 800A	—	S-N600
400	FR-F740-07700-EC	—	1000AF 900A	1000AF 1000A	—	S-N800
450	FR-F740-08660-EC	—	1000AF 1000A	1000AF 1000A	—	1000A Rated product
500	FR-F740-09620-EC	—	1200AF 1200A	1200AF 1200A	—	1000A Rated product
560	FR-F740-10940-EC	—	1600AF 1500A	1600AF 1600A	—	1200A Rated product
630	FR-F740-12120-EC	—	2000AF 2000A	2000AF 2000A	—	1400A Rated product

*1 Selections for use of the Mitsubishi 4-pole standard motor with power supply voltage of 400VAC 50Hz.

*2 Select the MCCB according to the inverter power supply capacity.
Install one MCCB per inverter.
For installations in the United States or Canada, use the fuse certified by the UL and cUL.
(Refer to the Instruction Manual (basics).)



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

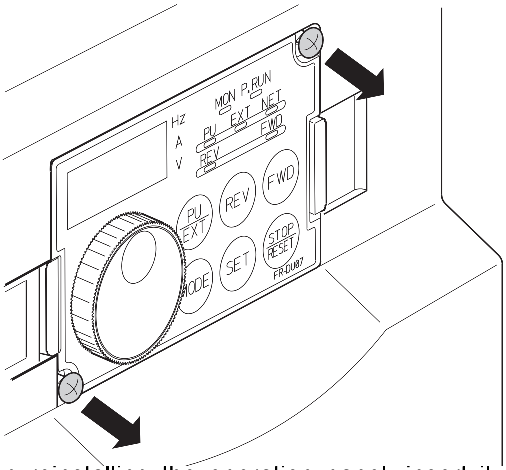
*4 When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.

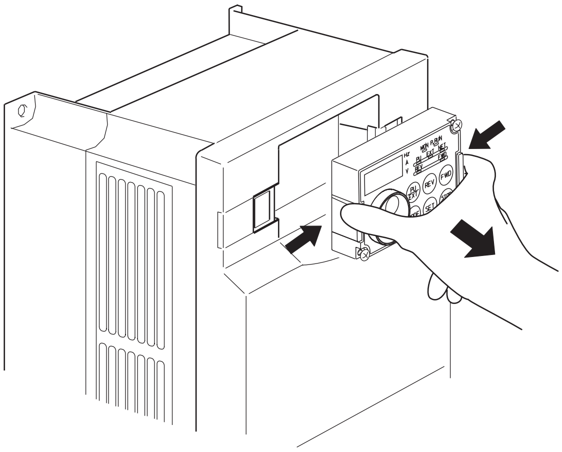
1.3 Method of removal and reinstallation of the front cover

•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.





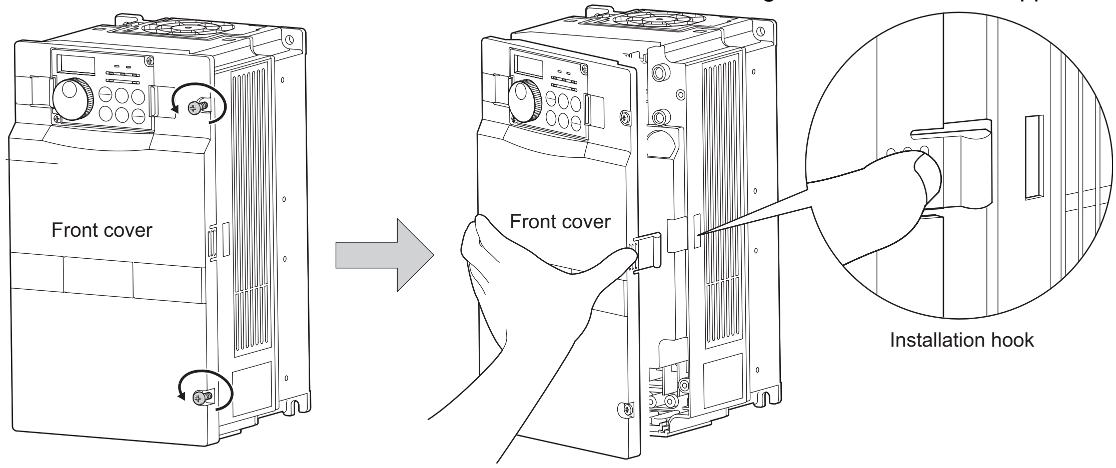
When reinstalling the operation panel, insert it straight to reinstall securely and tighten the fixed screws of the operation panel.

FR-F740-00620-EC 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.

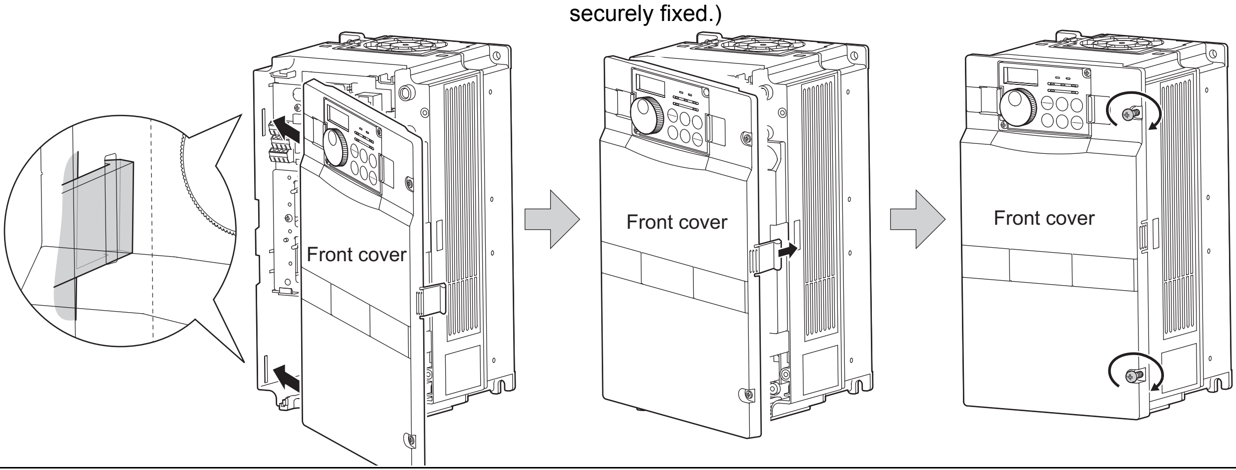


•Reinstallation

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.)

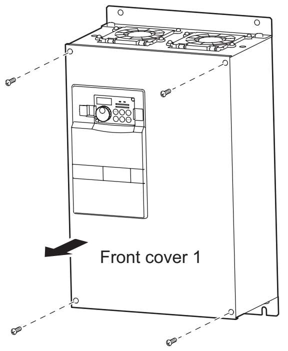
3) Tighten the installation screws and fix the front cover.



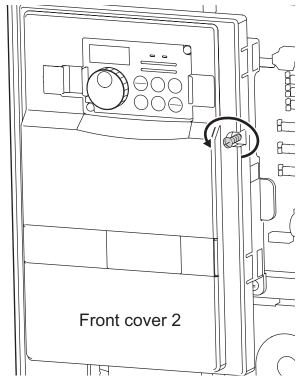
FR-F740-00770-EC or more

•Removal

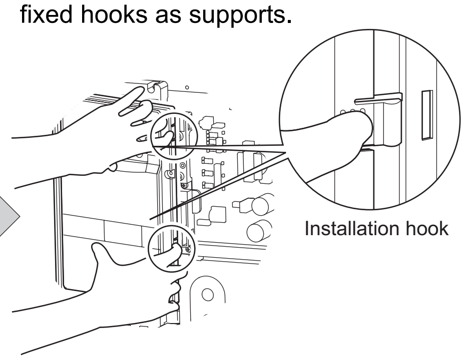
1) Remove installation screws on the front cover 1 to remove the front cover 1.



2) Loosen the installation screws of the front cover 2.

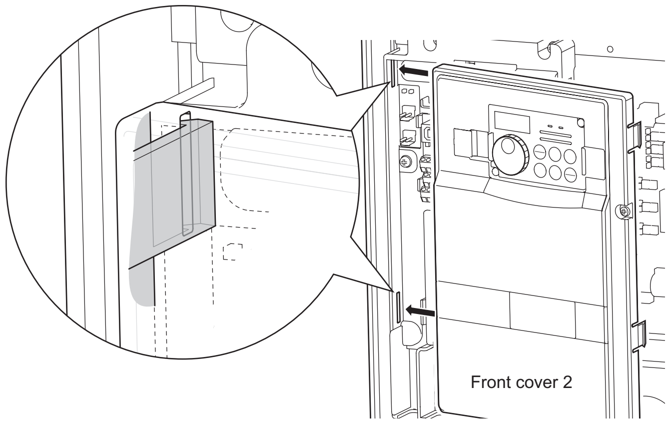


3) Pull the front cover 2 toward you to remove by pushing an installation hook on the right side using left fixed hooks as supports.

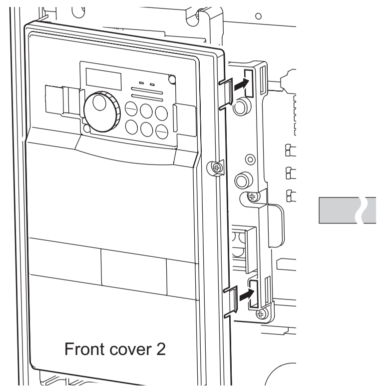


•Reinstallation

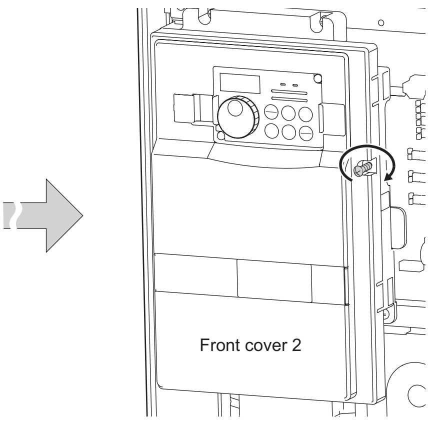
1) Insert the two fixed hooks on the left side of the front cover 2 into the sockets of the inverter.



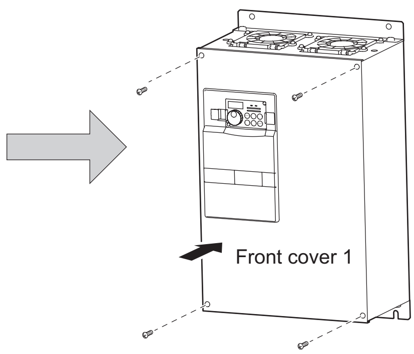
2) Using the fixed hooks as supports, securely press the front cover 2 against the inverter. (Although installation can be done with the operation panel mounted, make sure that a connector is securely fixed.)



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



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



REMARKS

· For the FR-F740-04320 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	LD	-10 to +50°C (non-freezing)
	SLD(Initial setting)	-10 to +40°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 *1	

*1 $2.9m/s^2$ or less for the 04320 or more.

(1) Temperature

The permissible ambient temperature of the inverter is -10°C to +50°C (when LD is set) or -10°C to +40°C (when SLD is set). 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 9.)*
- 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 tempearture 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 9.)*
- 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.

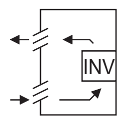
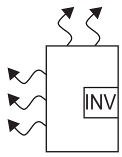
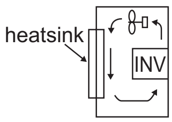
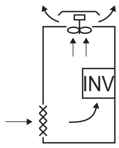
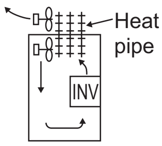
(7) Vibration, impact

The vibration resistance of the inverter is up to 5.9m/s^2 (2.9m/s^2 for the 04320 or more) at 10 to 55Hz frequency and 1mm amplitude.
Vibration or impact, if less than the specified value, applied for a long time may make the mechanism loose or cause poor contact to the connectors.
Especially when impact is imposed repeatedly, caution must be taken as the part pins are likely to break.

Countermeasures
- Provide the 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.)

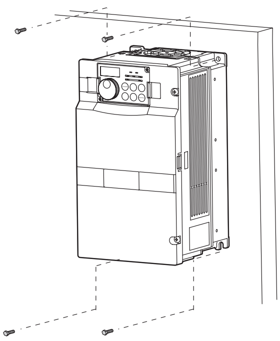
Cooling System		Enclosure Structure	Comment
Natural cooling	Natural ventilation (Enclosed, open type)		Low in cost and generally used, but the enclosure size increases as the inverter capacity increases. For relatively small capacities.
	Natural ventilation (Totally enclosed type)		Being a totally enclosed 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

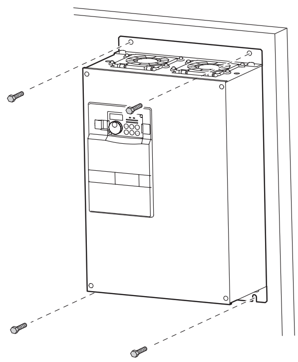
(1) Installation of the Inverter

Installation on the enclosure

00620 or less



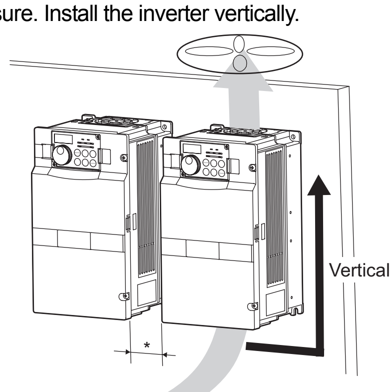
00770 or more



Fix six positions for the FR-F740-04320 to 08660 and fix eight positions for the FR-F740-09620 to 12120.

CAUTION

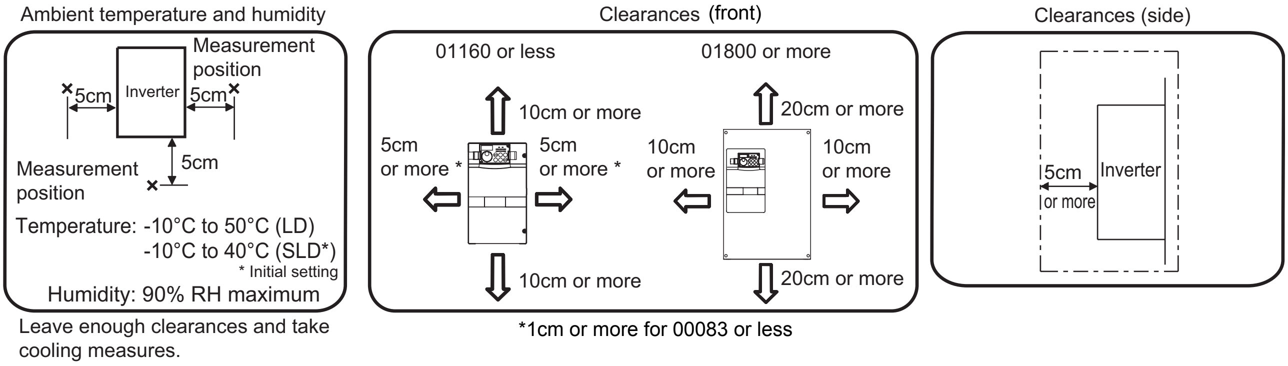
When encasing multiple inverters, install them in parallel as a cooling measure. Install the inverter vertically.



*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.



REMARKS

- For replacing the cooling fan of the 04320 or more, 30cm of space is necessary in front of the inverter. Refer to *page 264* for fan replacement.

(3) Inverter mounting orientation

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

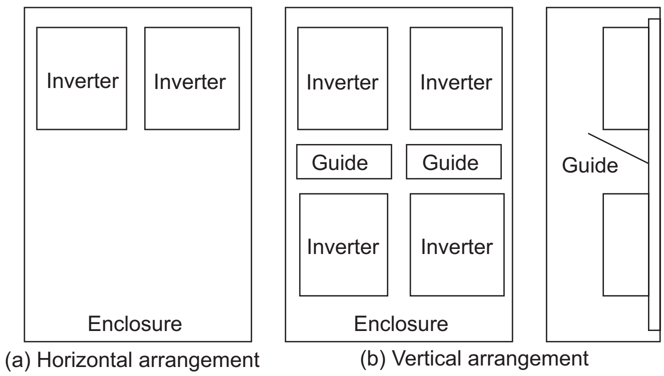
(4) Above the inverter

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.

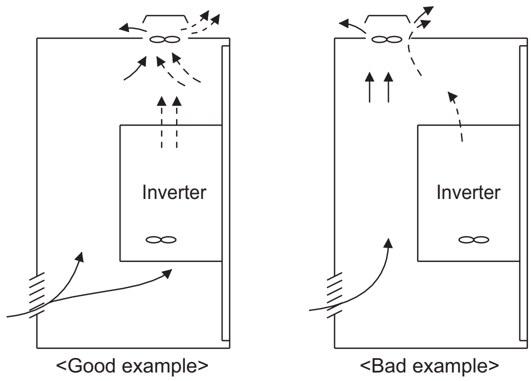
When mounting multiple inverters, fully take caution not to make the ambient temperature of the inverter higher than the permissible value by providing ventilation and increasing the enclosure size.



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.)



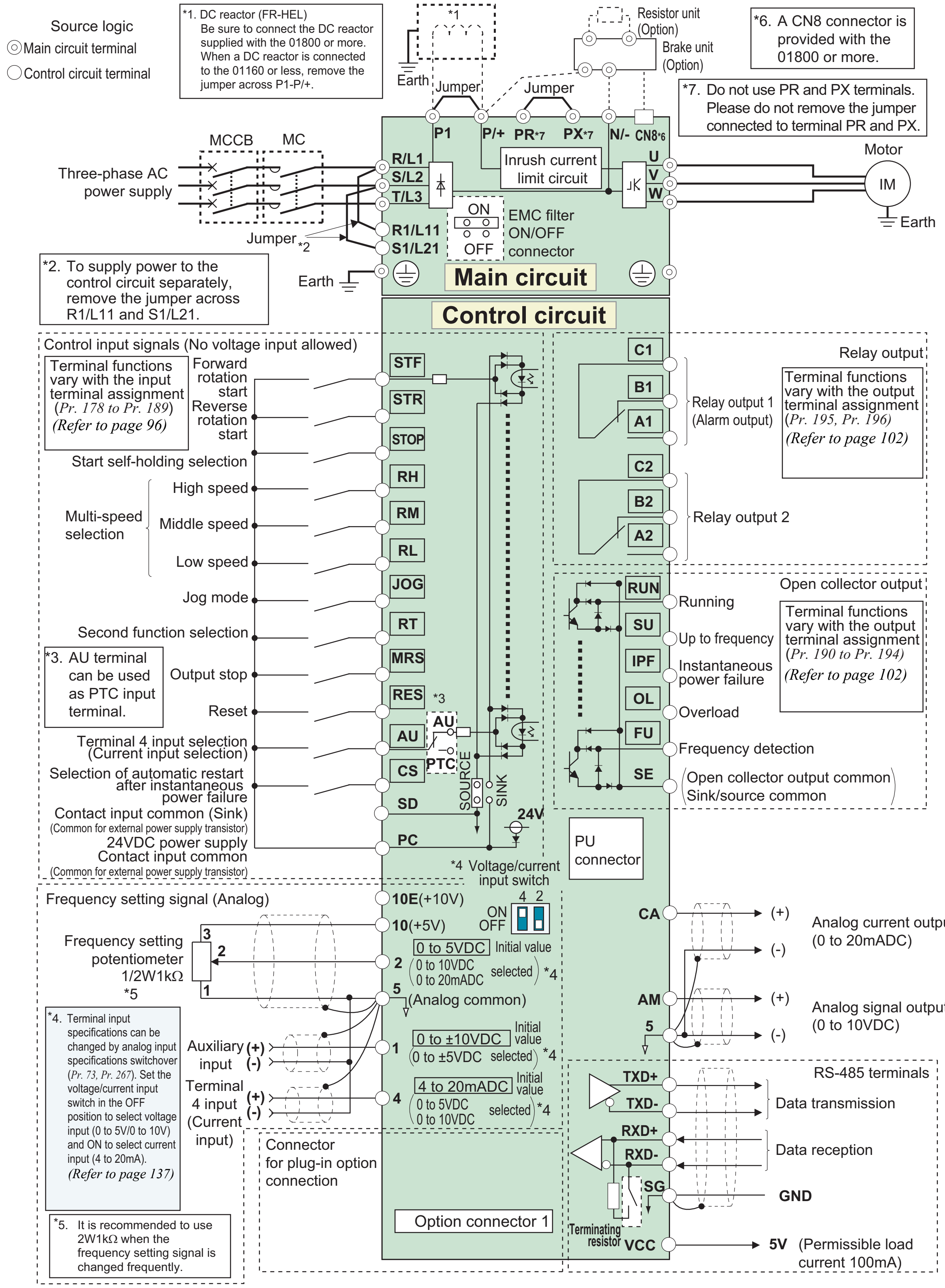
Placement of ventilation fan and inverter

2 WIRING

This chapter explains 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

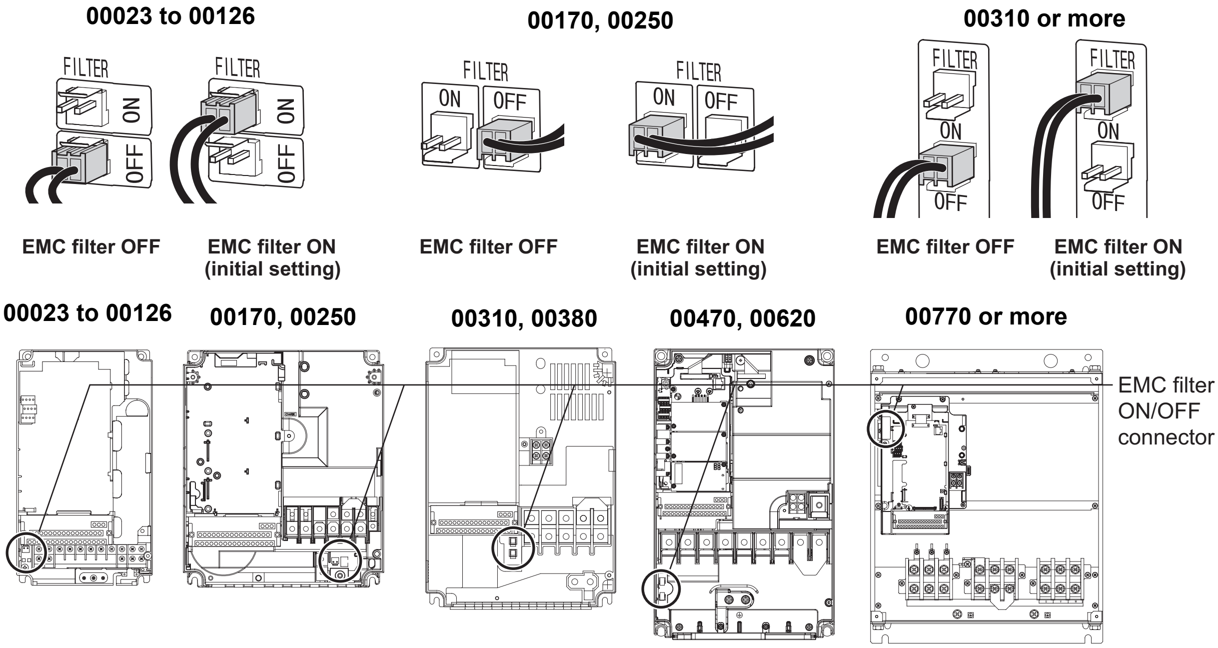


CAUTION

- 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

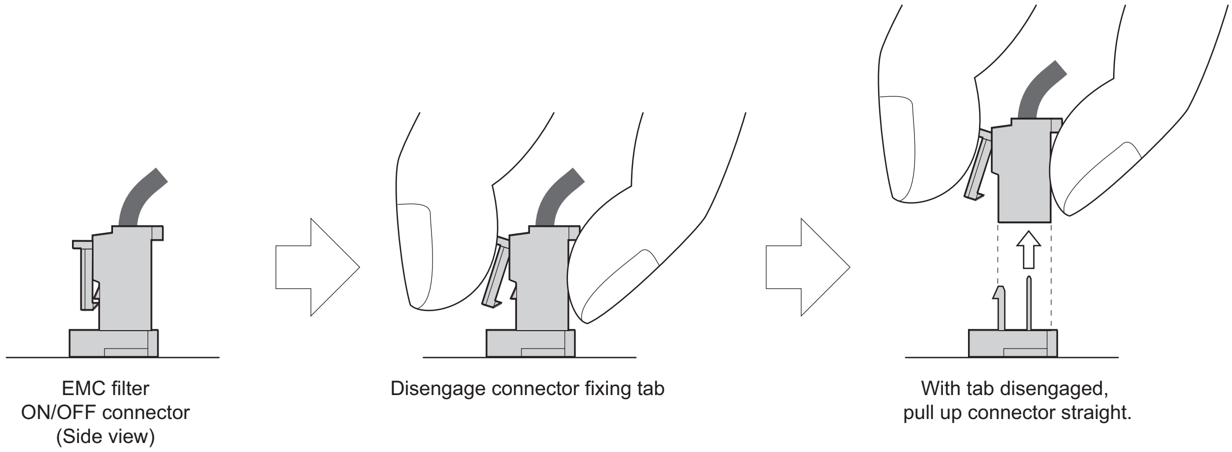
This inverter is equipped with a built-in EMC filter (capacitive filter) and common mode core.
The EMC filter is effective for reduction of air-propagated noise on the input side of the inverter.
The EMC filter is factory-set to enable (ON). To disable it, fit the EMC filter ON/OFF connector to the OFF position.
The input side common mode core, built-in the FR-F740-01160 or less inverter, is always valid regardless of on/off of the EMC filter on/off connector.



<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. (For the front cover removal method, refer to *Instruction Manual (basic).*)

(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.

⚠ 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

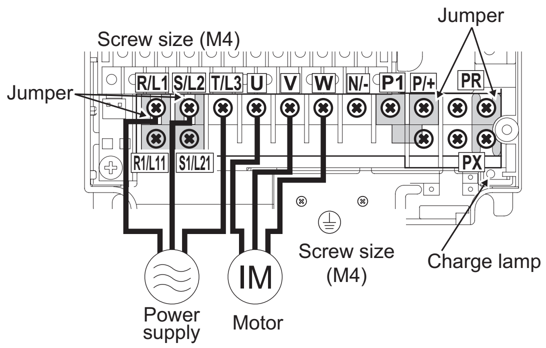
2.2.1 Specification of main circuit terminal

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 (FR-HC, MT-HC) or power regeneration common converter (FR-CV).
U, V, W	**Inverter output**	Connect a three-phase squirrel-cage 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 (FR-HC, MT-HC) or power regeneration common converter (FR-CV), remove the jumpers from terminals R/L1-R1/L11 and S/L2-S1/L21 and apply external power to these terminals. 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. 00380 or less : 60VA, 00470 or more : 80VA
P/+, N/-	**Brake unit connection**	Connect the brake unit (FR-BU, BU and MT-BU5), power regeneration common converter (FR-CV), high power factor converter (FR-HC and MT-HC) or power regeneration converter (MT-RC).
P/+, P1	**DC reactor connection**	For the 01160 or less, remove the jumper across terminals P/+ - P1 and connect the DC reactor. (Be sure to connect the DC reactor supplied with the 01800 or more.)
PR, PX	Please do not remove or use terminals PR and PX or the jumper connected.	
⏚	**Earth**	For earthing the inverter chassis. Must be earthed.

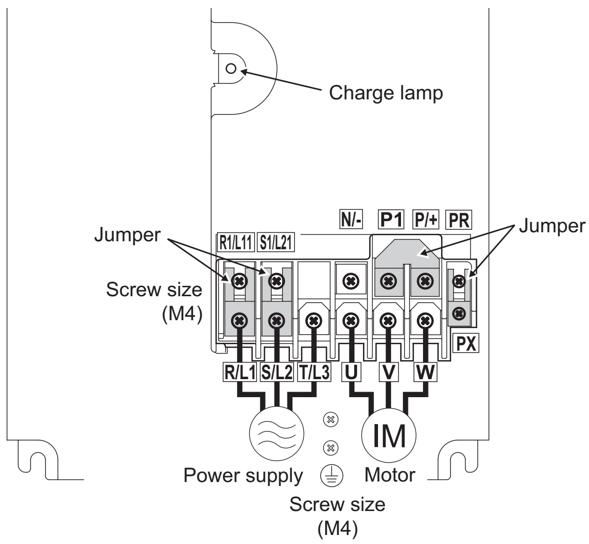
2.2.2 Terminal arrangement of the main circuit terminal, power supply and the motor wiring.

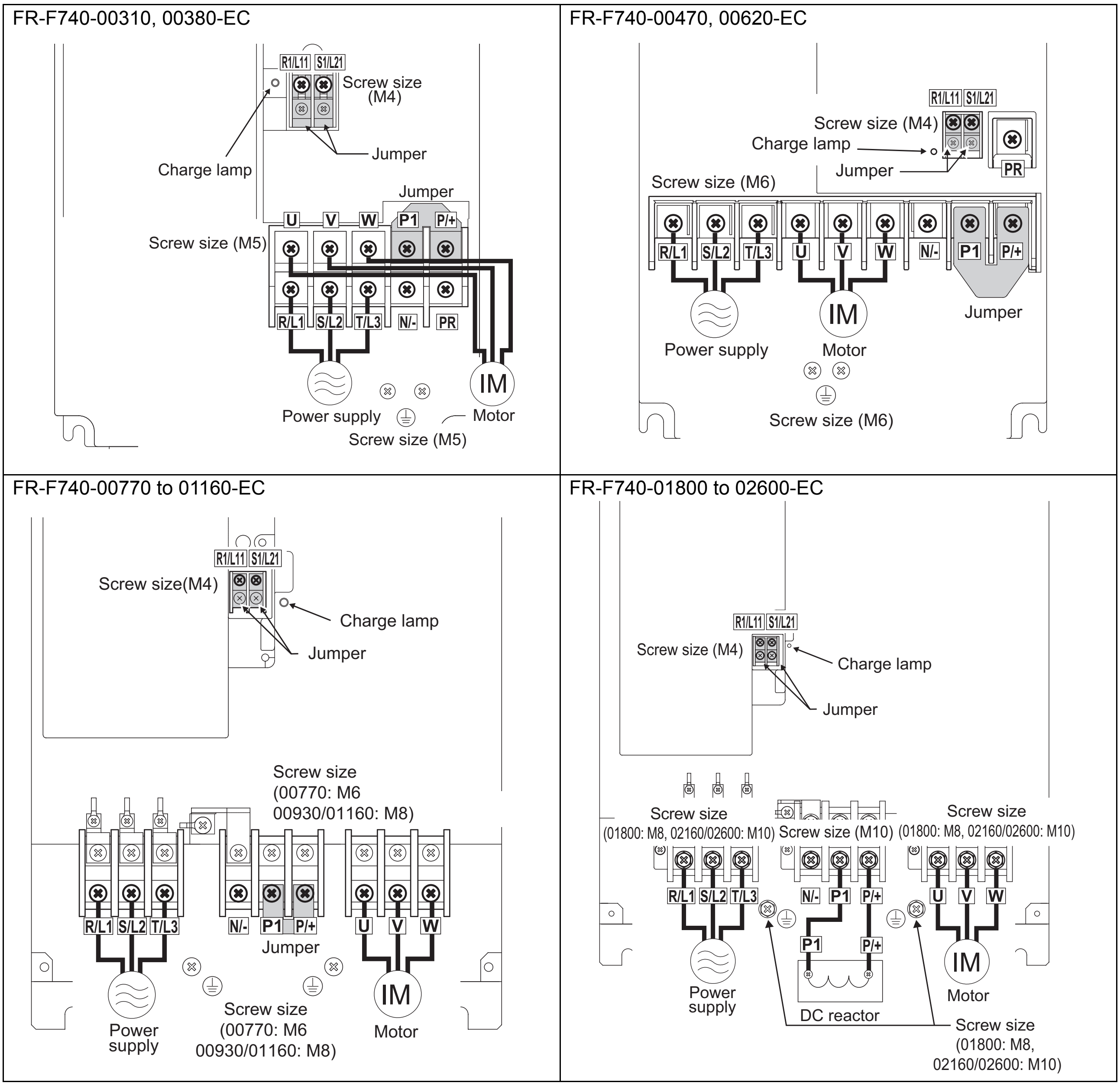
400V class

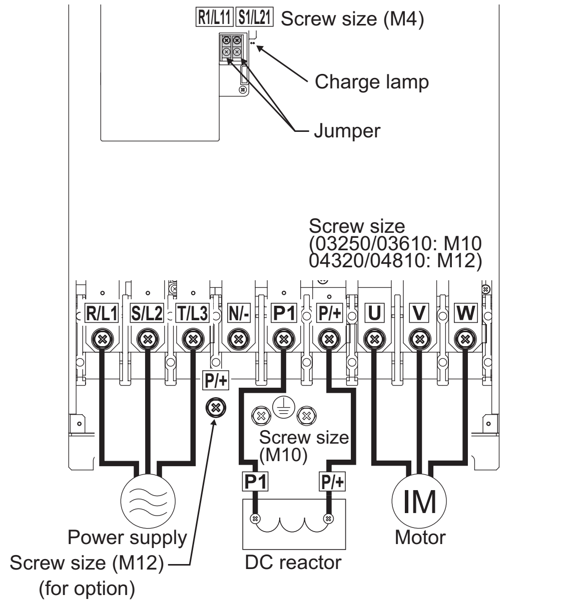
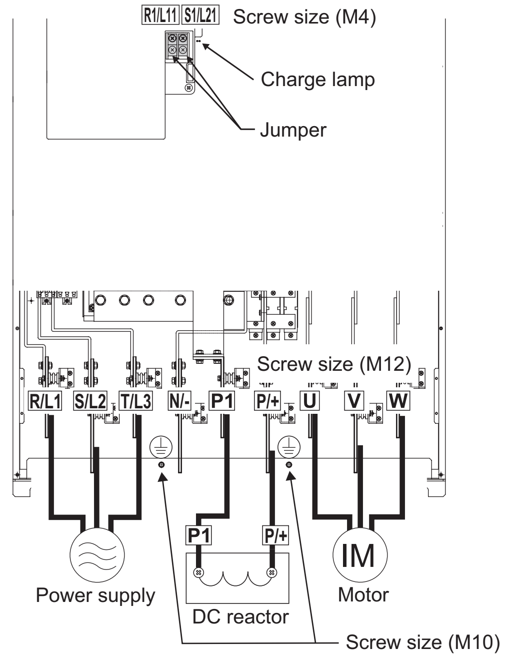
FR-F740-00023 to 00126-EC



FR-F740-00170, 00250-EC

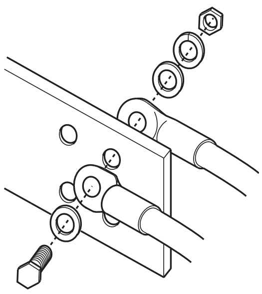



FR-F740-00310, 00380-EC
R1/L11
S1/L21
Screw size (M4)
Jumper
Charge lamp
Jumper
Screw size (M5)
U V W P1 P/+
R/L1 S/L2 T/L3 N/- PR
IM
Power supply
Motor
Screw size (M5)
FR-F740-00470, 00620-EC
R1/L11 S1/L21
Screw size (M4)
Charge lamp
Jumper
PR
Screw size (M6)
R/L1 S/L2 T/L3 U V W N/- P1 P/+
IM
Jumper
Power supply
Motor
Screw size (M6)
FR-F740-00770 to 01160-EC
R1/L11 S1/L21
Screw size(M4)
Charge lamp
Jumper
Screw size
(00770: M6
00930/01160: M8)
R/L1 S/L2 T/L3
N/- P1 P/+
U V W
Jumper
IM
Power
supply
Screw size
(00770: M6
00930/01160: M8)
Motor
FR-F740-01800 to 02600-EC
R1/L11 S1/L21
Screw size (M4)
Charge lamp
Jumper
Screw size
(01800: M8, 02160/02600: M10)
Screw size (M10)
Screw size
(01800: M8, 02160/02600: M10)
R/L1 S/L2 T/L3
N/- P1 P/+
U V W
P1 P/+
IM
Power
supply
Motor
DC reactor
Screw size
(01800: M8,
02160/02600: M10)

FR-F740-03250 to 04810-EC	FR-F740-05470 to 12120-EC
	

CAUTION

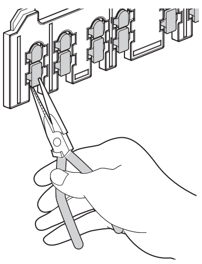
- The power supply cables must be connected to R/L1, S/L2, T/L3. Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter. (Phase sequence needs not to be matched.)
- Connect the motor to U, V, W. At this time, turning on the forward rotation switch (signal) rotates the motor in the counterclockwise direction when viewed from the motor shaft.
- When wiring the inverter main circuit conductor of the 05470 or more, tighten a nut from the right side of the conductor. When wiring two wires, place wires on both sides of the conductor. (Refer to the drawing below.) For wiring, use bolts (nuts) provided with the inverter.

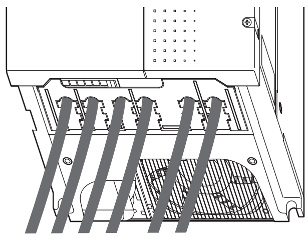


- Handling of the wiring cover
  (FR-F740-00470, 00620-EC)
  For the hook of the wiring cover, cut off the necessary parts using a pair of long-nose pliers etc.

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.

400V class (when input power supply is 440V based on the rated current for 110% overload for 1 minute)

Applicable Inverter Type	Terminal Screw Size *4	Tightening Torque N·m	Crimping (Compression) Terminal		Cable Sizes							
					HIV, etc. (mm2) *1			AWG/MCM *2		PVC, etc. (mm2) *3		
			R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	cable	R/L1, S/L2, T/L3	U, V, W	R/L1, S/L2, T/L3	U, V, W	cable
FR-F740-00023 to 00083-EC	M4	1.5	2-4	2-4	2	2	2	14	14	2.5	2.5	2.5
FR-F740-00126-EC	M4	1.5	2-4	2-4	2	2	3.5	12	14	2.5	2.5	4
FR-F740-00170-EC	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	12	12	4	4	4
FR-F740-00250-EC	M4	1.5	5.5-4	5.5-4	5.5	5.5	8	10	10	6	6	10
FR-F740-00310-EC	M5	2.5	8-5	8-5	8	8	8	8	8	10	10	10
FR-F740-00380-EC	M5	2.5	14-5	8-5	14	8	14	6	8	16	10	16
FR-F740-00470-EC	M6	4.4	14-6	14-6	14	14	14	6	6	16	16	16
FR-F740-00620-EC	M6	4.4	22-6	22-6	22	22	14	4	4	25	25	16
FR-F740-00770-EC	M6	4.4	22-6	22-6	22	22	14	4	4	25	25	16
FR-F740-00930-EC	M8	7.8	38-8	38-8	38	38	22	1	2	50	50	25
FR-F740-01160-EC	M8	7.8	60-8	60-8	60	60	22	1/0	1/0	50	50	25
FR-F740-01800-EC	M8	7.8	60-8	60-8	60	60	38	1/0	1/0	50	50	25
FR-F740-02160-EC	M10	14.7	100-10	100-10	80	80	38	3/0	3/0	70	70	35
FR-F740-02600-EC	M10	14.7	100-10	150-10	100	125	38	4/0	4/0	95	95	50
FR-F740-03250-EC	M10	14.7	150-10	150-10	125	125	38	250	250	120	120	70
FR-F740-03610-EC	M10	14.7	150-10	150-10	150	150	38	300	300	150	150	95
FR-F740-04320-EC	M12-M10	24.5	100-12	100-12	2×100	2×100	38	2×4/0	2×4/0	2×95	2×95	95
FR-F740-04810-EC	M12-M10	24.5	100-12	100-12	2×100	2×100	38	2×4/0	2×4/0	2×95	2×95	95
FR-F740-05470-EC	M12-M10	24.5	150-12	150-12	2×125	2×125	38	2×250	2×250	2×120	2×120	120
FR-F740-06100-EC	M12-M10	24.5	150-12	150-12	2×150	2×150	38	2×300	2×300	2×150	2×150	150
FR-F740-06830-EC	M12-M10	24.5	200-12	200-12	2×200	2×200	60	2×350	2×350	2×185	2×185	2×95
FR-F740-07700-EC	M12-M10	24.5	C2-200	C2-200	2×200	2×200	60	2×400	2×400	2×185	2×185	2×95
FR-F740-08660-EC	M12-M10	24.5	C2-250	C2-250	2×250	2×250	60	2×500	2×500	2×240	2×240	2×120
FR-F740-09620-EC	M12-M10	24.5	C2-250	C2-250	2×250	2×250	100	2×500	2×500	2×240	2×240	2×120
FR-F740-10940-EC	M12-M10	24.5	C2-200	C2-200	3×200	3×200	100	3×350	3×350	3×185	3×185	2×150
FR-F740-12120-EC	M12-M10	24.5	C2-200	C2-200	3×200	3×200	100	3×400	3×400	3×185	3×185	2×150

*1 For the 01160 or less, the recommended cable size is that of the cable (e.g. HIV cable (600V class 2 vinyl-insulated cable)) 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 01800 or more, the recommended cable size is that of the cable (e.g. LMFC (heat resistant flexible cross-linked polyethylene insulated cable)) 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 For the 00930 or less, the recommended cable size is that of the cable (THHW cable) with continuous maximum permissible temperature of 75°C. Assumes that the ambient temperature is 40°C or less and the wiring distance is 20m or less.
For the 01160 or more, the recommended cable size is that of the cable (THHN cable) with continuous maximum permissible temperature of 90°C. Assumes that the ambient temperature is 40°C or less and wiring is performed in an enclosure.
(Selection example for use mainly in the United States.)

*3 For the 00930 or less, the recommended cable size is that of the cable (PVC cable) with continuous maximum permissible temperature of 70°C. Assumes that the ambient temperature is 40°C or less and the wiring distance is 20m or less.
For the 01160 or more, the recommended cable size is that of the cable (XLPE cable) with continuous maximum permissible temperature of 90°C. Assumes that the ambient temperature is 40°C or less and wiring is performed in an enclosure.
(Selection example for use mainly in the Europe.)

*4 The terminal screw size indicates the terminal size for R/L1, S/L2, T/L3, U, V, W, and a screw for earthing.
For the 04320 or more, screw sizes are different. (<R/L1, S/L2, T/L3, U, V, W> - <a screw for earthing>)

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

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

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

- Always earth the motor and inverter.

  1)Purpose of earthing

  Generally, an electrical apparatus has an earth 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 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 is important to audio equipment, sensors, computers and other apparatuses that handle low-level signals or operate very fast.

  2)Earthing methods and earthing work

  As described previously, earthing 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:

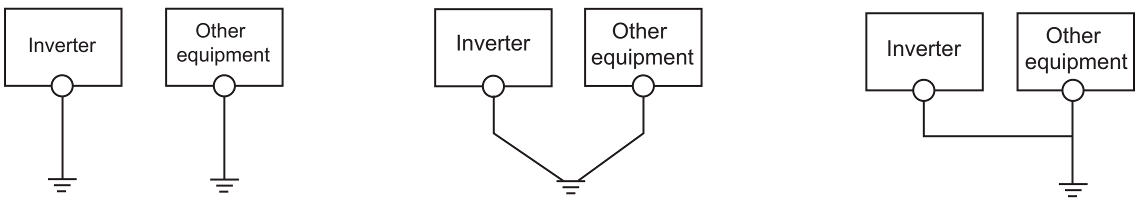
  (a) Where possible, use independent earthing for the inverter. If independent earthing (I) is impossible, use joint earthing (II) where the inverter is connected with the other equipment at an earthing point. Joint earthing as in (III) must be avoided as the inverter is connected with the other equipment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

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

  (c) Use the thickest possible earth cable. The earth 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 cable as far away as possible from the I/O wiring of equipment sensitive to noises and run them in parallel in the minimum distance.



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

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

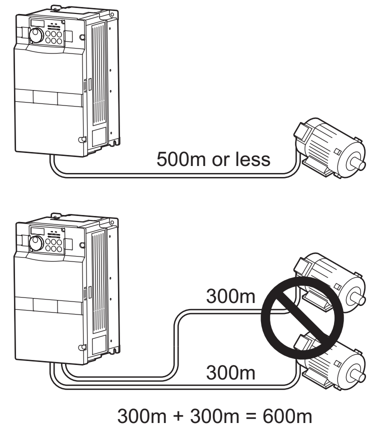
(3) Total wiring length

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

Pr. 72 PWM frequency selection Setting (carrier frequency) *	00023	00038	00052 or More
2 (2kH) or less	300m	500m	500m
3 (3kHz), 4 (4kHz)	200m	300m	500m
5 (5kHz) to 9 (9kHz)	100m		
10 (10kHz) or more	50m		

* For the 01800 or more, the setting range of *Pr. 72 PWM frequency selection* is "0 to 6".

Total wiring length (00038 or more)



When driving a 400V class motor by the inverter, surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
Refer to *page 44* for measures against deteriorated insulation.

CAUTION

- Especially for long-distance wiring, the inverter may be affected by a charging current caused by the stray capacitances of the wiring, leading to a malfunction of the overcurrent protective function or fast response current limit function or a malfunction or fault of the equipment connected on the inverter output side. If fast-response current limit function malfunctions, disable this function. (For *Pr.156 Stall prevention operation selection, refer to page 66* .)
- For details of *Pr. 72 PWM frequency selection , refer to page 136*. (When using an optional sine wave filter (MT-BSL/BSC) for the 01800 or more, set “25” in *Pr.72* (2.5kHz)).·

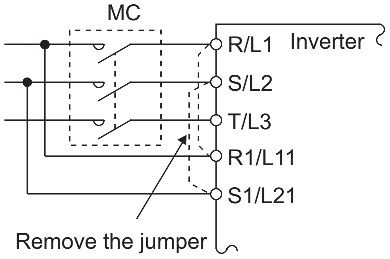
(4) Cable size of the control circuit power supply (terminal R1/L11, S1/L21)

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

2
WIRING

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

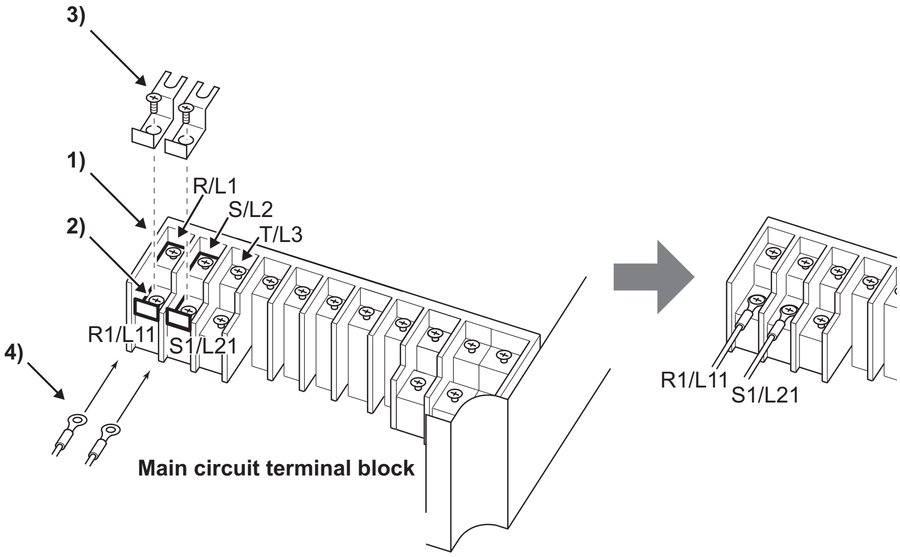
<Connection diagram>



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.

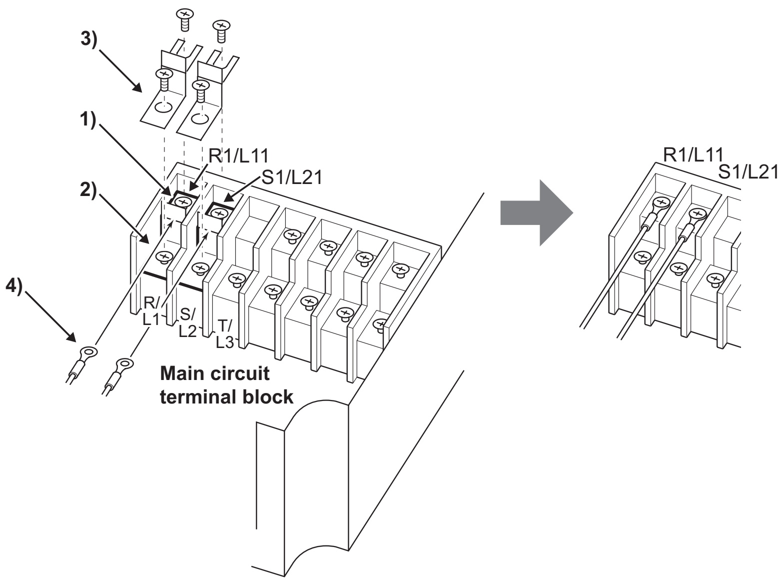
• FR-F740-00023 to 00126

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).



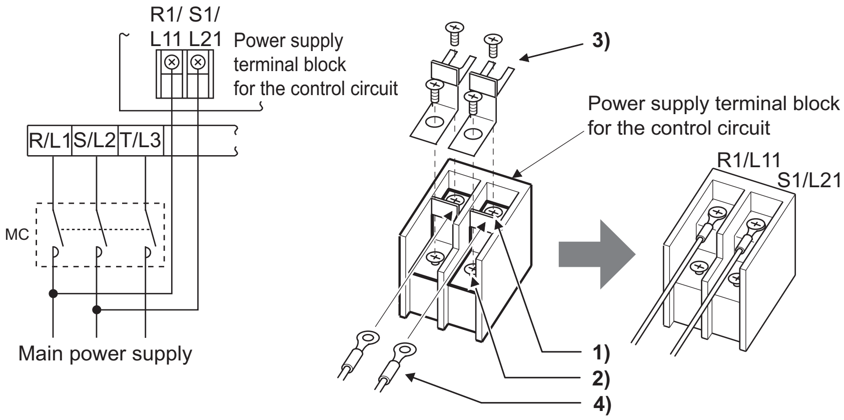
• FR-F740-00170, 00250

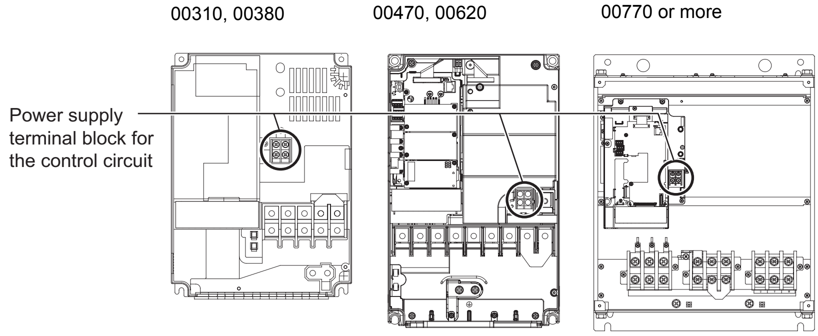
1) Remove the upper screws.
2) Remove the lower screws.
3) Remove the jumper.
4) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).



• FR-F740-00310 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 should be 60VA or more for 00380 or less, 80VA or more for 00470 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.

2.3 Control circuit specifications

2.3.1 Control circuit terminals

[ ] indicates that terminal functions can be selected using *Pr. 178 to Pr. 196 (I/O terminal function selection) (Refer to page 96.)*

(1) Input signals

Type	Terminal Symbol	Terminal Name	Description		Rated Specifications	Refer to
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	96
	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.			96
	RH, RM, RL	Multi-speed selection	Multi-speed can be selected according to the combination of RH, RM and RL signals.			96
	JOG	Jog mode selection	Turn on the JOG signal to select Jog operation (initial setting) and turn on the start signal (STF or STR) to start Jog operation.			96
	RT	Second function selection	Turn on the RT signal to select second function. When the second function such as "second torque boost" and "second V/F (base frequency)" are set, turning on the RT signal selects these functions.			96
	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.			96
	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.			96
	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 0 and 20mADC.) Turning the AU signal on makes terminal 2 (voltage input) invalid.			137
		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.			90
	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 120)*			96
	SD	External transistor common, contact input common (sink)	Common terminal for contact input terminal (sink logic). Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE.		———	—
	PC	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	25

Type	Terminal Symbol	Terminal Name	Description	Rated Specifications	Refer to
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. *(Refer to Pr. 73 Analog input selection in page 140.)*	10VDC±0.4V Permissible load current 10mA	137
	10			5.2VDC±0.2V Permissible load current 10mA	137
	2	Frequency setting (voltage)	Inputting 0 to 5VDC (or 0 to 10V, 0 to 20mA) provides the maximum output frequency at 5V (10V, 20mA) and makes input and output proportional. Use *Pr. 73* to switch from among input 0 to 5VDC (initial setting), 0 to 10VDC, and 0 to 20mA. 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	137
	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 to 10V).*1		137
	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).	Input resistance 10kΩ ± 1kΩ Maximum permissible voltage ± 20VDC	137
	5	Frequency setting common	Common terminal for frequency setting signal (terminal 2, 1 or 4) and analog output terminal AM and CA. Do not earth.	——	137

*1 Set *Pr.73, Pr.267*, and a voltage/current input switch correctly, then input analog signals in accordance with the settings. Application of voltage with switch is on (current input specification) or current with switch is off (voltage input specification) could lead to damage to the inverter or analog circuit of external devices. *(For details, refer to page 137.)*

(2) Output signals

Type	Terminal Symbol	Terminal Name	Description		Rated Specifications	Refer to
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	102
	A2, B2, C2	Relay output 2	1 changeover contact output			102
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.*2		Permissible load 24VDC 0.1A (A voltage drop is 3.4V maximum when the signal is on.)	102
	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		102
	OL	Overload warning	Switched low when stall prevention is activated by the stall prevention function. Switched high when stall prevention is cancelled. *2			102
	IPF	Instantaneous power failure	Switched low when an instantaneous power failure and under voltage protections are activated. *2			102
	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			102
	SE	Open collector output common	Common terminal for terminals RUN, SU, OL, IPF, FU		——	—

Type	Terminal Symbol	Terminal Name	Description		Rated Specifications	Refer to
Analog	CA	Analog current output	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)	Load impedance 200Ω to 450Ω Output signal 0 to 20mADC	116
Analog	AM	Analog voltage output			Output signal 0 to 10VDC Permissible load current 1mA (load impedance 10kΩ or more) Resolution 8 bit	116

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

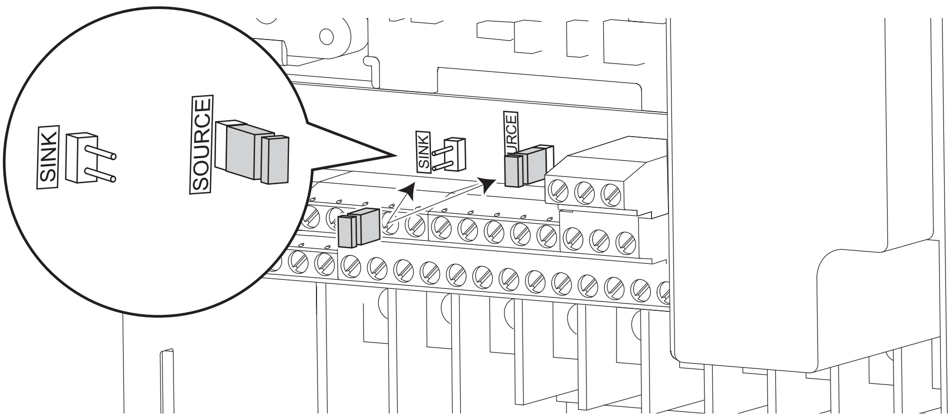
*3 Not output during inverter reset.

(3) Communication

Type	Terminal Symbol		Terminal Name	Description	Refer to
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 . Communication speed : 4800 to 38400bps . Overall length : 500m	169
RS-485	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	171
RS-485	RS-485 terminals	TXD-	Inverter transmission terminal		
RS-485	RS-485 terminals	RXD+	Inverter reception terminal		
RS-485	RS-485 terminals	RXD-	Inverter reception terminal		
RS-485	RS-485 terminals	SG	Earth		

2.3.2 Changing the control logic

The input signals are set to source logic (SOURCE) when shipped from the factory.
To change the control logic, the jumper connector on 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.)



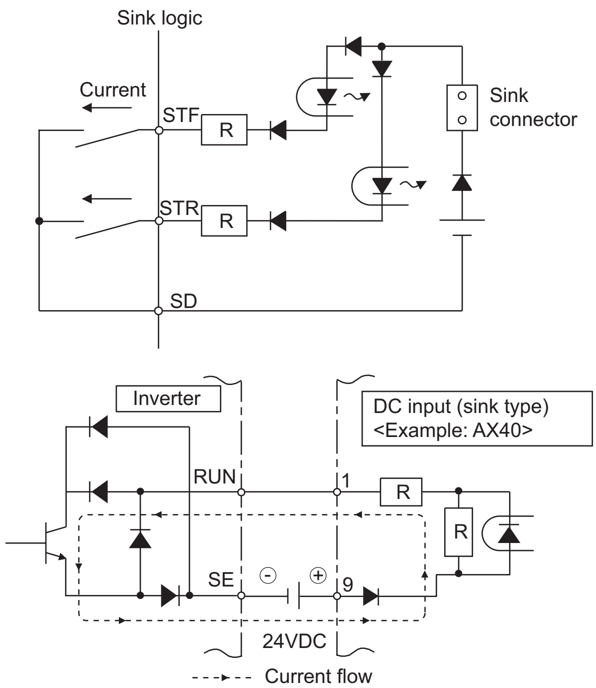
CAUTION

Turn off the inverter power before switching a jumper connector.

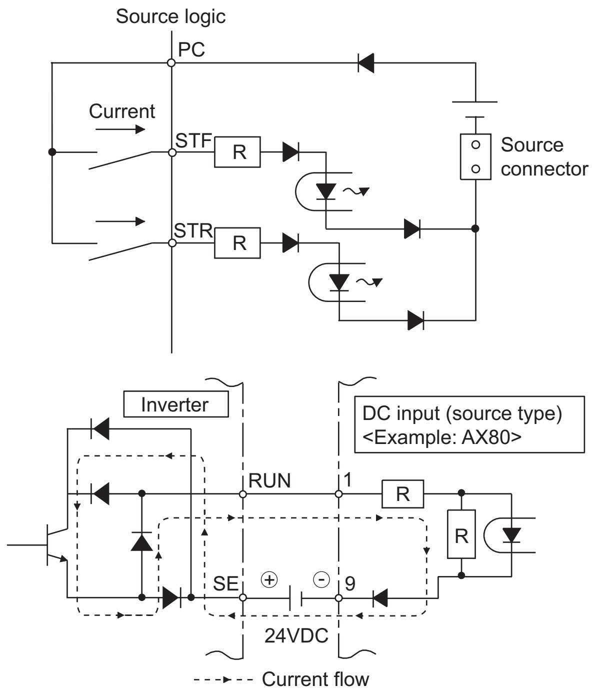
Sink logic and source logic

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

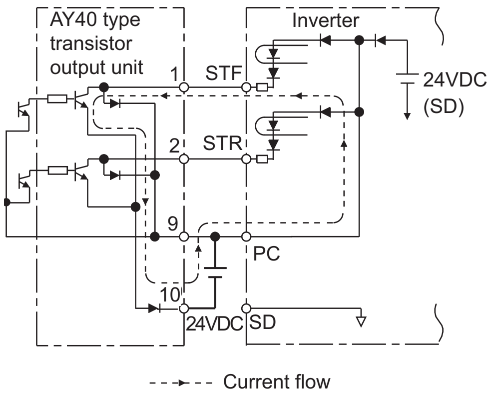
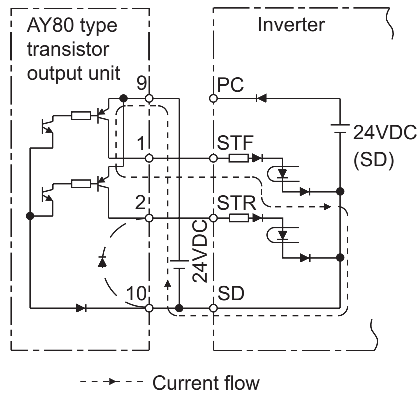
●Current flow concerning the input/output signal when sink logic is selected



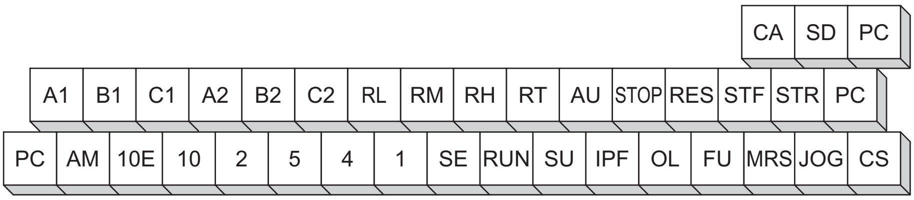
●Current flow concerning the input/output signal when source logic is selected



- When using an external power supply for transistor output

· Sink logic type 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.) 	· 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. 

2.3.3 Control circuit terminal layout



(1) Wiring method

Loosen the terminal screw and insert the cable into the terminal.

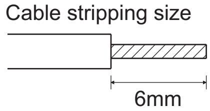
☞Screw Size: M3 ☞Tightening Torque: 0.5N·m to 0.6N·m

☞Cable size: $0.3mm^2$ to $0.75mm^2$

☞Screwdriver:Small ⊖ flat-blade screwdriver (Edge thickness: 0.4mm/ Edge width: 2.5mm)

CAUTION

Undertightening can cause cable disconnection or malfunction.
Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.



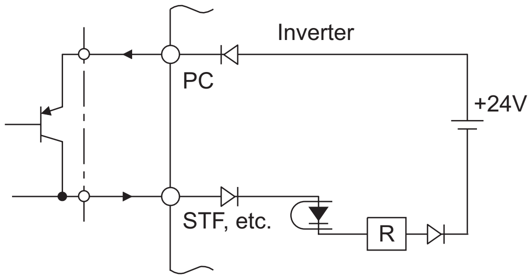
Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it.

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

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

(3) Signal inputs by contactless switches

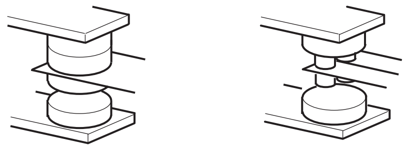
The contacted input terminals of the inverter (STF, STR, STOP, RH, RM, RL, JOG, RT, MRS, RES, AU, CS) can be controlled using a transistor instead of a contacted switch as shown on the right.



External signal input using transistor

2.3.4 Wiring instructions

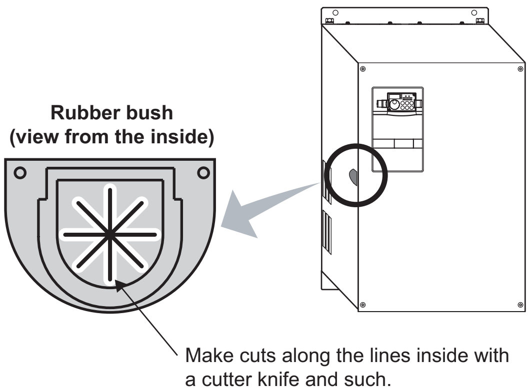
1) Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).
2) Use two or more parallel micro-signal contacts or twin contacts to prevent a contact faults when using contact inputs since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



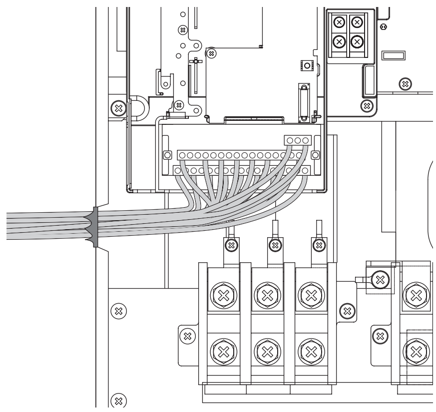
3) Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
4) Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp, etc.
5) It is recommended to use the cables of 0.75mm^2 gauge for connection to the control circuit terminals.
   If the 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.
6) The wiring length should be 30m maximum.

● Wiring of the control circuit of the 01800 or more

For wiring of the control circuit of the 01800 or more, separate away from wiring of the main circuit.
Make cuts in rubber bush of the inverter side and lead wires.

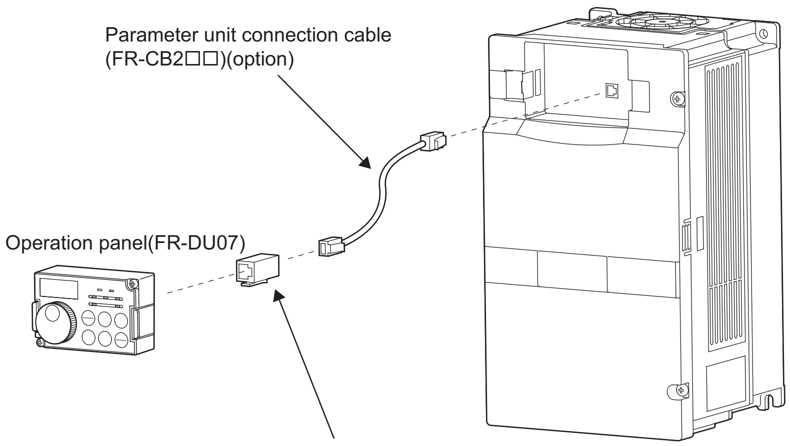


<Wiring>



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)

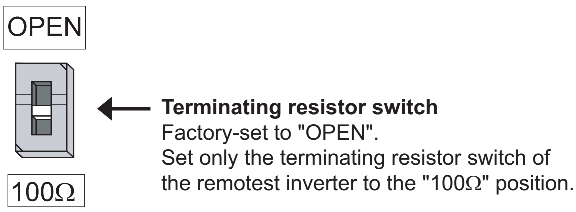
	Product	Type	Maker
1)	10BASE-T cable	SGLPEV-T 0.5mm × 4P *	Mitsubishi Cable Industries, Ltd.
2)	RJ-45 connector	5-554720-3	Tyco Electronics Corporation

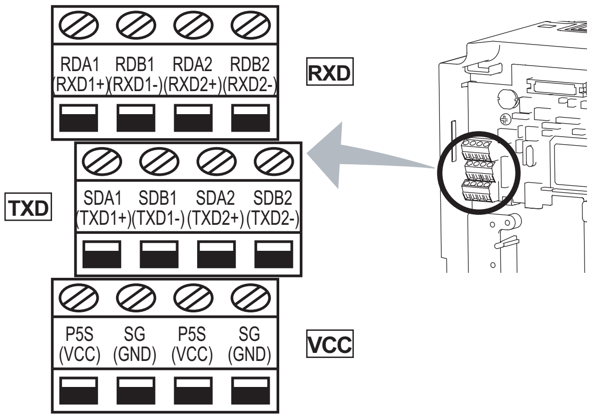
* Do not use pins No. 2, 8 of the 10BASE-T cable.

☞Refer to *page 174* 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 *page 169*.

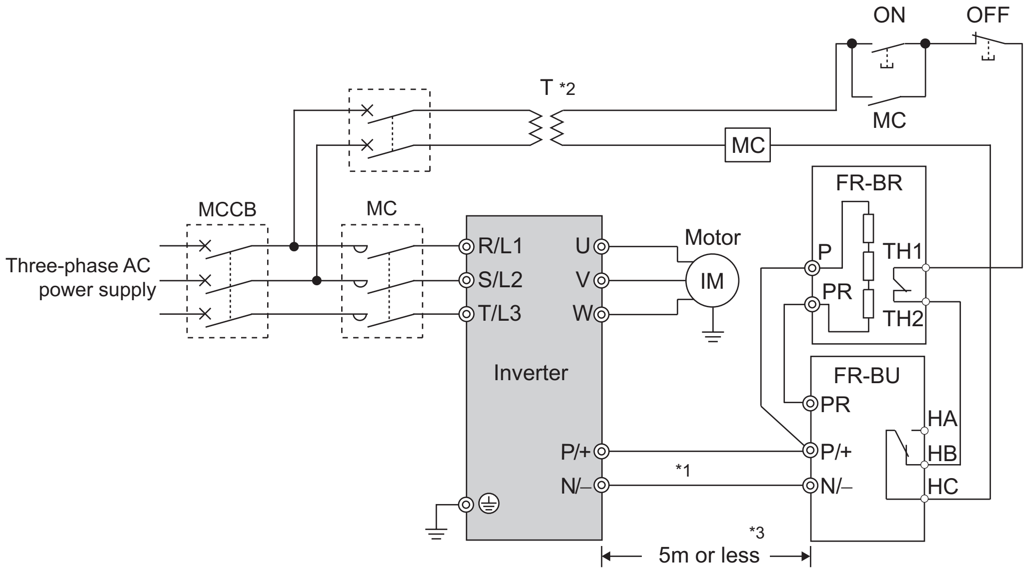
2.4 Connection of stand-alone option units

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)

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 (01160 or less)



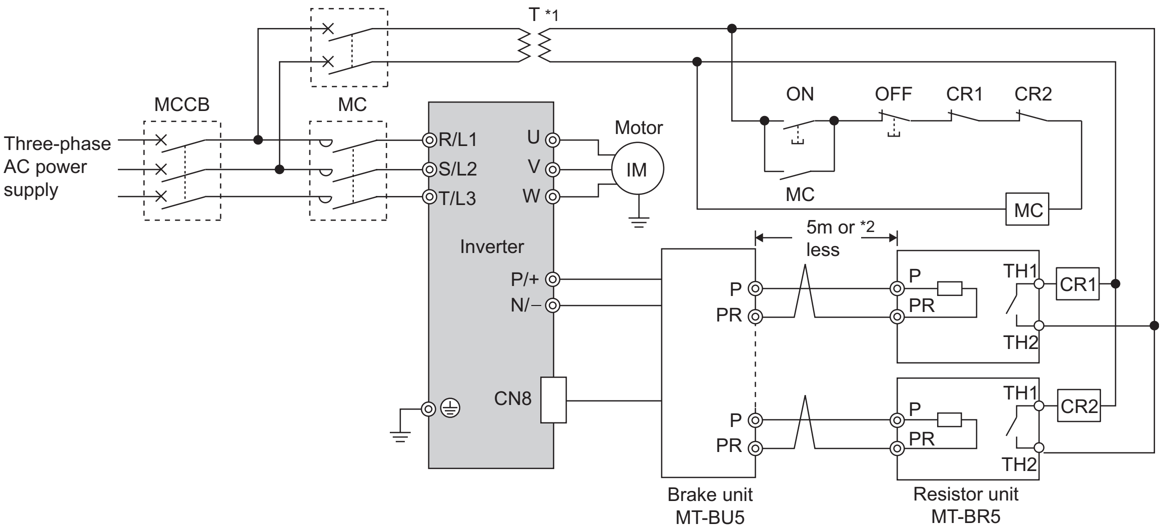
*1 Connect the inverter terminals (P/+, N/-) and brake unit (FR-BU (H)) terminals so that their terminal signals match with each other. (Incorrect connection will damage the inverter.)
*2 When the power supply is 400V class, install a step-down transformer.
*3 The wiring distance between the inverter, 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

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

(2) Connection with the MT-BU5 (01800 or more)

After making sure that the wiring is correct, set "1" in *Pr.30 Regenerative function selection*. (*Refer to page 94*)



*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.

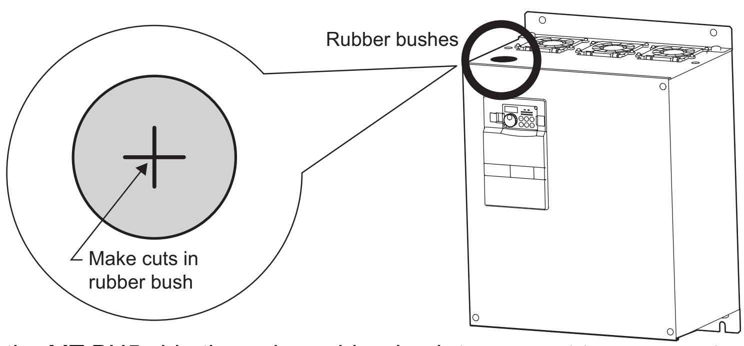
CAUTION

- 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).

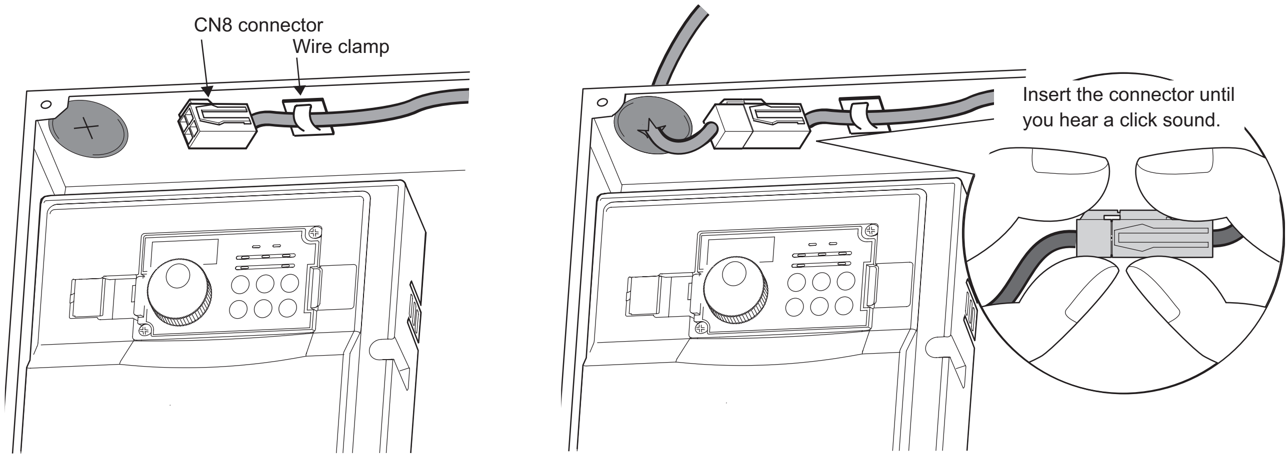
<Inserting the CN8 connector>

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.

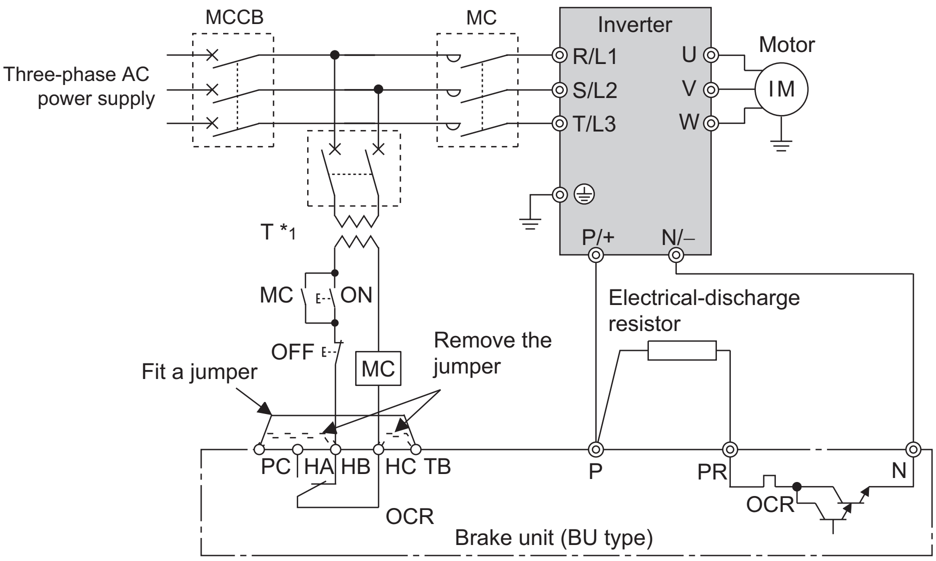


CAUTION

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

2.4.2 Connection of the brake unit (BU type)

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



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

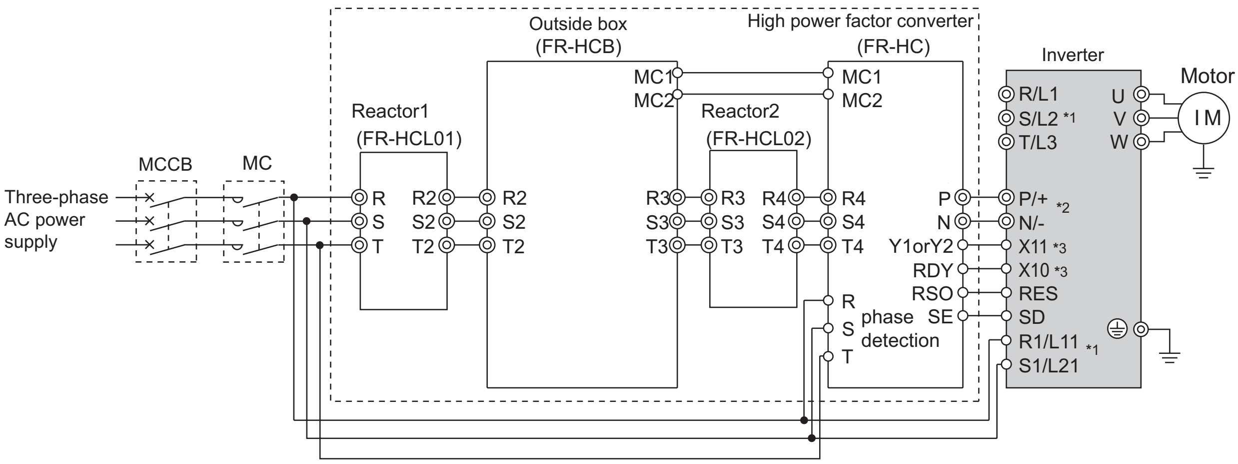
CAUTION

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

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

When connecting the high power factor converter (FR-HC) to suppress power harmonics, perform wiring securely as shown below.
Incorrect connection will damage the high power factor converter and inverter.
After making sure that the wiring is correct, set "2" in *Pr. 30 Regenerative function selection*. (*Refer to page 94.*)

(1) Connection with the FR-HC (01160 or less)

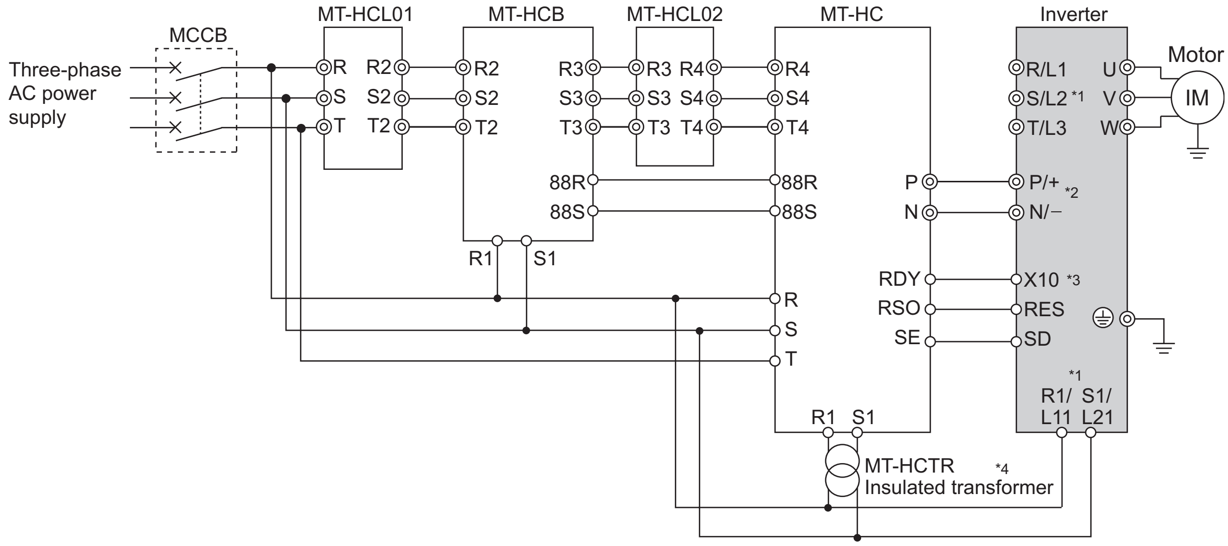


*1 Remove the jumpers across the inverter terminals R/L1-R1/L11, S/L2-S1/L21, and connect the control circuit power supply to the R1/L11 and S1/L21 terminals. Always keep the power input terminals R/L1, S/L2, T/L3 open. Incorrect connection will damage the inverter. (E.OPT (option alarm) will occur. (*Refer to page 252.*))
*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 96.*)
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 94.*)

CAUTION

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

(2) Connection with the MT-HC (01800 or more)



*1 Remove the jumper across terminals R-R1, S-S1 of the inverter, and connect the control circuit power supply to the R1 and S1 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 252.*)

*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 96.*) 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 94.)*

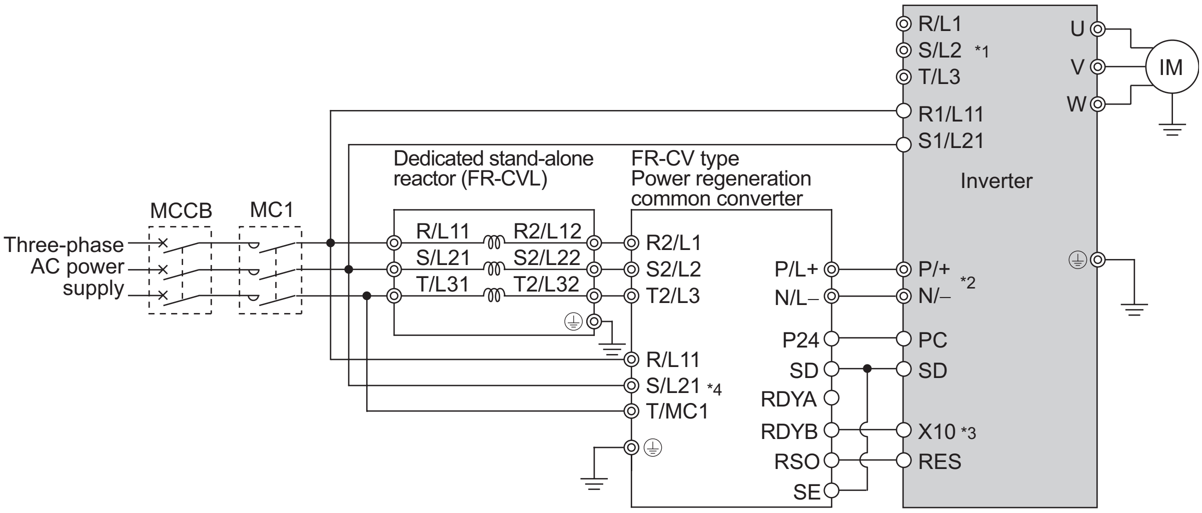
*4 Connect the power supply to terminals R1 and S1 of the MT-HC via an insulated transformer.

CAUTION

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

2.4.4 Connection of the power regeneration common converter (FR-CV)(01160 or less)

When connecting the power regeneration common converter (FR-CV), make connection so that the inverter terminals (P/+, N/-) and the terminal symbols of the power regeneration common converter (FR-CV) are the same.
After making sure that the wiring is correct, set "2" in *Pr. 30 Regenerative function selection*. (*Refer to page 94.)*



*1 Remove the jumpers across terminals R/L1-R1/L11 and S/L2-S1/L21 of the inverter, and connect the control circuit power supply across terminals R1/L11-S1/L21. Always keep the power input terminals R/L1, S/L2, T/L3 open. Incorrect connection will damage the inverter. (E.OPT (option alarm) will occur. *(Refer to page 252.)*)

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

*3 Assign the terminal for X10 signal using any of *Pr. 178 to Pr. 189 (input terminal function selection)*. *(Refer to page 96)*

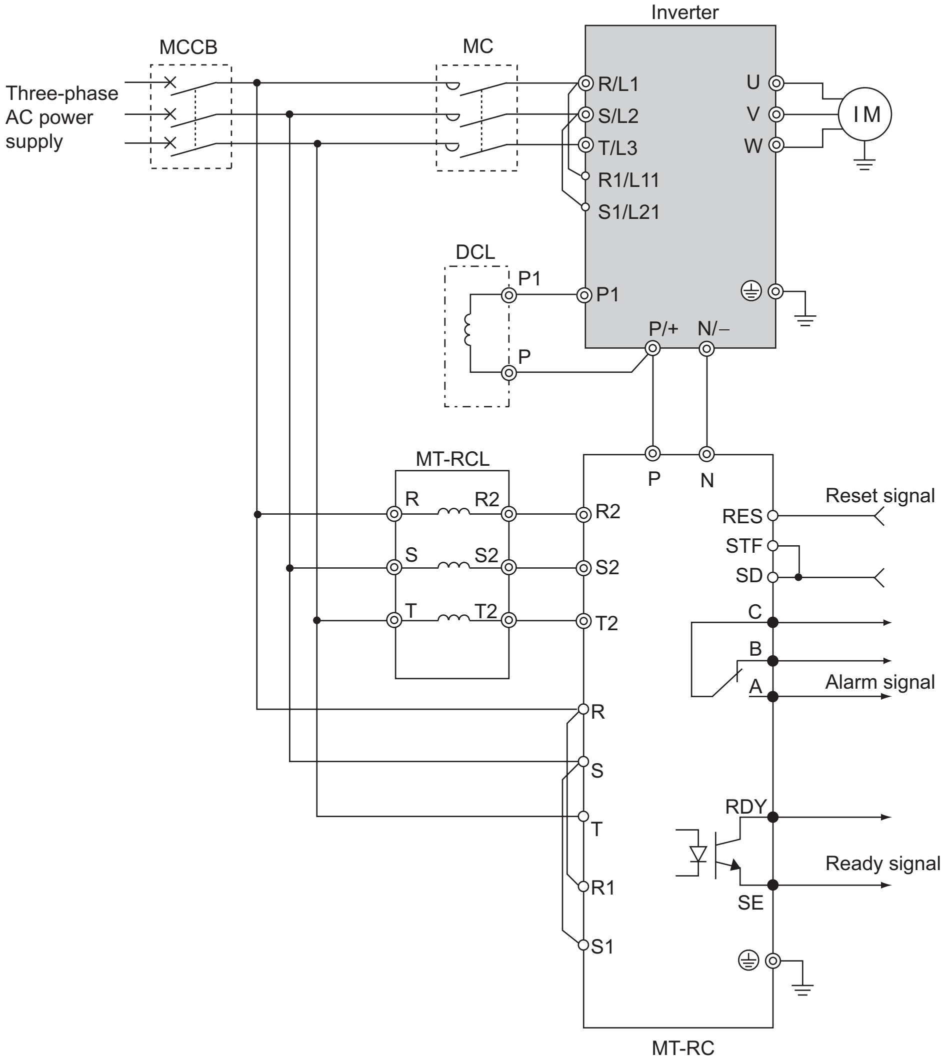
*4 Be sure to connect the power supply and terminals R/L11, S/L21, T/MC1. Operating the inverter without connecting them will damage the power regeneration common converter.

CAUTION

- The voltage phases of terminals R/L11, S/L21, T/MC1 and terminals R2/L1, S2/L2, T2/L3 must be matched.
- Use sink logic when the FR-CV is connected. The FR-CV cannot be connected when source logic (initial setting) is selected.
- Do not remove a jumper across terminal P/+ and P1 except when connecting a DC reactor.

2.4.5 Connection of power regeneration converter (MT-RC) (01800 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*.

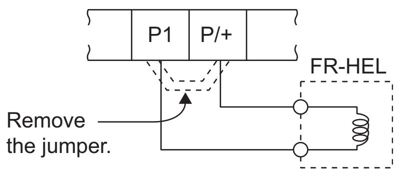


CAUTION

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

2.4.6 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 01160 or less, the jumper connected across terminals P1-P/+ must be removed. Otherwise, the reactor will not exhibit its performance.
For the 01800 or more, a DC reactor is supplied. Always install the reactor.



CAUTION

· The wiring distance should be within 5m.
· The size of the cables used should be equal to or larger than that of the power supply cables (R/L1, S/L2, T/L3). *(Refer to page 17)*

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 leakage currents

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

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

● To-earth leakage currents
- Take caution as long wiring will increase the leakage current. Decreasing the carrier frequency of the inverter reduces the leakage current.
- Increasig the motor capacity increases the leakage current.

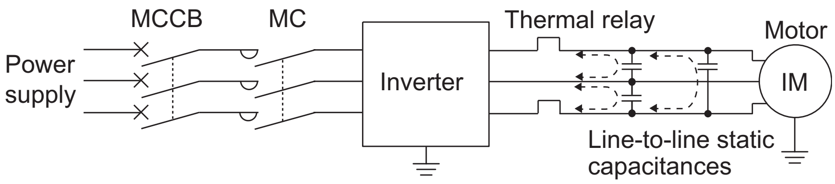
(2) Line-to-line leakage currents

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 (00170 or less), the external thermal relay is likely to operate unnecessarily because the ratio of the leakage current to the rated motor current increases.

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

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

- Dedicated motor SF-JR 4P
- Carrier frequency: 14.5kHz
- Used wire: 2mm^2, 4cores Cabtyre cable



Line-to-line leakage currents path

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

●Installation and selection of moulded case circuit breaker

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

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

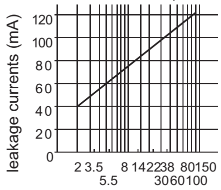
When using the earth leakage circuit breaker with the inverter circuit, select its rated sensitivity current as follows, independently of the PWM carrier frequency:

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

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

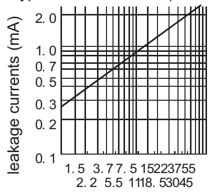
Example of leakage current per 1km during the commercial power supply operation when the CV cable is routed in metal conduit

(Three-phase three-wire delta connection 400V60Hz)



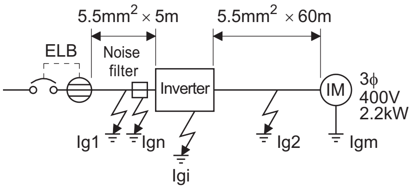
Leakage current example of three-phase induction motorduring the commercial power supply operation

(Totally-enclosed fan-cooled type motor 400V60Hz)



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

Example

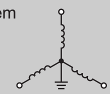


	Breaker Designed for Harmonic and Surge Suppression	Standard Breaker
Leakage current Ig1 (mA)	$\frac{1}{3} \times 66 \times \frac{5m}{1000m} = 0.11$	
Leakage current Ign (mA)	0 (without noise filter)	
Leakage current Igi (mA)	1 (without EMC filter) Refer to the following table for the leakage current of the inverter*	
Leakage current Ig2 (mA)	$\frac{1}{3} \times 66 \times \frac{60m}{1000m} = 1.32$	
Motor leakage current Igm (mA)	0.36	
Total leakage current (mA)	2.79	6.15
Rated sensitivity current (mA)	30	100

* *Refer to page 13* for the presence/absence of the EMC filter.

●Inverter leakage current (with and without EMC filter)

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

	Voltage (V)	EMC Filter	
		ON (mA)	OFF (mA)
Phase earthing 	400	30	1
Earthed-neutral system 	400	1	1

CAUTION

- Install the earth leakage breaker (ELB) on the input side of the inverter.
- In the ⅄ connection earthed-neutral system, the sensitivity current is purified against an earth fault in the inverter output side. Earthing must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)
- When the breaker is installed on the output side of the inverter, it may be unnecessarily operated by harmonics even if the effective value is less than the rating.In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.
- 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

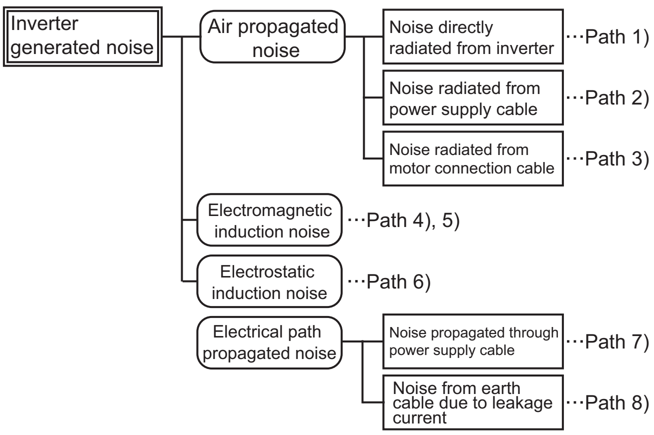
3.1.2 Inverter-generated noises and their reduction techniques

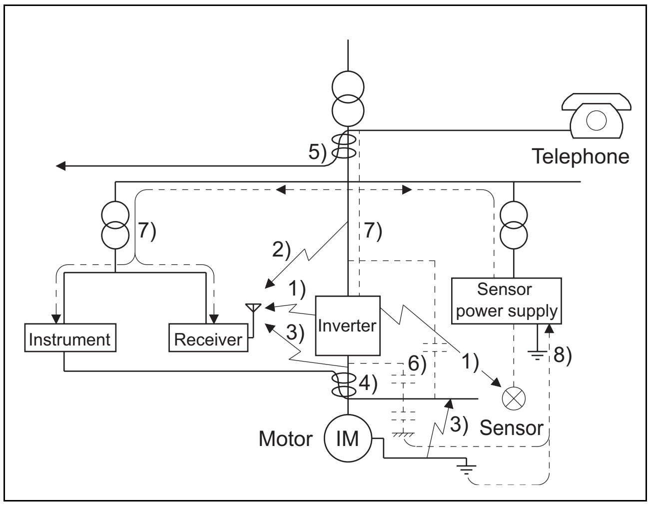
Some noises enter the inverter to malfunction it and others are radiated by the inverter to malfunction peripheral devices. Though the inverter is designed to be insusceptible to noises, it handles low-level signals, so it requires the following basic techniques. Also, since the inverter chops outputs 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 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 to signal cables.
- Earth 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.



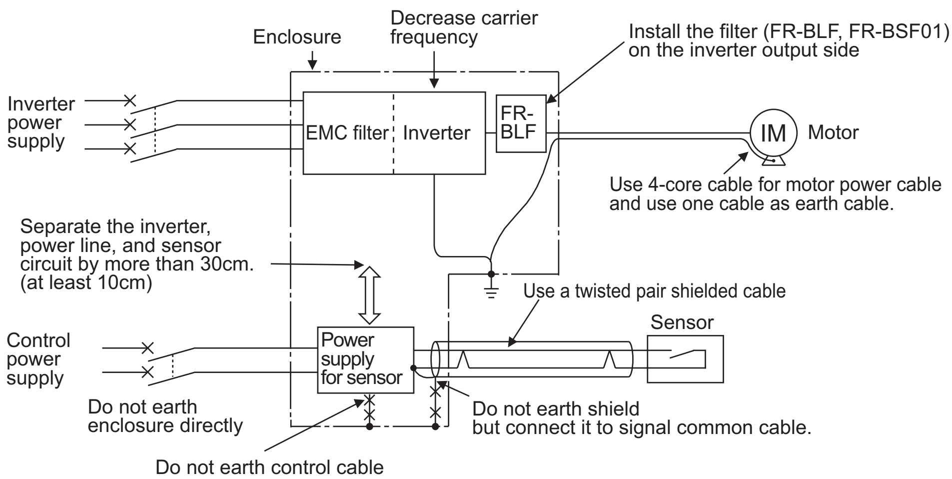


Noise Propagation Path	Measures
1) 2) 3)	When devices that handle low-level signals and are liable to malfunction due to noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or when their signal cables are run near the inverter, the devices may be 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 13)* (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 13)* (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 cable of the inverter to malfunction the device. In such a case, disconnection of the earth 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



3.1.3 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.

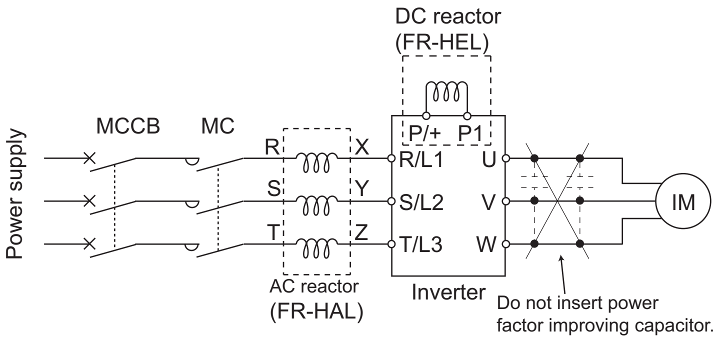
●The differences between harmonics and noises are indicated below:

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.

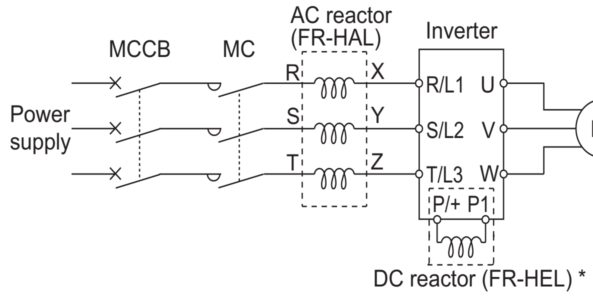


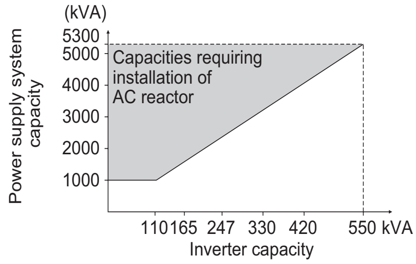
CAUTION

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.

3.2 Installation of a reactor

When the inverter is connected near a large-capacity power transformer (1000kVA or more) or when a power capacitor is to be switched over, an excessive peak current may flow in the power input circuit, damaging the converter circuit. To prevent this, always install the AC reactor (FR-HAL)





* When connecting the FR-HEL to the 01160 or less, remove the jumper across terminals P/+ - P1. For the 01800 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 17)*

3.3 Power-off and magnetic contactor (MC)

(1) Inverter input side magnetic contactor (MC)

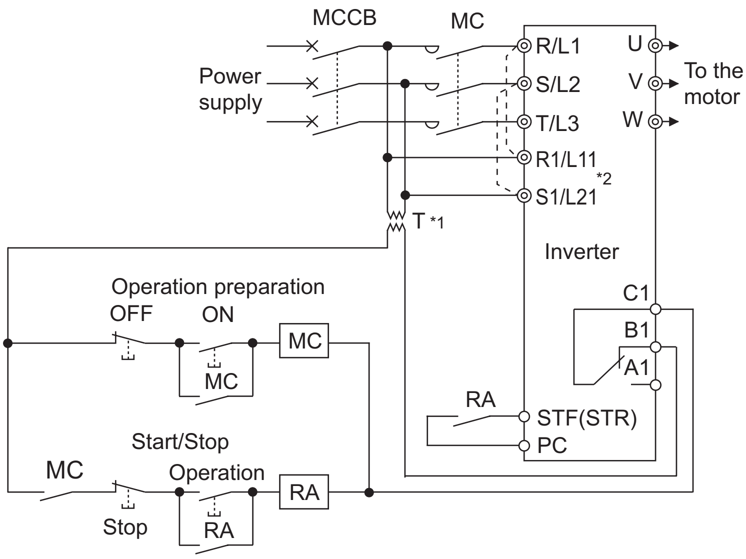
On the inverter input side, it is recommended to provide an MC for the following purposes.

(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) 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 current at powering on will shorten the life of the converter part (switching life is 100 million times), frequent on/off 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-PC) to make a start or stop. *(Refer to page 100)*

*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 20* for removal of the jumper.)

(2) Handling of the inverter output side magnetic contactor

Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned on while the inverter is operating, overcurrent protection of the inverter and such will activate. When an MC is provided to switch to a commercial power supply, for example, it is recommended to use electronic bypass function *Pr. 135 to Pr. 139 (Refer to page 206)*.

3.4 Inverter-driven 400V class motor

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

●Measures

It is recommended to take either of the following measures:

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

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

(2) Suppressing the surge voltage on the inverter side
Connect the surge voltage suppression filter (FR-ASF-H) to the 01160 or less and the sine wave filter (MT-BSL/BSC) to the 01800 or more on the inverter output side.

CAUTION

· For details of *Pr. 72 PWM frequency selection* , refer to *page 136*. (When using an optional sine wave filter (MT-BSL/BSC) for the 01800 or more, set “25“ in *Pr.72* (2.5kHz).)
For explanation of surge voltage suppression filter (FR-ASF-H) and sine wave filter (MT-BSL/BSC), refer to the manual of each option.

3.5 Precautions for use of the inverter

The FR-F700 series is a highly reliable product, but incorrect peripheral circuit making or operation/handling method may shorten the product life or damage the product.
Before starting operation, always recheck the following items.

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

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

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

(4) Use cables of the size to make a voltage drop 2% maximum.
If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.
Refer to *page 17* for the recommended 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 19.)*

(6) Electromagnetic wave interference
The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, set the EMC filter valid to minimize interference. *(Refer to page 13)*

(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.

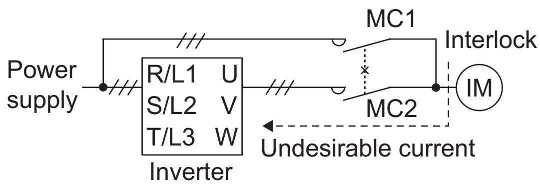
(8) Before starting wiring or other work after the inverter is operated, wait for at least 10 minutes after the power supply has been switched off, and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power off and it is dangerous.

(9) A short circuit or earth 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 fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter modules.
· Fully check the to-earth 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 12)*

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



(13) 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.

(14) Instructions for overload operation
When performing operation an of frequent start/stop of the inverter, increase/decrease in the temperature of the transistor element of the inverter may 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 bound current, starting current, etc. Decreasing current may increase the life. However, decreasing current will result in insufficient torque and the inverter may not start. Therefore, increase the inverter capacity to have enough allowance for current.

(15) 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.

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.

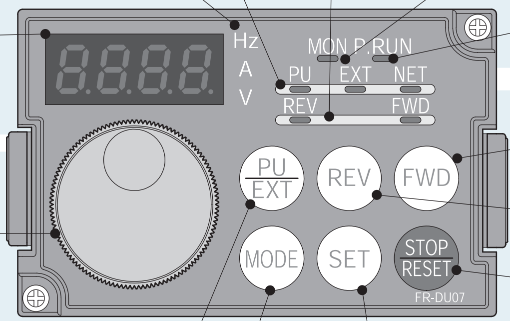
Rotation direction indication
FWD: Lit during forward rotation
REV: Lit during reverse rotation
On: Forward/reverse operation
Flickering: When the frequency command is not given even if the forward/reverse command is given.

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.

No function

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



FWD **Start command forward rotation**

REV **Start command reverse rotation**

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

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

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

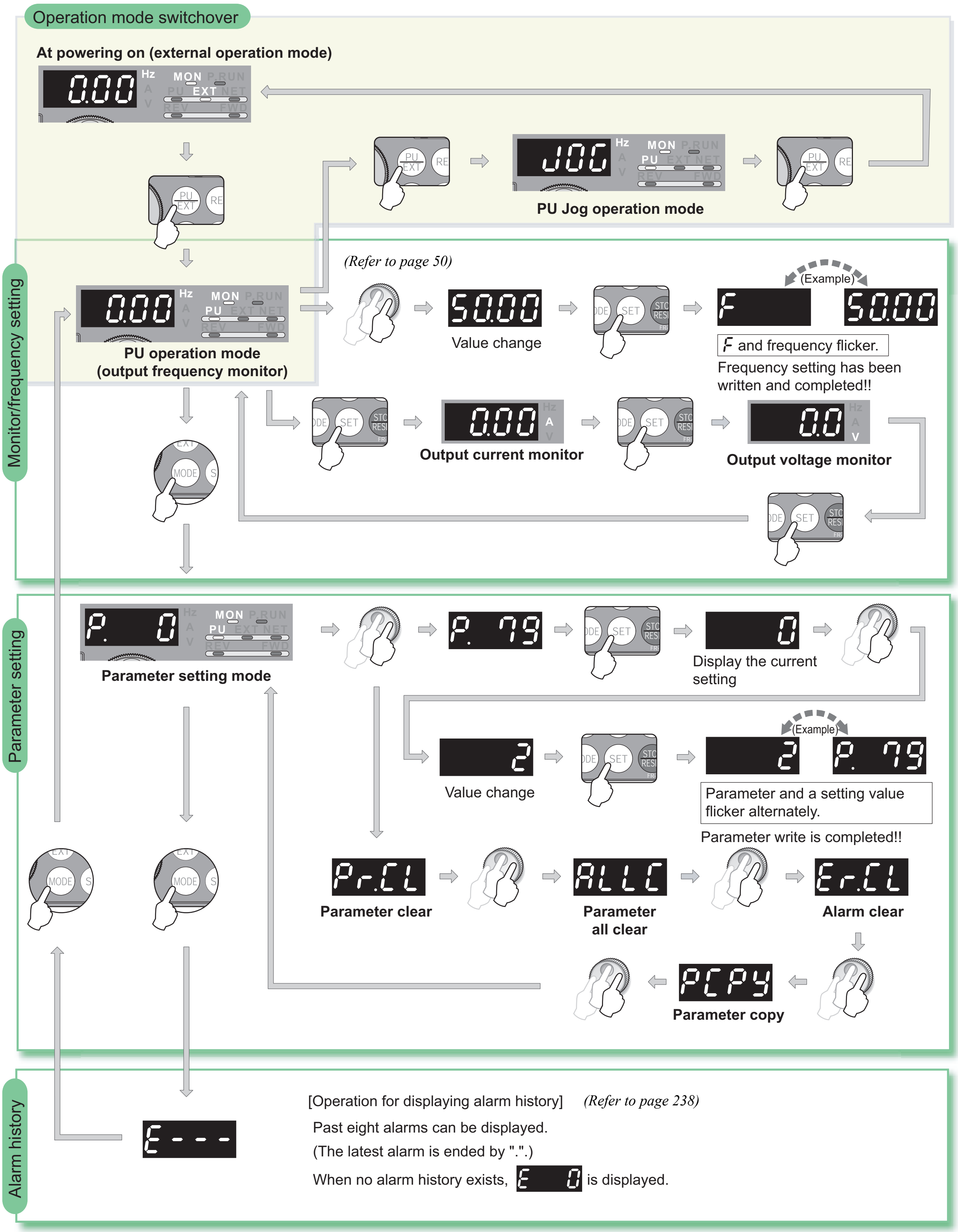
Running frequency → Output current → Output voltage *

* 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
PARAMETERS

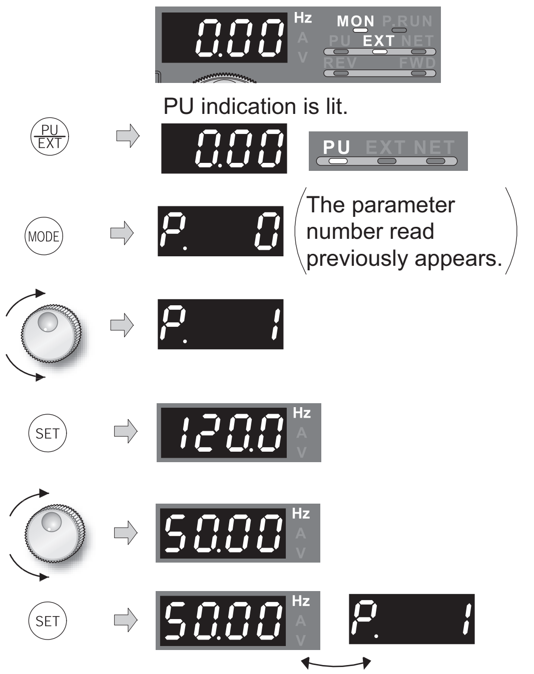
4.1.3 Change the parameter setting value

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

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. 1 (*Pr. 1*) appears.
5. Press SET to read the currently set value.
   "120.0"(initial value) appears.
6. Turn the setting dial to change it to the set value of "50.00".
7. Press SET to set.

Display



· By turning the setting 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 244*.

REMARKS

· The number of digits displayed on the operation panel (FR-DU07) is four. Only the upper four digits of values can be displayed and set. If the values to be displayed have five digits or more including decimal places, the fifth or later numerals can not be displayed nor set.

(Example) When *Pr.1*
When 60Hz is set, 60.00 is displayed.
When 120Hz is set, 120.0 is displayed. The second decimal places can not be displayed nor set.

4.1.4 Setting dial push

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

4.2 Parameter List

4.2.1 Parameter list

In the initial setting, only the simple mode parameters are displayed.
Set *Pr. 160 User group read selection* as required.

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

REMARKS

- The parameters marked ◎ are the simple mode parameters.
- The parameters marked with [shaded] 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 2 *(page 292)* for instruction codes for communication and availability of parameter clear, all clear, and parameter copy of each parameter.

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Basic functions	◎ 0	**Torque boost**	0 to 30%	0.1%	6/4/3/2/ 1.5/1%	63	
	◎ 1	**Maximum frequency**	0 to 120Hz	0.01Hz	120/60Hz	72	
	◎ 2	**Minimum frequency**	0 to 120Hz	0.01Hz	0Hz	72	
	◎ 3	**Base frequency**	0 to 400Hz	0.01Hz	50Hz	74	
	◎ 4	**Multi-speed setting (high speed)**	0 to 400Hz	0.01Hz	50Hz	78	
	◎ 5	**Multi-speed setting (middle speed)**	0 to 400Hz	0.01Hz	30Hz	78	
	◎ 6	**Multi-speed setting (low speed)**	0 to 400Hz	0.01Hz	10Hz	78	
	◎ 7	**Acceleration time**	0 to 3600/ 360s	0.1/0.01s	5s/15s	85	
	◎ 8	**Deceleration time**	0 to 3600/ 360s	0.1/0.01s	10s/30s	85	
	◎ 9	**Electronic thermal O/L relay**	0 to 500/0 to 3600A	0.01/0.1A	Rated inverter current	89	
DC injection brake	10	**DC injection brake operation frequency**	0 to 120Hz, 9999	0.01Hz	3Hz	92	
	11	**DC injection brake operation time**	0 to 10s, 8888	0.1s	0.5s	92	
	12	**DC injection brake operation voltage**	0 to 30%	0.1%	4/2/1%	92	
—	13	**Starting frequency**	0 to 60Hz	0.01Hz	0.5Hz	87	
—	14	**Load pattern selection**	0, 1	1	1	76	
Jog operation	15	**Jog frequency**	0 to 400Hz	0.01Hz	5Hz	80	
	16	**Jog acceleration/deceleration time**	0 to 3600/360s	0.1/0.01s	0.5s	80	
—	17	**MRS input selection**	0, 2	1	0	98	
—	18	**High speed maximum frequency**	120 to 400Hz	0.01Hz	120/60Hz	72	
—	19	**Base frequency voltage**	0 to 1000V, 8888, 9999	0.1V	8888	74	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Acceleration/ deceleration times	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	50Hz	85	
	21	Acceleration/deceleration time increments	0, 1	1	0	85	
Stall prevention	22	Stall prevention operation level	0 to 120%, 9999	0.1%	110%	66	
	23	Stall prevention operation level compensation factor at double speed	0 to 150%, 9999	0.1%	9999	66	
Multi-speed setting	24 to 27	Multi-speed setting (4 speed to 7 speed)	0 to 400Hz, 9999	0.01Hz	9999	78	
—	28	Multi-speed input compensation selection	0, 1	1	0	82	
—	29	Acceleration/deceleration pattern selection	0, 1, 2, 3	1	0	88	
—	30	Regenerative function selection	0, 2/0, 1, 2	1	0	94	
Frequency jump	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	73	
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	73	
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	73	
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	73	
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	73	
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	73	
—	37	Speed display	0, 1 to 9998	1	0	110	
Frequency detection	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	106	
	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	106	
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	106	
Second functions	44	Second acceleration/deceleration time	0 to 3600/360s	0.1/0.01s	5s	85	
	45	Second deceleration time	0 to 3600/360s, 9999	0.1/0.01s	9999	85	
	46	Second torque boost	0 to 30%, 9999	0.1%	9999	63	
	47	Second V/F (base frequency)	0 to 400Hz, 9999	0.01Hz	9999	74	
	48	Second stall prevention operation current	0 to 120%	0.1%	110%	66	
	49	Second stall prevention operation frequency	0 to 400Hz, 9999	0.01Hz	0Hz	66	
	50	Second output frequency detection	0 to 400Hz	0.01Hz	30Hz	106	
	51	Second electronic thermal O/L relay	0 to 500A, 9999/ 0 to 3600A, 9999	0.01/0.1A	9999	89	
Monitor functions	52	DU/PU main display data selection	0, 5, 6, 8 to 14, 17, 20, 23 to 25, 50 to 57, 100	1	0	111	
	54	CA terminal function selection	1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53	1	1	116	
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	50Hz	116	
	56	Current monitoring reference	0 to 500A/0 to 3600A	0.01/0.1A	Rated inverter current	116	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Automatic restart functions	57	Restart coasting time	0, 0.1 to 5s, 9999/ 0, 0.1 to 30s, 9999	0.1s	9999	120	
	58	Restart cushion time	0 to 60s	0.1s	1s	120	
—	59	Remote function selection	0, 1, 2, 3	1	0	83	
—	◎ 60	Energy saving control selection	0, 4, 9	1	0	130	
—	65	Retry selection	0 to 5	1	0	126	
—	66	Stall prevention operation reduction starting frequency	0 to 400Hz	0.01Hz	50Hz	66	
Retry	67	Number of retries at alarm occurrence	0 to 10, 101 to 110	1	0	126	
	68	Retry waiting time	0 to 10s	0.1s	1s	126	
	69	Retry count display erase	0	1	0	126	
—	70	Special regenerative brake duty	0 to 10%	0.1%	0%	94	
—	71	Applied motor	0, 1, 2, 20	1	0	91	
—	72	PWM frequency selection	0 to 15/0 to 6, 25	1	2	136	
—	73	Analog input selection	0 to 7, 10 to 17	1	1	140	
—	74	Input filter time constant	0 to 8	1	1	141	
—	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17, 100 to 103, 114 to 117	1	14	149	
—	76	Alarm code output selection	0, 1, 2	1	0	128	
—	77	Parameter write selection	0, 1, 2	1	0	152	
—	78	Reverse rotation prevention selection	0, 1, 2	1	0	153	
—	◎ 79	Operation mode selection	0, 1, 2, 3, 4, 6, 7	1	0	155	
Simple magnetic flux vector control	80	Motor capacity(simple magnetic flux vector control)	0.4 to 55kW, 9999/ 0 to 3600kW, 9999	0.01/0.1kW	9999	64	
	90	Motor constant (R1)	0 to 50Ω, 9999/ 0 to 400mΩ, 9999	0.001Ω/ 0.01mΩ	9999	64	
Adjustable 5 points V/F	100	V/F1(first frequency)	0 to 400Hz, 9999	0.01Hz	9999	77	
	101	V/F1(first frequency voltage)	0 to 1000V	0.1V	0V	77	
	102	V/F2(second frequency)	0 to 400Hz, 9999	0.01Hz	9999	77	
	103	V/F2(second frequency voltage)	0 to 1000V	0.1V	0V	77	
	104	V/F3(third frequency)	0 to 400Hz, 9999	0.01Hz	9999	77	
	105	V/F3(third frequency voltage)	0 to 1000V	0.1V	0V	77	
	106	V/F4(fourth frequency)	0 to 400Hz, 9999	0.01Hz	9999	77	
	107	V/F4(fourth frequency voltage)	0 to 1000V	0.1V	0V	77	
	108	V/F5(fifth frequency)	0 to 400Hz, 9999	0.01Hz	9999	77	
	109	V/F5(fifth frequency voltage)	0 to 1000V	0.1V	0V	77	
PU connector communication	117	PU communication station number	0 to 31	1	0	174	
	118	PU communication speed	48, 96, 192, 384	1	192	174	
	119	PU communication stop bit length	0, 1, 10, 11	1	1	174	
	120	PU communication parity check	0, 1, 2	1	2	174	
	121	Number of PU communication retries	0 to 10, 9999	1	1	174	
	122	PU communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	9999	174	
	123	PU communication waiting time setting	0 to 150ms, 9999	1	9999	174	
	124	PU communication CR/LF presence/absence selection	0, 1, 2	1	1	174	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
—	◎ 125	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	50Hz	142	
—	◎ 126	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	50Hz	142	
PID operation	127	PID control automatic switchover frequency	0 to 400Hz, 9999	0.01Hz	9999	198	
	128	PID action selection	10, 11, 20, 21, 50, 51, 60, 61	1	10	198	
	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	198	
	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	198	
	131	PID upper limit	0 to 100%, 9999	0.1%	9999	198	
	132	PID lower limit	0 to 100%, 9999	0.1%	9999	198	
	133	PID action set point	0 to 100%, 9999	0.01%	9999	198	
	134	PID differential time	0.01 to 10.00s, 9999	0.01s	9999	198	
Electronic bypass	135	Electronic bypass sequence selection	0, 1	1	0	206	
	136	MC switchover interlock time	0 to 100s	0.1s	1s	206	
	137	Start waiting time	0 to 100s	0.1s	0.5s	206	
	138	Bypass selection at an alarm	0, 1	1	0	206	
	139	Automatic switchover frequency from inverter to bypass operation	0 to 60Hz, 9999	0.01Hz	9999	206	
Backlash measures	140	Backlash acceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	88	
	141	Backlash acceleration stopping time	0 to 360s	0.1s	0.5s	88	
	142	Backlash deceleration stopping frequency	0 to 400Hz	0.01Hz	1Hz	88	
	143	Backlash deceleration stopping time	0 to 360s	0.1s	0.5s	88	
—	144	Speed setting switchover	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	1	4	110	
PU	145	PU display language selection	0 to 7	1	1	231	
Current detection	148	Stall prevention level at 0V input	0 to 120%	0.1%	110%	66	
	149	Stall prevention level at 10V input	0 to 120%	0.1%	120%	66	
	150	Output current detection level	0 to 120%	0.1%	110%	107	
	151	Output current detection signal delay time	0 to 10s	0.1s	0s	107	
	152	Zero current detection level	0 to 150%	0.1%	5%	107	
	153	Zero current detection time	0 to 1s	0.01s	0.5s	107	
—	154	Voltage reduction selection during stall prevention operation	0, 1	1	1	66	
—	155	RT signal function validity condition selection	0, 10	1	0	99	
—	156	Stall prevention operation selection	0 to 31, 100, 101	1	0	66	
—	157	OL signal output timer	0 to 25s, 9999	0.1s	0s	66	
—	158	AM terminal function selection	1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53	1	1	116	
—	159	Automatic switchover frequency range from bypass to inverter operation	0 to 10Hz, 9999	0.01Hz	9999	206	
—	◎160	User group read selection	0, 1, 9999	1	9999	153	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
—	**161**	**Frequency setting/key lock operation selection**	0, 1, 10, 11	1	0	231	
Automatic restart functions	**162**	**Automatic restart after instantaneous power failure selection**	0, 1, 10, 11	1	0	120	
	163	**First cushion time for restart**	0 to 20s	0.1s	0s	120	
	164	**First cushion voltage for restart**	0 to 100%	0.1%	0%	120	
	165	**Stall prevention operation level for restart**	0 to 120%	0.1%	110%	120	
Current detection	**166**	**Output current detection signal retention time**	0 to 10s, 9999	0.1s	0.1s	107	
	167	**Output current detection operation selection**	0, 1	1	0	107	
—	**168**	Parameter for manufacturer setting. Do not set.					
—	**169**						
Cumulative monitor clear	**170**	**Watt-hour meter clear**	0, 10, 9999	1	9999	111	
	171	**Operation hour meter clear**	0, 9999	1	9999	111	
User group	**172**	**User group registered display/batch clear**	9999, (0 to 16)	1	0	153	
	173	**User group registration**	0 to 999, 9999	1	9999	153	
	174	**User group clear**	0 to 999, 9999	1	9999	153	
Input terminal function assignment	**178**	**STF terminal function selection**	0 to 8, 10 to 14, 16, 24, 25, 37, 60, 62, 64 to 67, 9999	1	60	96	
	179	**STR terminal function selection**	0 to 8, 10 to 14, 16, 24, 25, 37, 61, 62, 64 to 67, 9999	1	61	96	
	180	**RL terminal function selection**	0 to 8, 10 to 14, 16, 24, 25, 37, 62, 64 to 67, 9999	1	0	96	
	181	**RM terminal function selection**		1	1	96	
	182	**RH terminal function selection**		1	2	96	
	183	**RT terminal function selection**		1	3	96	
	184	**AU terminal function selection**	0 to 8, 10 to 14, 16, 24, 25, 37, 62 to 67, 9999	1	4	96	
	185	**JOG terminal function selection**	0 to 8, 10 to 14, 16, 24, 25, 37, 62, 64 to 67, 9999	1	5	96	
	186	**CS terminal function selection**		1	6	96	
	187	**MRS terminal function selection**		1	24	96	
	188	**STOP terminal function selection**		1	25	96	
	189	**RES terminal function selection**		1	62	96	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Output terminal function assignment	190	RUN terminal function selection	0 to 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70 to 78, 90 to 96, 98, 99, 100 to 105, 107, 108, 110 to 116, 125, 126, 145 to 147, 164, 170, 190 to 196, 198, 199, 9999	1	0	102	
	191	SU terminal function selection		1	1	102	
	192	IPF terminal function selection		1	2	102	
	193	OL terminal function selection		1	3	102	
	194	FU terminal function selection		1	4	102	
	195	ABC1 terminal function selection	0 to 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70 to 78, 90, 91, 94 to 96, 98, 99, 100 to 105, 107, 108, 110 to 116, 125, 126, 145 to 147, 164, 170, 190, 191, 194 to 196, 198, 199, 9999	1	99	102	
	196	ABC2 terminal function selection		1	9999	102	
Multi-speed setting	232 to 239	Multi-speed setting (8 speed to 15 speed)	0 to 400Hz, 9999	0.01Hz	9999	78	
—	240	Soft-PWM operation selection	0, 1	1	1	136	
—	241	Analog input display unit switchover	0, 1	1	0	142	
—	242	Terminal 1 added compensation amount (terminal 2)	0 to 100%	0.1%	100%	140	
—	243	Terminal 1 added compensation amount (terminal 4)	0 to 100%	0.1%	75%	140	
—	244	Cooling fan operation selection	0, 1	1	1	224	
Slip compensation	245	Rated slip	0 to 50%, 9999	0.01%	9999	65	
	246	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	65	
	247	Constant-power range slip compensation selection	0, 9999	1	9999	65	
—	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	0.1s	9999	95	
—	251	Output phase failure protection selection	0, 1	1	1	129	
Frequency compensation function	252	Override bias	0 to 200%	0.1%	50%	140	
	253	Override gain	0 to 200%	0.1%	150%	140	
Life check	255	Life alarm status display	(0 to 15)	1	0	225	
	256	Inrush current limit circuit life display	(0 to 100%)	1%	100%	225	
	257	Control circuit capacitor life display	(0 to 100%)	1%	100%	225	
	258	Main circuit capacitor life display	(0 to 100%)	1%	100%	225	
	259	Main circuit capacitor life measuring	0, 1	1	0	225	
—	260	PWM frequency automatic switchover	0, 1	1	1	136	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Power failure stop	261	**Power failure stop selection**	0, 1, 2	1	0	124	
	262	**Subtracted frequency at deceleration start**	0 to 20Hz	0.01Hz	3Hz	124	
	263	**Subtraction starting frequency**	0 to 120Hz, 9999	0.01Hz	50Hz	124	
	264	**Power-failure deceleration time 1**	0 to 3600/ 360s	0.1/0.01s	5s	124	
	265	**Power-failure deceleration time 2**	0 to 3600/ 360s, 9999	0.1/0.01s	9999	124	
	266	**Power failure deceleration time switchover frequency**	0 to 400Hz	0.01Hz	50Hz	124	
—	267	**Terminal 4 input selection**	0, 1, 2	1	0	137	
—	268	**Monitor decimal digits selection**	0, 1, 9999	1	9999	111	
—	269	Parameter for manufacturer setting. Do not set.					
—	299	**Rotation direction detection selection at restarting**	0, 1, 9999	1	9999	120	
RS-485 communication	331	**RS-485 communication station number**	0 to 31(0 to 247)	1	0	174	
	332	**RS-485 communication speed**	3, 6, 12, 24, 48, 96, 192, 384	1	96	174	
	333	**RS-485 communication stop bit length**	0, 1, 10, 11	1	1	174	
	334	**RS-485 communication parity check selection**	0, 1, 2	1	2	174	
	335	**RS-485 communication retry count**	0 to 10, 9999	1	1	174	
	336	**RS-485 communication check time interval**	0 to 999.8s, 9999	0.1s	0s	174	
	337	**RS-485 communication waiting time setting**	0 to 150ms, 9999	1	9999	174	
	338	**Communication operation command source**	0, 1	1	0	164	
	339	**Communication speed command source**	0, 1, 2	1	0	164	
	340	**Communication startup mode selection**	0, 1, 2, 10, 12	1	0	163	
	341	**RS-485 communication CR/LF selection**	0, 1, 2	1	1	174	
	342	**Communication EEPROM write selection**	0, 1	1	0	175	
	343	**Communication error count**	—	1	0	186	
Remote output	495	**Remote output selection**	0, 1	1	0	109	
	496	**Remote output data 1**	0 to 4095	1	0	109	
	497	**Remote output data 2**	0 to 4095	1	0	109	
Maintenance	503	**Maintenance timer**	0 (1 to 9998)	1	0	227	
	504	**Maintenance timer alarm output set time**	0 to 9998, 9999	1	9999	227	
—	539	**Modbus-RTU communication check time interval**	0 to 999.8s, 9999	0.1s	9999	186	
Communication	549	**Protocol selection**	0, 1	1	0	186	
	550	**NET mode operation command source selection**	0, 1, 9999	1	9999	164	
	551	**PU mode operation command source selection**	1, 2	1	2	164	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Current average monitor	555	Current average time	0.1 to 1.0s	0.1s	1s	228	
	556	Data output mask time	0.0 to 20.0s	0.1s	0s	228	
	557	Current average value monitor signal output reference current	0 to 500A/0 to 3600A	0.01/0.1A	Rated inverter current	228	
—	563	Energization time carrying-over times	(0 to 65535)	1	0	111	
—	564	Operating time carrying-over times	(0 to 65535)	1	0	111	
Multiple rating	570	Multiple rating setting	0, 1	1	0	71	
—	571	Holding time at a start	0.0 to 10.0s, 9999	0.1s	9999	87	
—	573	4mA input check selection	1, 9999	1	9999	147	
PID control	575	Output interruption detection time	0 to 3600s, 9999	0.1s	1s	198	
	576	Output interruption detection level	0 to 400Hz	0.01Hz	0Hz	198	
	577	Output interruption cancel level	900 to 1100%	0.1%	1000%	198	
Pump function	578	Auxiliary motor operation selection	0 to 3	1	0	211	
	579	Motor connection function selection	0 to 3	1	0	211	
	580	MC switching interlock time	0 to 100s	0.1s	1s	211	
	581	Start waiting time	0 to 100s	0.1s	1s	211	
	582	Auxiliary motor connection-time deceleration time	0 to 3600s, 9999	0.1s	1s	211	
	583	Auxiliary motor disconnection-time acceleration time	0 to 3600s, 9999	0.1s	1s	211	
	584	Auxiliary motor 1 starting frequency	0 to 400Hz	0.01Hz	50Hz	211	
	585	Auxiliary motor 2 starting frequency	0 to 400Hz	0.01Hz	50Hz	211	
	586	Auxiliary motor 3 starting frequency	0 to 400Hz	0.01Hz	50Hz	211	
	587	Auxiliary motor 1 stopping frequency	0 to 400Hz	0.01Hz	0Hz	211	
	588	Auxiliary motor 2 stopping frequency	0 to 400Hz	0.01Hz	0Hz	211	
	589	Auxiliary motor 3 stopping frequency	0 to 400Hz	0.01Hz	0Hz	211	
	590	Auxiliary motor start detection time	0 to 3600s	0.1s	5s	211	
	591	Auxiliary motor stop detection time	0 to 3600s	0.1s	5s	211	
Traverse function	592	Traverse function selection	0, 1, 2	1	0	220	
	593	Maximum amplitude amount	0 to 25%	0.1%	10%	220	
	594	Amplitude compensation amount during deceleration	0 to 50%	0.1%	10%	220	
	595	Amplitude compensation amount during acceleration	0 to 50%	0.1%	10%	220	
	596	Amplitude acceleration time	0.1 to 3600s	0.1s	5s	220	
	597	Amplitude deceleration time	0.1 to 3600s	0.1s	5s	220	
—	611	Acceleration time at a restart	0 to 3600s, 9999	0.1s	5/15s	120	
—	867	AM output filter	0 to 5s	0.01s	0.01s	116	
—	869	Current output filter	0 to 5s	0.01s	0.02s	116	
—	872	Input phase failure protection selection	0, 1	1	0	129	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Regeneration avoidance function	882	Regeneration avoidance operation selection	0, 1, 2	1	0	222	
	883	Regeneration avoidance operation level	300 to 800V	0.1V	DC760V	222	
	884	Regeneration avoidance at deceleration detection sensitivity	0 to 5	1	0	222	
	885	Regeneration avoidance compensation frequency limit value	0 to 10Hz, 9999	0.01Hz	6Hz	222	
	886	Regeneration avoidance voltage gain	0 to 200%	0.1%	100%	222	
Free parameter	888	Free parameter 1	0 to 9999	1	9999	230	
	889	Free parameter 2	0 to 9999	1	9999	230	
Energy saving monitor	891	Cumulative power monitor digit shifted times	0 to 4, 9999	1	9999	131	
	892	Load factor	30 to 150%	0.1%	100%	131	
	893	Energy saving monitor reference (motor capacity)	0.1 to 55kW/ 0 to 3600kW	0.01/0.1kW	SLD/LD value of Applied moter Capacity	131	
	894	Control selection during commercial power-supply operation	0, 1, 2, 3	1	0	131	
	895	Power saving rate reference value	0, 1, 9999	1	9999	131	
	896	Power unit cost	0 to 500, 9999	0.01	9999	131	
	897	Power saving monitor average time	0, 1 to 1000h, 9999	1	9999	131	
	898	Power saving cumulative monitor clear	0, 1, 10, 9999	1	9999	131	
	899	Operation time rate (estimated value)	0 to 100%, 9999	0.1%	9999	131	
Calibration parameters	C0 (900)	CA terminal calibration	—	—	—	117	
	C1 (901)	AM terminal calibration	—	—	—	117	
	C2 (902)	Terminal 2 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	142	
	C3 (902)	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	142	
	125 (903)	Terminal 2 frequency setting gain frequency	0 to 400Hz	0.01Hz	50Hz	142	
	C4 (903)	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	142	
	C5 (904)	Terminal 4 frequency setting bias frequency	0 to 400Hz	0.01Hz	0Hz	142	
	C6 (904)	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	142	
	126 (905)	Terminal 4 frequency setting gain frequency	0 to 400Hz	0.01Hz	50Hz	142	
	C7 (905)	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	142	

Function	Parameters	Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
Analog output current calibration	C8 (930)	Current output bias signal	0 to 100%	0.1%	0%	117	
	C9 (930)	Current output bias current	0 to 100%	0.1%	0%	117	
	C10 (931)	Current output gain signal	0 to 100%	0.1%	100%	117	
	C11 (931)	Current output gain current	0 to 100%	0.1%	100%	117	
—	989	Parameter copy alarm release	10, 100	1	10/100	—	
PU	990	PU buzzer control	0, 1	1	1	233	
	◎ 991	PU contrast adjustment	0 to 63	1	58	233	
Clear parameter	Pr.CL	Parameter clear	0, 1	1	0	234	
	ALLC	All parameter clear	0, 1	1	0	235	
	Er.CL	Alarm history clear	0, 1	1	0	238	
	PCPY	Parameter copy	0, 1, 2, 3	1	0	236	

4.3 Adjust the output torque of the motor (current)

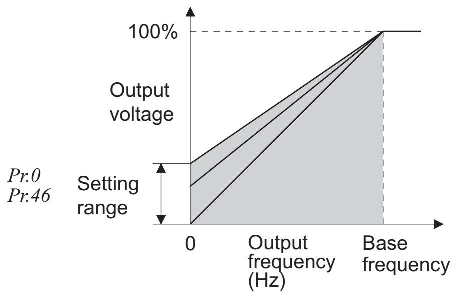
Purpose	Parameter that must be Set		Refer to Page
Set starting torque manually	**Manual torque boost**	**Pr. 0, Pr. 46**	63
Automatically control output current according to load	**Simple magnetic flux vector control**	**Pr. 71, Pr. 80, Pr. 90**	64
Compensate for motor slip to secure low-speed torque	**Slip compensation**	**Pr. 245 to Pr. 247**	65
Limit output current to prevent inverter trip	**Stall prevention operation**	**Pr. 22, Pr. 23, Pr. 66, Pr. 154, Pr. 156, Pr. 157**	66
Change the overload current rating specifications	**Multiple rating setting**	**Pr. 570**	71

4.3.1 *Manual torque boost (Pr. 0, Pr. 46)*

You can compensate for a voltage drop in the low-frequency region to improve motor torque reduction in the low-speed range.
- Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
- The starting torque boost can be changed by switching terminals.

Parameter Number	Name	Initial Value		Setting Range	Description
0	**Torque boost**	00023	6%	0 to 30%	Set the output voltage at 0Hz as %.
		00038 to 00083	4%		
		00126, 00170	3%		
		00250 to 00770	2%		
		00930, 01160	1.5%		
		01800 or more	1%		
46 *1	**Second torque boost**	9999		0 to 30%	Set the torque boost value when the RT signal is on.
				9999	Without second torque boost

*1 They can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*



(1) Starting torque adjustment

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

(2) Set multiple torque boost (RT signal, *Pr. 46*)

- Use the second torque boost when changing the torque boost according to application or when using multiple motors by switching between them by one inverter.
- *Pr. 46 Second torque boost* is made valid when the RT signal turns on.

REMARKS

- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 98)*
- The RT signal is assigned to the RT terminal in the default setting. 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

- Increase the setting when the distance between the inverter and motor is long or when motor torque is insufficient in the low-speed range. If the setting is too large, an overcurrent trip may occur.
- The *Pr. 0* and *Pr. 46* settings are valid only when V/F control is selected.
- When using the inverter dedicated motor (constant torque motor) with the 00126 or 00170, set the torque boost value to 2%. If the initial set *Pr. 71* value is changed to the setting for use with a constant-torque motor, the *Pr. 0* setting changes to the corresponding value in above.
- 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. 3 Base frequency, Pr. 19 Base frequency voltage ☞ *Refer to page 74*
Pr. 71 Applied motor ☞ *Refer to page 91*
Pr. 80 Motor capacity ☞ *Refer to page 64*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 96*

4.3.2 Simple magnetic flux vector control (Pr.80, Pr.90)

Providing optimum excitation to the motor can also produce high torque in a low-speed range.
(Simple magnetic flux vector control)

Parameter Number	Name	Initial Value	Setting Range		Description
80	**Motor capacity(simple magnetic flux vector control)**	9999	01160 or less	0.4 to 55kW	Set the capacity of the motor used to select simple magnetic flux vector control.
			01800 or more	0 to 3600kW	
			9999		V/F control is performed
90	**Motor constant (R1)**	9999	01160 or less	0 to 50Ω	Used to set the motor primary resistance value. (Normally setting is not necessary.)
			01800 or more	0 to 400mΩ	
			9999		Use the Mitsubishi motor (SF-JR, SF-HRCA) constants

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

POINT

· The number of motor poles should be any of 2, 4 and 6 poles.
· Single-motor operation (One motor for one inverter)
· The wiring length from inverter to motor should be within 30m

(1) Automatically control optimum torque *(Pr.80)*

When simple magnetic flux vector control is not used, set "9999" (initial value) in *Pr.80*.
· Set the used motor capacity (equal to or one rank higher than the inverter capacity).

REMARKS

When using a constant-torque motor, set *Pr. 71 Applied motor* to "1" (constant-torque motor).

CAUTION

· When simple magnetic flux vector control is selected, the rated motor frequency is set in *Pr. 3* and the rated motor voltage is set in *Pr. 19*. The base frequency voltage is handled as 200V class : 200V, 400V class : 400V when "9999" or "8888" is set in *Pr. 19* .
· Adjustable 5 points V/F, energy saving operation mode, optimum excitation control function only under V/F control. They do not function for simple magnetic flux vector control.

(2) Set the motor constant *(Pr.90)*

· Normally setting is not necessary. When you need more torque under simple magnetic flux vector control for other manufacturer's motor, set the motor primary resistance value (R1) for 人connection. When the setting value is "9999" (initial value), the motor constant is based on the Mitsubishi motor constant (SF-JR, SF-HRCA).

♦ Parameters referred to ♦

Pr. 3 Base frequency, Pr. 19 Base frequency voltage ☞ *Refer to page 74*
Pr. 60 Energy saving control selection ☞ *Refer to page 130*
Pr. 71 Applied motor ☞ *Refer to page 91*
Pr. 77 Parameter write selection ☞ *Refer to page 152*

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

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

Parameter Number	Name	Initial Value	Setting Range	Description
245	**Rated slip**	9999	0.01 to 50%	Used to set the rated motor slip.
			0, 9999	No slip compensation
246	**Slip compensation time constant**	0.5s	0.01 to 10s	Used to set the slip compensation response time. When the value is made smaller, response will be faster. However, as load inertia is greater, a regenerative overvoltage (E.OV□) error is more liable to occur.
247	**Constant-power range slip compensation selection**	9999	0	Slip compensation is not made in the constant power range (frequency range above the frequency set in *Pr. 3*)
			9999	Slip compensation is made in the constant power range.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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

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

REMARKS

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

♦ Parameters referred to ♦

Pr. 1 Maximum frequency ☞ *Refer to page 72*
Pr. 3 Base frequency ☞ *Refer to page 74*

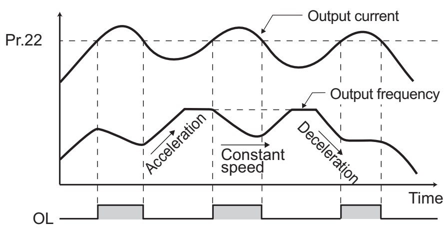
4.3.4 Stall prevention operation (Pr. 22, Pr. 23, Pr. 48, Pr. 49, Pr. 66, Pr. 148, Pr. 149, Pr. 154, Pr. 156, Pr. 157)

This function monitors the output current and automatically changes the output frequency to prevent the inverter from coming to 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	Description
22	**Stall prevention operation level**	110% *	0	Stall prevention operation selection becomes invalid.
			0.1 to 120% *	Set the current value at which stall prevention operation will be started.
			9999	Analog variable
23	**Stall prevention operation level compensation factor at double speed**	9999	0 to 150% *	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**	110% *	0	Second stall prevention operation invalid
			0.1 to 120% *	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 400Hz	Set the frequency at which stall prevention operation of *Pr. 48* is started.
			9999	*Pr. 48* is valid when the RT signal is on.
66	**Stall prevention operation reduction starting frequency**	50Hz	0 to 400Hz	Set the frequency at which the stall operation level is started to reduce.
148	**Stall prevention level at 0V input**	110% *	0 to 120% *	Stall prevention operation level can be changed by the analog signal input to terminal 1.
149	**Stall prevention level at 10V input**	120% *	0 to 120% *	
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

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*
* When *Pr. 570 Multiple rating setting* = "1", performing parameter clear changes the initial value and setting range. *(Refer to page 71)*



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 110% (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.

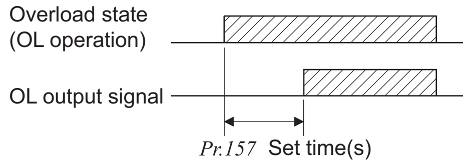
CAUTION

- 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 140%. The torque will not be developed by doing so. (When *Pr. 570* = "1")

(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.



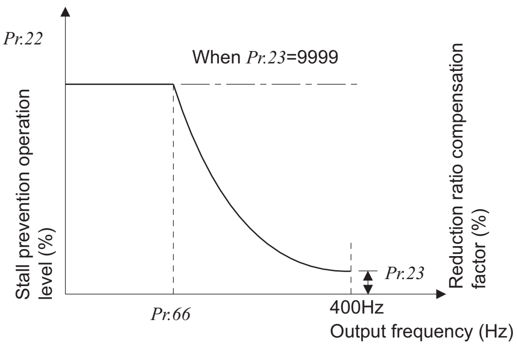
REMARKS

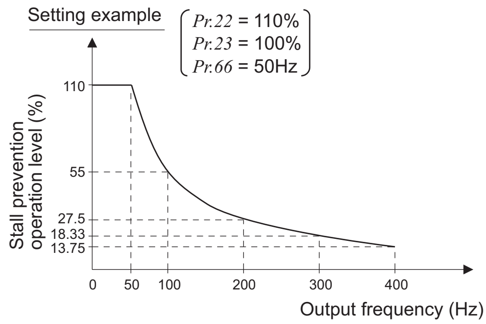
- The OL signal is assigned to the terminal OL in the initial setting. The OL signal can also be assigned to the other terminal by setting "3 (positive logic) or 103 (negative logic)" to any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

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 50Hz in *Pr. 66* and 100% in *Pr. 23*.
- Formula for stall prevention operation level

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

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

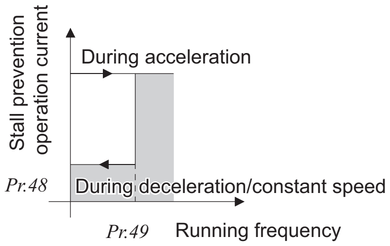
- When *Pr. 23 Stall prevention operation level compensation factor at double speed* = "9999" (initial value), the stall prevention operation level is kept constant at the *Pr. 22* setting up to 400Hz.

4

PARAMETERS

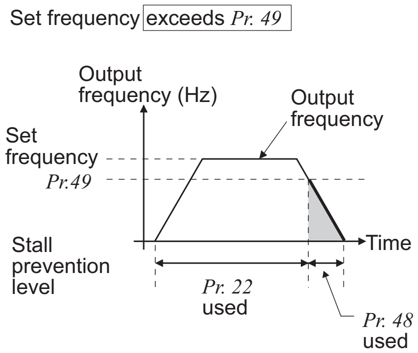
(4) Set multiple stall prevention operation levels (*Pr. 48, Pr. 49*)

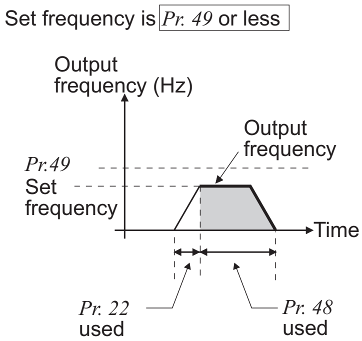
- Setting "9999" in *Pr. 49 Second stall prevention operation frequency* and turning the RT signal on make *Pr. 48 Second stall prevention operation current* valid.
- In *Pr. 48*, you can set the stall prevention operation level at the output frequency from 0Hz to that set in *Pr. 49*. During acceleration, 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* setting to weaken the deceleration torque (stopping torque).



Pr. 49 Setting	Operation
0(initial value)	The second stall prevention operation is not performed.
0.01Hz to 400Hz	If the output frequency is equal to or less than the frequency set in *Pr. 49*, the second stall prevention function activates. (during constant speed or deceleration)*1
9999 *2	The second 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. 22* = "9999" (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.)

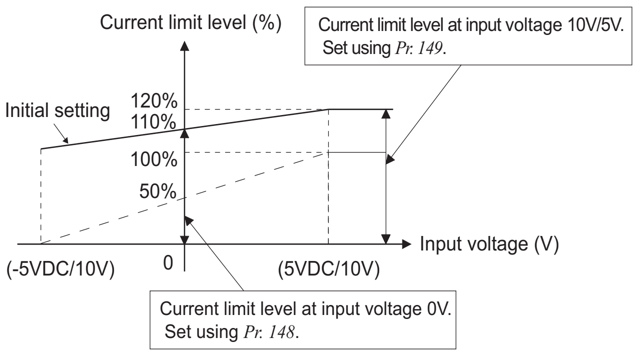




REMARKS
- When *Pr. 49* ≠ "9999" (level changed according to frequency) and *Pr. 48* = "0%", the stall prevention operation level is 0% at or higher than the frequency set in *Pr. 49*.
- In the initial setting, the RT signal is assigned to the RT terminal. By setting "3" to any of *Pr. 178 to Pr. 189 (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 signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 99)*

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



- Set *Pr. 22 Stall prevention operation level* to "9999".
  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.
- Set the current limit level at the input voltage of 0V in *Pr. 148 Stall prevention level at 0V input.*
- Set the current limit level at the input voltage of 10V or 5V in *Pr. 149 Stall prevention level at 10V input*

REMARKS
- The fast-response current limit level cannot be set.
- When *Pr. 22* = 9999 (analog variable), functions other than the terminal 1 (auxiliary input, override function, PID control) are not executed.

(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

(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
100 *3 Driving	○	○	○	○	○
100 *3 Regeneration	●	●	●	●	— *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
101 *3 Driving	●	○	○	○	○
101 *3 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 137*
- *Pr. 178 to Pr. 189 (Input terminal function selection)* ☞ *Refer to page 96*
- *Pr. 190 to Pr. 196 (output terminal function selection)* ☞ *Refer to page 102*
- *Pr. 570 Multiple rating setting* ☞ *Refer to page 71*

4.3.5 Multiple rating (Pr.570)

You can use the inverter by changing the overload current rating specifications according to load applications. Note that the control rating of each function changes.

Parameter Number	Name	Initial Value	Setting Range	Description
570	Multiple rating setting	0	0	SLD Ambient temperature 40°C, Overload current rating 110% 60s, 120% 3s (Inverse time characteristics)
			1	LD Ambient temperature 50°C, Overload current rating 120% 60s, 150% 3s (Inverse time characteristics)

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

- The initial value and setting range of the following parameters are changed by performing parameter clear and reset after changing this parameter setting.

Parameter Number	Name		*Pr. 570* Setting: 0 (initial value)	*Pr. 570* Setting: 1	Refer to Page
9	Electronic thermal O/L relay	Initial Value	SLD rated current *1	LD rated current *1	89
22	Stall prevention operation level	Setting Range	0, 0.1 to 120%, 9999	0, 0.1 to 150%, 9999	66
		Initial Value	110%	120%	
23	Stall prevention operation level compensation factor at double speed	Setting Range	0 to 150%, 9999	0 to 200%, 9999	66
		Initial Value	9999	9999	
48	Second stall prevention operation current	Setting Range	0, 0.1 to 120%	0, 0.1 to 150%	66
		Initial Value	110%	120%	
56	Current monitoring reference	Initial Value	SLD rated current *1	LD rated current *1	116
148	Stall prevention level at 0V input	Setting Range	0 to 120%	0 to 150%	66
		Initial Value	110%	120%	
149	Stall prevention level at 10V input	Setting Range	0 to 120%	0 to 150%	66
		Initial Value	120%	150%	
150	Output current detection level	Setting Range	0 to 120%	0 to 150%	107
		Initial Value	110%	120%	
165	Stall prevention operation level for restart	Setting Range	0 to 120%	0 to 150%	120
		Initial Value	110%	120%	
557	Current average value monitor signal output reference current	Initial Value	SLD rated current *1	LD rated current *1	228
893	Energy saving monitor reference (motor capacity)	Initial Value	SLD value of Applied moter Capacity *2	LD value of Applied moter Capacity *2	131

*1 The rated current differs according to the inverter capacity. *Refer to rated specifications (page 274).*
*2 For the 01160 or less, SLD/LD value of Applied moter Capacity is the same. *Refer to rated specifications (page 274).*

CAUTION

When *Pr. 570* = "0" (initial value), *Pr.260 PWM frequency automatic switchover* becomes invalid. *(Refer to page 136.)*

4.4 Limit the output frequency

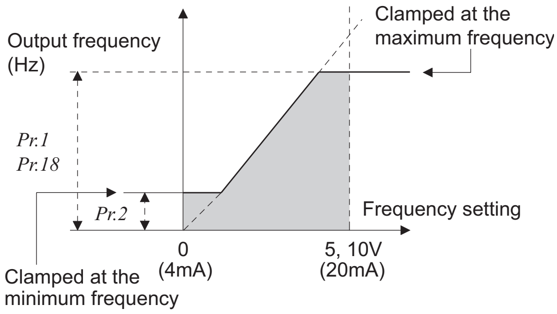
Purpose	Parameter that must be Set		Refer to Page
Set upper limit and lower limit of output frequency	**Maximum/minimum frequency**	**Pr. 1, Pr. 2, Pr. 18**	72
Perform operation by avoiding mechanical resonance points	**Frequency jump**	**Pr. 31 to Pr. 36**	73

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

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

Parameter Number	Name	Initial Value		Setting Range	Description
1	**Maximum frequency**	01160 or less	120Hz	0 to 120Hz	Set the upper limit of the output frequency.
		01800 or more	60Hz		
2	**Minimum frequency**	0Hz		0 to 120Hz	Set the lower limit of the output frequency.
18 *	**High speed maximum frequency**	01160 or less	120Hz	120 to 400Hz	Set when performing the operation at 120Hz or more.
		01800 or more	60Hz		

* The parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



(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.
- When you want to perform operation above 120Hz, set the upper limit of the output frequency to *Pr. 18 High speed maximum frequency*. (When *Pr. 18* is set, *Pr. 1* automatically switches to the frequency of *Pr. 18*. When *Pr. 18* is set, *Pr. 18* automatically switches to the frequency of *Pr. 1*.)

REMARKS

- When performing operation above 60Hz using the frequency setting analog signal, change *Pr. 125 (Pr. 126) (frequency setting gain)*. If only *Pr. 1* or *Pr. 18* is changed, operation above 60Hz cannot be performed

(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 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

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

♦ Parameters referred to ♦

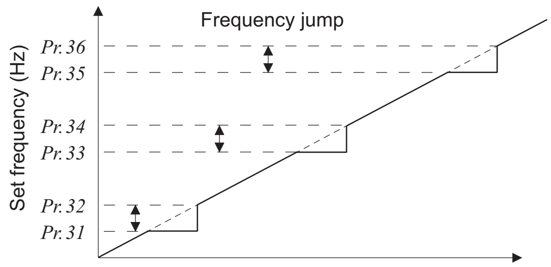
Pr. 13 Starting frequency ☞ *Refer to page 87*
Pr. 15 Jog frequency ☞ *Refer to page 80*
Pr. 125 Terminal 2 frequency setting gain frequency, Pr. 126 Terminal 4 frequency setting gain frequency ☞ *Refer to page 142*

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

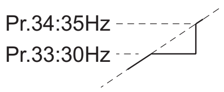
When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped.

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

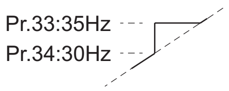
The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



- 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.

4.5 Set V/F pattern

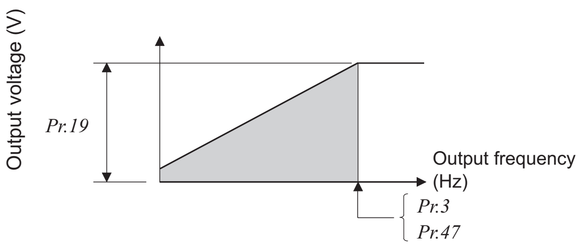
Purpose	Parameter that must be Set		Refer to Page
Set motor ratings	**Base frequency, base frequency voltage**	**Pr. 3, Pr. 19, Pr. 47**	74
Select a V/F pattern according to applications	**Load pattern selection**	**Pr. 14**	76
Use special motor	**Adjustable 5 points V/F**	**Pr. 71, Pr. 100 to Pr. 109**	77

4.5.1 Base frequency, voltage (Pr. 3, Pr. 19, Pr. 47)

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

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

* The parameters can be set when *Pr. 160 User group read selection* = "0" *(Refer to page 153)*



(1) Setting of base frequency *(Pr. 3)*

· When operating a standard motor, generally set the rated frequency of the motor to *Pr. 3 Base frequency*. When running the motor using electronic bypass operation, set *Pr. 3* to the same value as the power supply frequency.
· If the frequency given on the motor rating plate is "60Hz" only, always set to "60Hz". It may result in an inverter trip due to overload. Caution must be taken especially when *Pr. 14 Load pattern selection* = "1" (variable torque load).
· When using the Mitsubishi constant-torque motor, set *Pr. 3* to 60Hz.

(2) Set multiple base frequencies *(Pr. 47)*

· When you want to change the base frequency when switching two motors with one inverter, use the *Pr. 47 Second V/F (base frequency)*.
· *Pr. 47 Second V/F (base frequency)* is valid when the RT signal is on.

REMARKS

· The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 99)*
· 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.

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

· Use *Pr. 19 Base frequency voltage* to set the base voltage (e.g. rated motor voltage).
· If the setting is less than the power supply voltage, the maximum output voltage of the inverter is as set in *Pr. 19*.
· *Pr. 19* can be utilized in the following cases.
  (a) When regeneration frequency is high (e.g. continuous regeneration)
  During regeneration, the output voltage becomes higher than the reference and may cause an overcurrent trip (E.OC☐) due to an increased motor current.
  (b) When power supply voltage variation is large
  When the power supply voltage exceeds the rated voltage of the motor, speed variation or motor overheat may be caused by excessive torque or increased motor current.
  (c) When you want to expand constant-power characteristic range
  To expand the constant-power characteristic range at the base frequency or less, set a value greater than the power supply voltage to *Pr. 19*.

CAUTION

· When *Pr. 71 Applied motor* is set to "2" (adjustable 5 points V/F characteristic), the *Pr. 47* setting becomes invalid. In addition, you cannot set "8888" or "9999" in *Pr. 19*.
· The 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.

♦ Parameters referred to ♦

Pr. 14 Load pattern selection ☞ *Refer to page 76*
Pr. 29 Acceleration/deceleration pattern selection ☞ *Refer to page 88*
Pr. 71 Applied motor ☞ *Refer to page 91*
Pr. 80 Motor capacity(simple magnetic flux vector control) ☞ *Refer to page 64.*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 96.*

4

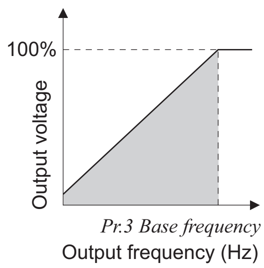
PARAMETERS

4.5.2 Load pattern selection (Pr. 14)

You can select the optimum output characteristic (V/F characteristic) for the application and load characteristics.

Parameter Number	Name	Initial Value	Setting Range	Description
14	**Load pattern selection**	1	0	For constant torque load
			1	For variable-torque loads

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



(1) For constant-torque load (setting "0")

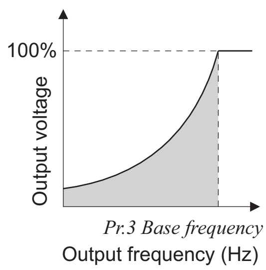
· At or less than the base frequency voltage, the output voltage varies linearly with the output frequency.

· Set this value when driving the load whose load torque is constant if the speed varies, e.g. conveyor, cart or roll drive.

POINT

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

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



(2) For variable-torque load (setting "1", initial value)

· At or less than the base frequency voltage, the output voltage varies with the output frequency in a square curve.

· Set this value when driving the load whose load torque varies in proportion to the square of the speed, e.g. fan or pump.

REMARKS

· The RT signal is assigned to the terminal RT in the initial 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.

♦ Parameters referred to ♦

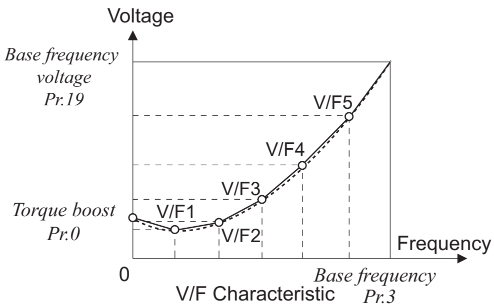
Pr. 3 Base frequency ☞ *Refer to page 74*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 96*

4.5.3 Adjustable 5 points V/F (Pr. 71, Pr. 100 to Pr. 109)

A dedicated V/F pattern can be made by freely setting the V/F characteristic between a startup and the base frequency and base voltage under V/F control (frequency voltage/frequency).
The torque pattern that is optimum for the machine's characteristic can be set.

Parameter Number	Name	Initial Value	Setting Range	Description
71	**Applied motor**	0	0, 1, 2, 20	Set "2" for adjustable 5 points V/F control.
100	**V/F1(first frequency)**	9999	0 to 400Hz, 9999	Set each points (frequency, voltage) of V/F pattern. 9999: No V/F setting
101	**V/F1(first frequency voltage)**	0V	0 to 1000V	
102	**V/F2(second frequency)**	9999	0 to 400Hz, 9999	
103	**V/F2(second frequency voltage)**	0V	0 to 1000V	
104	**V/F3(third frequency)**	9999	0 to 400Hz, 9999	
105	**V/F3(third frequency voltage)**	0V	0 to 1000V	
106	**V/F4(fourth frequency)**	9999	0 to 400Hz, 9999	
107	**V/F4(fourth frequency voltage)**	0V	0 to 1000V	
108	**V/F5(fifth frequency)**	9999	0 to 400Hz, 9999	
109	**V/F5(fifth frequency voltage)**	0V	0 to 1000V	

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



V/F Characteristic

- Any V/F characteristic can be provided by presetting the parameters of *V/F1 (first frequency voltage/first frequency) to V/F5*.
- For a machine of large static friction coefficient and small dynamic static friction coefficient, for example, set a V/F pattern that will increase the voltage only in a low-speed range since such a machine requires large torque at a start.

(Setting procedure)

1)Set the rated motor current in *Pr. 19 Base frequency voltage*. (No function at the setting of "9999" (initial value) or "8888".)
2)Set *Pr. 71 Applied motor* to "2" (Adjustable 5 points V/F characteristic).
3)Set the frequency and voltage you want to set in *Pr. 100 to Pr. 109*.

⚠ CAUTION

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

CAUTION

- Adjustable 5 points V/F characteristics function only under V/F control or optimum excitation control. They do not function for simple magnetic flux vector control.
- When *Pr. 19 Base frequency voltage* = "8888" or "9999", *Pr. 71* cannot be set to "2". To set *Pr. 71* to "2", set the rated voltage value in *Pr. 19*.
- When the frequency values at each point are the same, a write disable error (Er1) appears.
- Set the points (frequencies, voltages) of *Pr. 100 to Pr. 109* within the ranges of *Pr. 3 Base frequency* and *Pr. 19 Base frequency voltage*.
- When “2” is set in *Pr. 71*, *Pr. 47 Second V/F (base frequency)* will not function.
- When *Pr. 71* is set to "2", the electronic thermal relay function makes calculation as a standard motor.

REMARKS

- A greater energy saving effect can be expected by combining *Pr. 60 Energy saving control selection* and adjustable 5 points V/F.
- For the 00126 and 00170, the *Pr.0 Torque boost* and *Pr.12 DC injection brake operation voltage* settings are automatically changed according to the *Pr. 71* setting.

Pr. 71	Standard Motor Setting 0, 2, 20	Constant Torque Motor Setting 1
Pr. 0	3%	2%
Pr. 12	4%	2%

♦ Parameters referred to ♦

- *Pr. 3 Base frequency, Pr. 19 Base frequency voltage* ☞ *Refer to page 74*
- *Pr. 12 DC injection brake operation voltage* ☞ *Refer to page 92*
- *Pr. 47 Second V/F (base frequency)* ☞ *Refer to page 74*
- *Pr. 60 Energy saving control selection* ☞ *Refer to page 130*
- *Pr. 71 Applied motor* ☞ *Refer to page 91*
- *Pr. 80 Motor capacity(simple magnetic flux vector control), Pr. 90 Motor constant (R1)* ☞ *Refer to page 64*

4.6 Frequency setting by external terminals

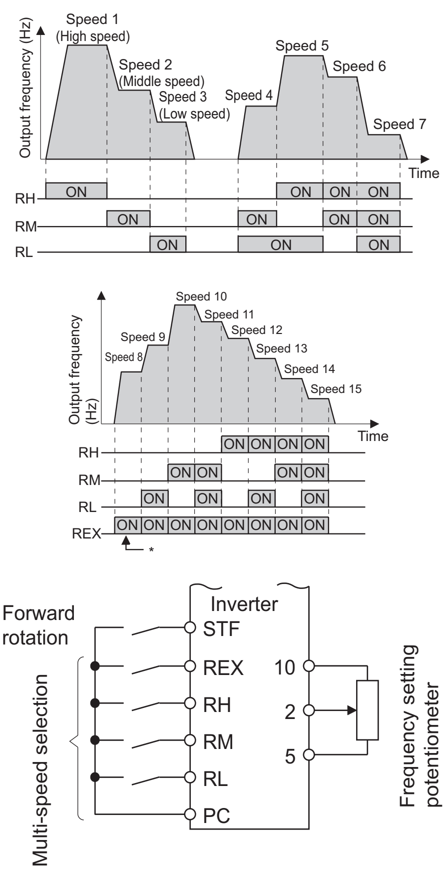
Purpose	Parameter that must be Set		Refer to Page
Make frequency setting by combination of terminals	**Multi-speed operation**	**Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239**	78
Perform jog operation	**Jog operation**	**Pr. 15, Pr. 16**	80
Added compensation for multi-speed setting and remote setting	**Multi-speed input compensation selection**	**Pr. 28**	82
Infinitely variable speed setting by terminals	**Remote setting function**	**Pr. 59**	83

4.6.1 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
4	**Multi-speed setting (high speed)**	50Hz	0 to 400Hz	Set the ferquency when RH turns on.
5	**Multi-speed setting (middle speed)**	30Hz	0 to 400Hz	Set the ferquency when RM turns on.
6	**Multi-speed setting (low speed)**	10Hz	0 to 400Hz	Set the ferquency when RL turns on.
24 *	**Multi-speed setting (speed4)**	9999	0 to 400Hz, 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 400Hz, 9999	
26 *	**Multi-speed setting (speed 6)**	9999	0 to 400Hz, 9999	
27 *	**Multi-speed setting (speed 7)**	9999	0 to 400Hz, 9999	
232 *	**Multi-speed setting (speed 8)**	9999	0 to 400Hz, 9999	
233 *	**Multi-speed setting (speed 9)**	9999	0 to 400Hz, 9999	
234 *	**Multi-speed setting (speed 10)**	9999	0 to 400Hz, 9999	
235 *	**Multi-speed setting (speed 11)**	9999	0 to 400Hz, 9999	
236 *	**Multi-speed setting (speed 12)**	9999	0 to 400Hz, 9999	
237 *	**Multi-speed setting (speed 13)**	9999	0 to 400Hz, 9999	
238 *	**Multi-speed setting (speed 14)**	9999	0 to 400Hz, 9999	
239 *	**Multi-speed setting (speed 15)**	9999	0 to 400Hz, 9999	

The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.
* The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



Multi-Speed Operation

(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)*, you can assign the signals 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. 186* to assign the function.

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

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 137* 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

- The RH, RM, RL, REX signals 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.

♦ Parameters referred to ♦

Pr. 1 Maximum frequency, Pr. 2 Minimum frequency ☞ *Refer to page 72*
Pr. 15 Jog frequency ☞ *Refer to page 80*
Pr. 28 Multi-speed input compensation selection ☞ *Refer to page 82*
Pr. 59 Remote function selection ☞ *Refer to page 83*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 96*

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

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

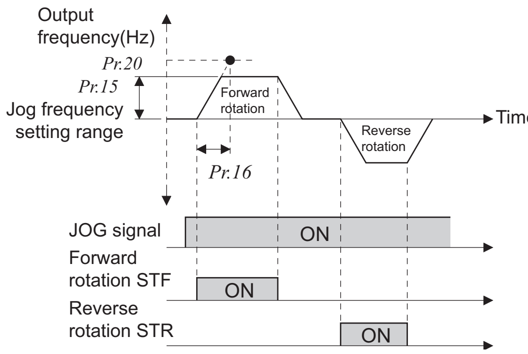
Parameter Number	Name	Initial Value	Setting Range	Description
15	**Jog frequency**	5Hz	0 to 400Hz	Set the frequency for jog operation.
16	**Jog acceleration/ deceleration time**	0.5s	0 to 3600/360s*	Set the acceleration/deceleration time for jog operation. As the acceleration/deceleration time set the time taken to reach the frequency set in *Pr. 20 Acceleration/deceleration reference frequency*. (Initial value is 60Hz) The acceleration and deceleration times cannot be set separately.

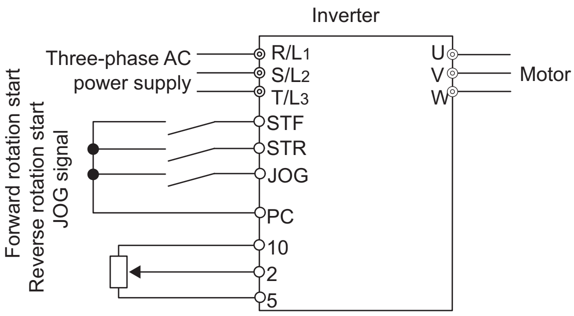
The above parameters are displayed as simple mode parameters only when the parameter unit (FR-PU04/FR-PU07) is connected. When the operation panel (FR-DU07) is connected, the above parameters can be set only when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

* 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)

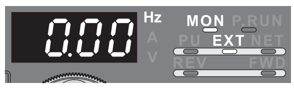




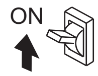
Connection diagram for external jog operation

Operation / **Indication**

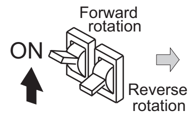
1. Screen at powering on
   - Confirm that the external operation mode is selected. ([EXT] lit)
     If not displayed, press PU/EXT to change to the external [EXT] operation mode.
     If the operation mode still does not change, set Pr. 79 to change to the external operation mode.

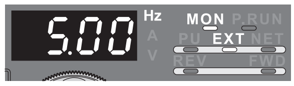


2. Turn the JOG switch on.



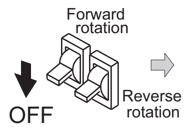
3. Turn the start switch (STF or STR) on.
   - The motor rotates while start switch (STF or STR) is ON.
   - Rotates at 5Hz. (Initial value of *Pr. 15*)

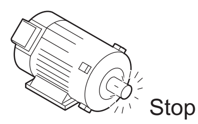




Rotates while ON

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



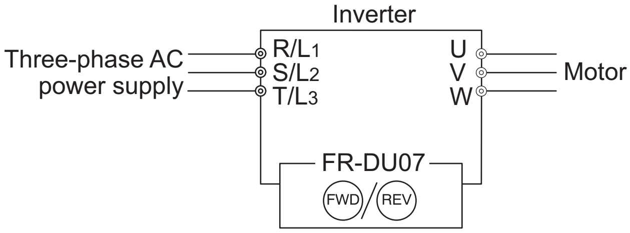


REMARKS

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

(2) Jog operation from PU

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

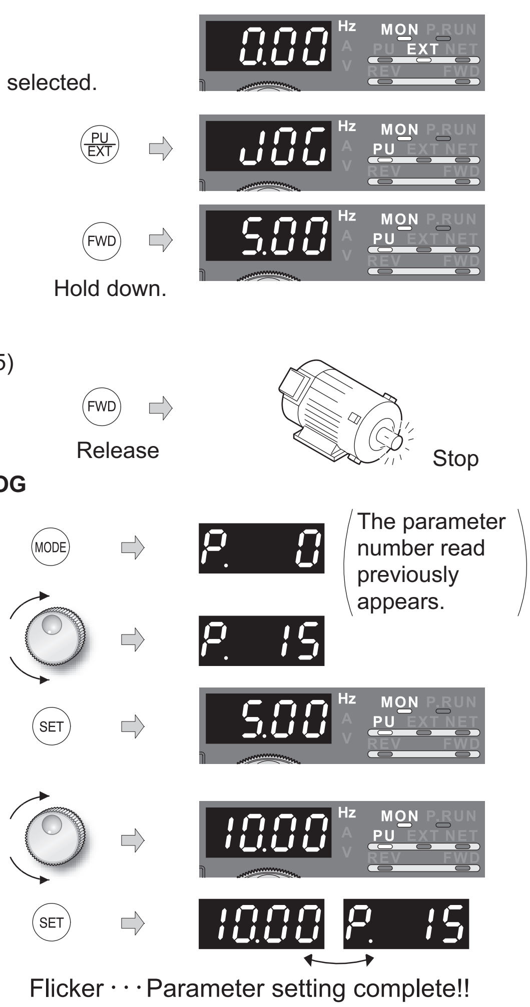


Operation / **Indication**

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

· When *Pr. 29 Acceleration/deceleration pattern selection* = "1" (S-pattern acceleration/deceleration A), the acceleration/ deceleration time is the period of time required to reach *Pr. 3 Base frequency*.
· The *Pr. 15* setting should be equal to or higher than the *Pr. 13 Starting frequency* 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 98)*)
· 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 87*
· *Pr. 29 Acceleration/deceleration pattern selection* ☞ *Refer to page 88*
· *Pr. 20 Acceleration/deceleration reference frequency, Pr. 21 Acceleration/deceleration time increments* ☞ *Refer to page 85*
· *Pr. 79 Operation mode selection* ☞ *Refer to page 155*
· *Pr. 178 to Pr. 189 (input terminal function selection)* ☞ *Refer to page 96*

4.6.3 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

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

REMARKS

· Select the compensation input voltage (0 to ±5V, 0 to ±10V) and used terminal (terminal 1, 2) using *Pr. 73 Analog input selection*.

♦ Parameters referred to ♦

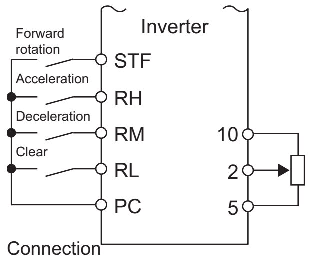
Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 (multi-speed operation) ☞ *Refer to page 78*
Pr. 73 Analog input selection ☞ *Refer to page 137*
Pr. 59 Remote function selection ☞ *Refer to page 83*

4.6.4 Remote setting function (Pr. 59)

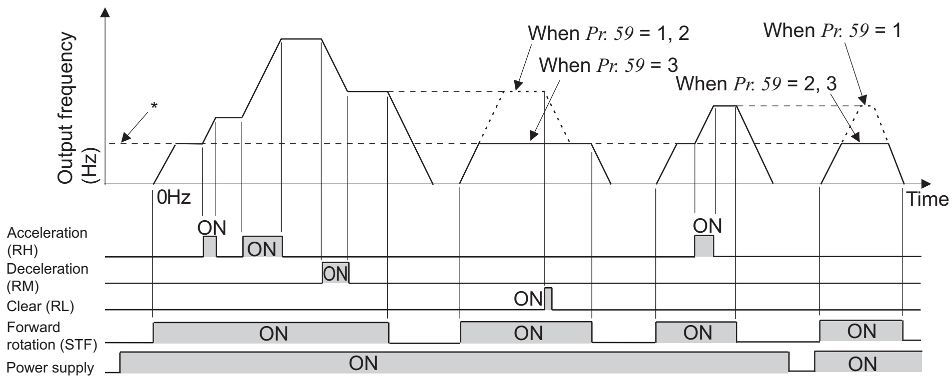
- Even if the operation panel is located away from the enclosure, you can use contact signals to perform continuous variable-speed operation, without using analog signals.

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.)

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



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" to *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)

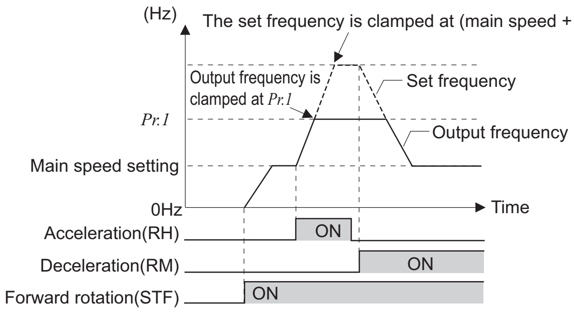
<Frequency setting storage conditions>

· 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).



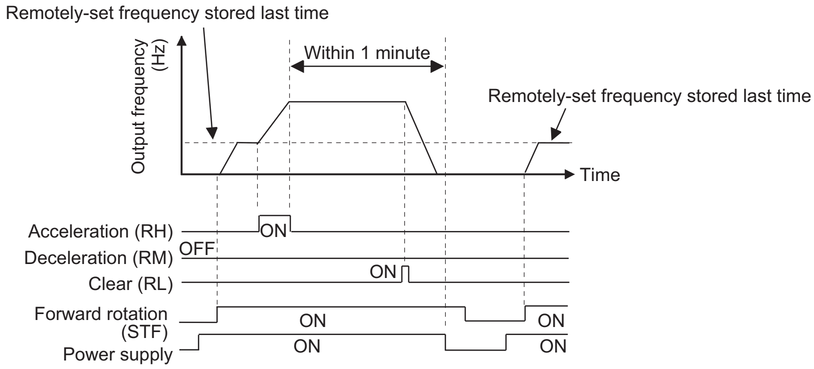
· When the acceleration or deceleration signal switches on, acceleration/deceleration time is as set in *Pr. 44 Second acceleration/deceleration time* and *Pr. 45 Second deceleration time*. Note that when long time has been set in *Pr. 7* or *Pr. 8*, the acceleration/deceleration time is as set in *Pr. 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 Second acceleration/deceleration time* and *Pr. 45 Second deceleration time*, 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

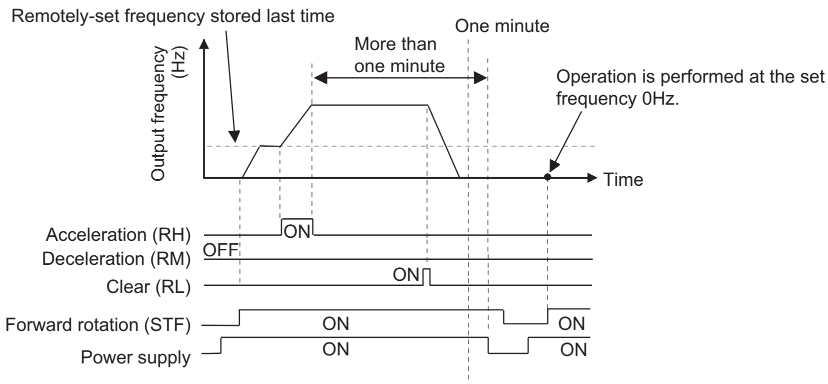
During jog operation or PID control operation, the remote setting function is invalid.

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, Pr. 18 High speed maximum frequency ☞ *Refer to page 72*
Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 44 Second acceleration/deceleration time, Pr. 45 Second deceleration time. ☞ *Refer to page 85*
Pr. 28 Multi-speed input compensation selection ☞ *Refer to page 82*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 96*

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

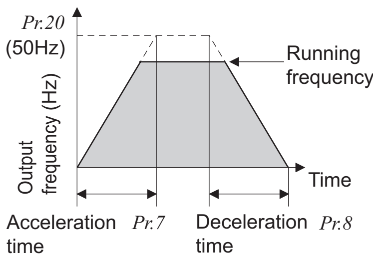
Purpose	Parameter that must be set		Refer to page
Motor acceleration/deceleration time setting	**Acceleration/deceleration times**	**Pr.7, Pr.8, Pr.20, Pr.21, Pr.44, Pr.45**	85
Starting frequency	**Starting frequency and start-time hold**	**Pr.13, Pr.571**	87
Set acceleration/deceleration pattern suitable for application	**Acceleration/deceleration pattern and back lash measures**	**Pr.29, Pr.140 to Pr.143**	88

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

Used to set motor acceleration/deceleration time.
Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease.
For the acceleration time at automatic restart after instantaneous power failure, refer to *Pr. 611 Acceleration time at a restart (page 120)*.

Parameter Number	Name	Initial Value		Setting Range	Description	
7	**Acceleration time**	00170 or less	5s	0 to 3600/ 360s *2	Set the motor acceleration time.	
		00250 or more	15s			
8	**Deceleration time**	00170 or less	10s	0 to 3600/ 360s *2	Set the motor deceleration time.	
		00250 or more	30s			
20 *1	**Acceleration/ deceleration reference frequency**	50Hz		1 to 400Hz	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 *1	**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 *1	**Second acceleration/ deceleration time**	5s		0 to 3600/360s *2	Set the acceleration/deceleration time when the RT signal is on.	
45 *1	**Second deceleration time**	9999		0 to 3600/360s *2	Set the deceleration time when the RT signal is on.	
				9999	Acceleration time = deceleration time	

*1 The parameters can be set when *Pr. 160 User group read selection* = "0" *(Refer to page 153)*
*2 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".



(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* = 50Hz (initial value), *Pr. 13* = 0.5Hz, and acceleration can be made up to the maximum operating frequency of 40Hz in 10s

$$Pr.7 = \frac{50\text{Hz}}{40\text{Hz} - 0.5\text{Hz}} \times 10\text{s} \fallingdotseq 12.7\text{s}$$

4
PARAMETERS

(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 *Pr. 20* = 120Hz, *Pr. 10* = 3Hz, and deceleration can be made up to the maximum operating frequency of 40Hz in 10s

$$Pr.8 = \frac{120\text{Hz}}{40\text{Hz} - 3\text{Hz}} \times 10\text{s} \fallingdotseq 32.4\text{s}$$

(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)*.
  (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. 44* and *Pr. 45* are valid when the RT signal is on.
- When "9999" is set in *Pr. 45*, the deceleration time becomes equal to the acceleration time *(Pr. 44)*.

CAUTION

- In S-shaped acceleration/deceleration pattern A *(refer to page 88)*, 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

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

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

- Guideline for acceleration/deceleration time when *Pr. 3 Base frequency* = 50Hz (0Hz to set frequency)

Frequency setting (Hz) / Acceleration/deceleration time (s)	50	120	200	400
5	5	16	38	145
15	15	47	115	429

- The RT 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 signal acts as the second function selection signal and makes the other second function valid. *(Refer to page 99)*
- The RT signal is assigned to the RT terminal in the default setting. 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.
- If the *Pr. 20* setting is changed, the *Pr. 125 and Pr. 126 (frequency setting signal gain frequency)* settings do not change. Set *Pr. 125 and Pr. 126* to adjust the gains.
- When the *Pr. 7, Pr. 8, Pr. 44 and Pr. 45* settings are 0.03s or less, the acceleration/deceleration time is 0.04s. At that time, set *Pr. 20* to "120Hz" or less.
- 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 ♦

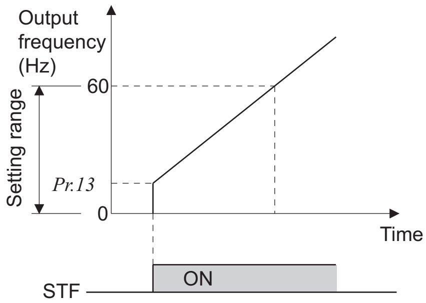
Pr. 3 Base frequency ☞ *Refer to page 74*
Pr. 10 DC injection brake operation frequency ☞ *Refer to page 92*
Pr. 29 Acceleration/deceleration pattern selection ☞ *Refer to page 88*
Pr. 125, Pr. 126 (Frequency setting gain frequency) ☞ *Refer to page 142*
Pr. 178 to Pr.189 (Input terminal function selection) ☞ *Refer to page 96*

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

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

Parameter Number	Name	Initial Value	Setting Range	Description
13	**Starting frequency**	0.5Hz	0 to 60Hz	Frequency at start can be set in the range 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

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

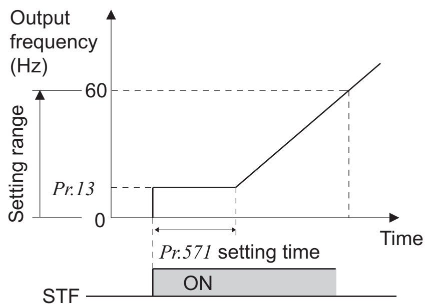


(1) Starting frequency setting *(Pr.13)*

- 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 ♦

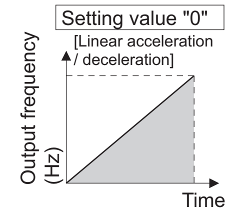
Pr.2 Minimum frequency ☞ *Refer to page 72*

4.7.3 Acceleration/deceleration pattern (Pr.29, Pr.140 to Pr.143)

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.

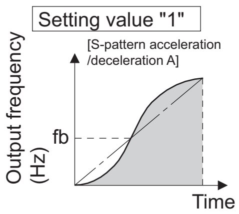
Parameter Number	Name	Initial Value	Setting Range	Description
29	**Acceleration/deceleration pattern selection**	0	0	Linear acceleration/ deceleration
			1	S-pattern acceleration/deceleration A
			2	S-pattern acceleration/deceleration B
			3	Backlash measures
140	**Backlash acceleration stopping frequency**	1Hz	0 to 400Hz	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 400Hz	
143	**Backlash deceleration stopping time**	0.5s	0 to 360s	

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



(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.

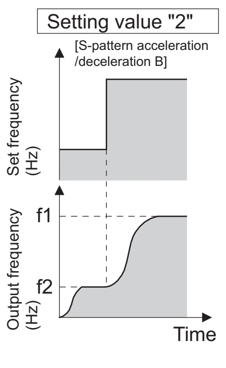


(2) S-pattern acceleration/deceleration A (*Pr. 29* = "1")

· 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, *Pr. 3 Base frequency* (fb) is the inflection point of the S pattern and you can set the acceleration/deceleration time appropriate for motor torque reduction in a constant-power operation region of base frequency or higher.

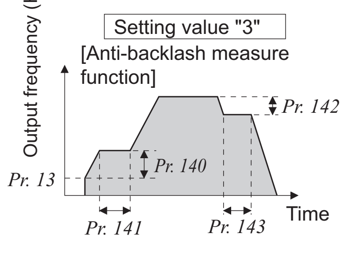
CAUTION

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



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

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



(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.

♦ Parameters referred to ♦

Pr. 3 Base frequency ☞ Refer to page 74
Pr. 7 Acceleration time, Pr. 8 Deceleration time, Pr. 20 Acceleration/deceleration reference frequency ☞ Refer to page 85

4.8 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, Pr. 51**	89
Use the constant torque motor	**Applied motor**	**Pr. 71**	91

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

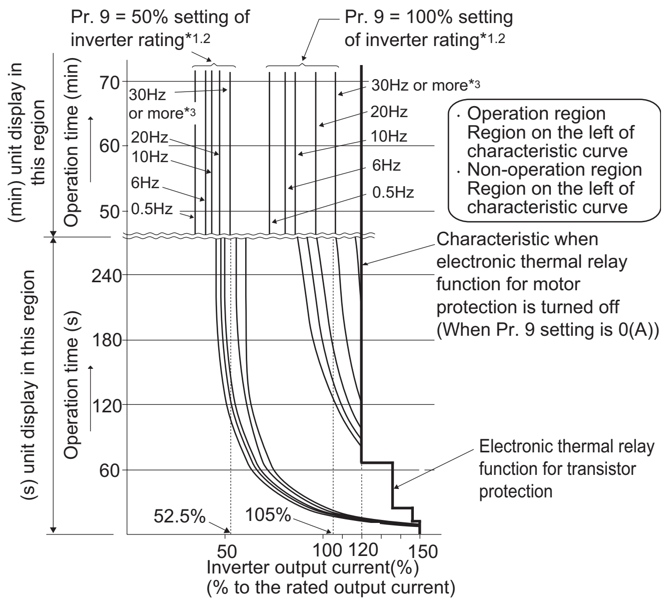
Set the current of the electronic thermal O/L relay to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

Parameter Number	Name	Initial Value	Setting Range		Description
9	**Electronic thermal O/L relay**	Rated inverter current	01160 or less	0 to 500A	Set the rated motor current.
			01800 or more	0 to 3600A	
51 *2	**Second electronic thermal O/L relay** *3	9999	01160 or less	0 to 500A	Made valid when the RT signal is on. Set the rated motor current.
			01800 or more	0 to 3600A	
			9999		Second electronic thermal O/L relay invalid

*1 The parameters can be set when *Pr. 160 User group read selection* = "0" *(Refer to page 153)*
*2 When parameter is read using the FR-PU04, a parameter name different from an actual parameter is displayed.

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

Electronic thermal 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 (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).)
· When using the Mitsubishi 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*.

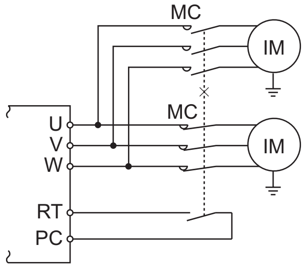
*1 When a value 50% of the inverter rated output current (current value) is set in *Pr. 9*
*2 The % value denotes the percentage to the inverter rated output current. It is not the percentage to the motor rated current.
*3 When you set the electronic thermal relay function dedicated to the Mitsubishi 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) Set multiple electronic thermal relay functions *(Pr. 51)*

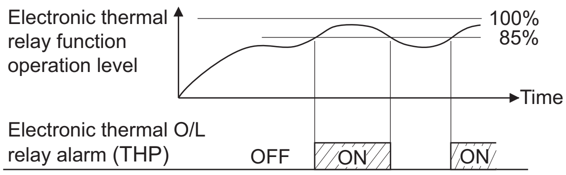
Use this function when rotating two motors of different rated currents individually by a single inverter. (When rotating two motors together, use external thermal relays.)
- Set the rated current of the second motor in *Pr. 51*.
- When the RT signal is on, thermal protection is provided based on the *Pr. 51* setting.



REMARKS
- The RT signal acts as the second function selection signal and makes the other second functions valid. *(Refer to page 98)*
- 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)*, you can assign the RT signal to the other terminal.

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

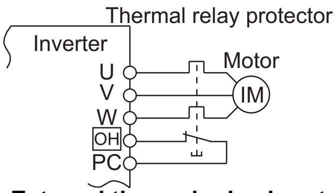
100%: Electronic thermal relay function alarm operation value



- 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
- The signal can be assigned to the input terminal using any of *Pr. 190 to Pr. 196 (output terminal function selection)*. When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.

(4) External thermal relay input (OH signal)

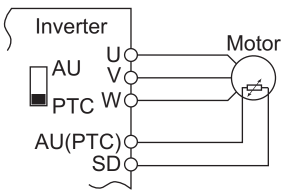


External thermal relay input connection example

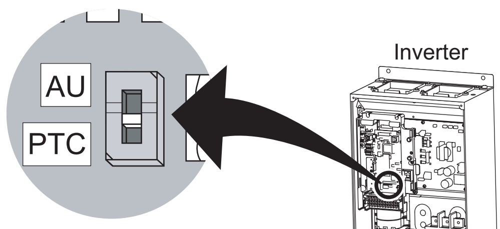
- To protect the motor against overheat, use the OH signal when using an external thermal relay or the built-in thermal protector of the motor.
- When the thermal relay operates, the inverter shuts off the output and outputs the alarm signal (E.OHT).
- For the terminal used for OH signal input, assign the function by setting "7" to any of *Pr. 178 to Pr. 189 (input terminal function selection)*

CAUTION
- The 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.

(5) 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" to *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 91*
Pr. 72 PWM frequency selection ☞ *Refer to page 136*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 96*
Pr. 190 to Pr. 196 (Output terminal function selection) ☞ *Refer to page 102*
Specifications of the AU terminal ☞ *Refer to page 22*

4.8.2 Applied motor (Pr. 71)

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, 2, 20	Selecting the standard motor or constant-torque motor sets the corresponding motor thermal characteristic.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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)	
		Standard (SF-JR, etc.)	Constant torque (SF-HRCA, etc.)
0 (initial value)	Thermal characteristics of a standard motor	○	
1	Thermal characteristics of the Mitsubishi constant-torque motor		○
2	Thermal characteristics of a standard motor Adjustable 5 points V/F*(Refer to page 77)*	○	
20	Mitsubishi standard motor SF-JR 4P(1.5kW or less)	○	

REMARKS

· For the 00126 and 00170, the *Pr. 0 Torque boost* and *Pr. 12 DC injection brake operation voltage* settings are automatically changed according to the *Pr. 71* setting as follows.

Pr. 71	Standard Motor Setting 0, 2, 20	Constant Torque Motor Setting 1
Pr. 0	3%	2%
Pr. 12	4%	2%

⚠ CAUTION

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

♦ Parameters referred to ♦

Pr. 0 Torque boost ☞ *Refer to page 63*
Pr. 12 DC injection brake operation voltage ☞ *Refer to page 92*
Pr. 100 to Pr. 109 (Adjustable 5 points V/F) ☞ *Refer to page 77*

4.9 Motor brake and stop operation

Purpose	Parameter that must be set		Refer to Page
Motor braking torque adjustment	**DC injection brake**	**Pr. 10 to Pr. 12**	92
Improve the motor braking torque with an option	**Selection of a regenerative brake**	**Pr. 30, Pr. 70**	94
Coast the motor to a stop	**Selection of motor stopping method**	**Pr. 250**	95

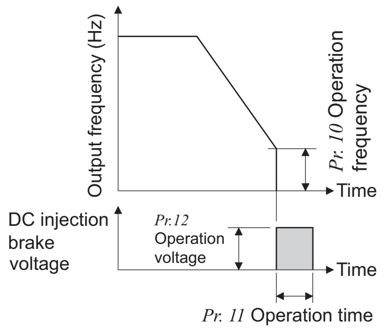
4.9.1 DC injection brake (Pr. 10 to Pr. 12)

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

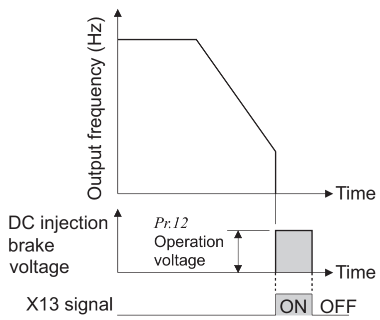
Parameter Number	Name	Initial Value		Setting Range	Description
10	**DC injection brake operation frequency**	3Hz		0 to 120Hz	Set the operation frequency of the DC injection brake.
				9999	Operated at *Pr. 13* or less.
11	**DC injection brake operation time**	0.5s		0	DC injection brake disabled
				0.1 to 10s	Set the operation time of the DC injection brake.
				8888	Operate when X13 signal is on
12	**DC injection brake operation voltage**	00170 or less	4%	0 to 30%	Set the DC injection brake voltage (torque). When "0" is set, DC injection brake is disabled.
		00250 to 01160	2%		
		01800 or more	1%		

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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



When *Pr. 11*="8888"



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

- When the frequency at which the DC injection brake operates is set in *Pr. 10*, the DC injection brake 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*.

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

- 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 while X13 signal is 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 96.)*
- When the motor does not stop due to large load moment (J), increasing the setting produces an effect.

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

- Use *Pr. 12* to set the percentage to the power supply voltage.
- When *Pr. 12* = "0%", the DC injection brake is not operated. (At a stop, the motor coasts.)
- When using the constant-torque motor (SF-JRCA) and energy saving motor (SF-HR, SF-HRCA), change the *Pr. 12* setting as follows.
  SF-JRCA: 00083 or less ...4%, 00126 to 01160...2%
  SF-HR, SF-HRCA: 00083 or less...4%, 00126 and 00170...3%, 00250 to 01160...2% (00620...1.5%)

REMARKS

- For the 00126 and 00170, when the *Pr. 12* setting is as below, changing the *Pr. 71 Applied motor* setting changes the *Pr. 12* setting automatically, it is not necessary to change the *Pr. 12* setting.
  (a) When *Pr. 12* is 4% (initial value)
  The *Pr. 12* setting is automatically changed to 2% if the *Pr. 71* value is changed from the value selecting the standard motor (0, 2) to the value selecting the constant motor (1).
  (b) When *Pr. 12* is 2%
  The *Pr. 12* setting is automatically changed to 4% if the *Pr. 71* value is changed from the value selecting the constant motor (1) to the value selecting the standard motor (0, 2).

⚠ CAUTION

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

♦ Parameters referred to ♦

Pr. 13 Starting frequency ☞ *Refer to page 87*
Pr. 71 Applied motor ☞ *Refer to page 91*

4
PARAMETERS

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

- Use the "high power factor converter (FR-HC, MT-HC) to reduce harmonics, improve the power factor, or continuously use the regenerative mode.

Parameter Number	Name	Initial Value	Setting Range	Description
30	**Regenerative function selection**	0	0	Without regenerative function, brake unit (FR-BU, BU type)
			1	Brake unit (MT-BU5), power regeneration converter (MT-RC) (Setting can be made only for the 01800 or more)
			2	High power factor converter (FR-HC, MT-HC), power regeneration common converter (FR-CV)
70	**Special regenerative brake duty**	0%	0 to 10%	Set the %ED of the brake transistor operation when using a brake unit (MT-BU5). (Setting can be made only for the 01800 or more

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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

· Set "0" (initial value) in *Pr. 30*. The *Pr. 70* setting is made invalid.

(2) When using a brake unit (MT-BU5) and power regeneration converter (MT-RC) (01800 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 (FR-HC, MT-HC) or power regeneration common converter (FR-CV)

· 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: FR-HC, MT-HC connection, FR-CV connection (inverter operation enable signal)
  To make protective coordination with the FR-HC, MT-HC or FR-CV, use the inverter operation enable signal to shut off the inverter output. Input the RDY signal of the FR-HC, MT-HC (RDYB signal of the FR-CV).
  (b) X11 signal: FR-HC, 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 FR-HC, MT-HC.
· For the terminal used for X10 or X11 signal input, assign its function by setting "10" (X10) or "11" (X11) to any of *Pr. 178 to Pr. 189*.

REMARKS

· The MRS signal can also be used instead of the X10 signal. *(Refer to page 96.)*
· Refer to *pages 30 to 34* for connection of the brake unit, high power factor converter (FR-HC, MT-HC) and power regeneration common converter (FR-CV).

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 ♦

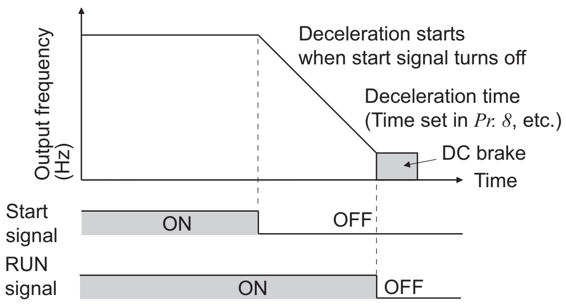
Pr. 178 to Pr.189 (input terminal function selection) ☞ *Refer to page 96*

4.9.3 Stop selection (Pr. 250)

Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns off. Used to stop the motor with a mechanical brake, etc. together with switching off of the start signal.
You can also select the operations of the start signals (STF/STR). (Refer to *page 100* for start signal selection)

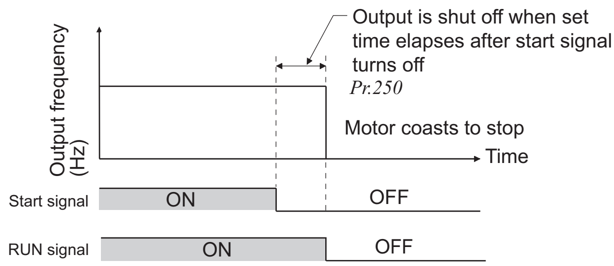
Parameter Number	Name	Initial Value	Setting Range	Description	
				Start Signal (STF/STR) *(Refer to page 100)*	Stop Operation
250	**Stop selection**	9999	0 to 100s	STF signal: Forward rotation start STR signal: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after 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	

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



(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.

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 85*
Pr. 13 Starting frequency ☞ *Refer to page 87*

4.10 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**	96
Set MRS signal (output shutoff) to normally closed contact specification	**MRS input selection**	**Pr. 17**	98
Make the second function valid only during constant speed operation.	**RT refection time selection**	**Pr. 155**	99
Assign start signal and forward/ reverse command to other signals	**Start signal (STF/STR) operation selection**	**Pr. 250**	100
Assign function to output terminal	**Output terminal function assignment**	**Pr. 190 to Pr. 196**	102
Detect output frequency.	**Up-to-frequency sensitivity Output frequency detection**	**Pr. 41 to Pr. 43, Pr. 50**	106
Detect output current.	**Output current detection Zero current detection**	**Pr. 150 to Pr. 153, Pr. 166, Pr. 167**	107
Remote output function	**Remote output**	**Pr. 495 to Pr. 497**	109

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

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

Parameters No.	Name	Initial Value	Initial Signal	Setting Range
178	**STF terminal function selection**	60	STF (forward rotation command)	0 to 8, 10 to 14, 16, 24, 25, 37, 60, 62, 64 to 67, 9999
179	**STR terminal function selection**	61	STR (reverse rotation command)	0 to 8, 10 to 14, 16, 24, 25, 37, 61, 62, 64 to 67, 9999
180	**RL terminal function selection**	0	RL (low-speed operation command)	0 to 8, 10 to 14, 16, 24, 25, 37, 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 8, 10 to 14, 16, 24, 25, 37, 62 to 67, 9999
185	**JOG terminal function selection**	5	JOG (Jog operation selection)	0 to 8, 10 to 14, 16, 24, 25, 37, 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)	

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(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		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	78
		Pr. 59 =1, 2 *1	Remote setting (setting clear)	Pr. 59	83
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	78
		Pr. 59 =1, 2 *1	Remote setting (deceleration)	Pr. 59	83
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	78
		Pr. 59 = 1, 2 *1	Remote setting (acceleration)	Pr. 59	83
3	RT	Second function selection		Pr. 44 to Pr. 51	99

Setting	Signal Name	Function	Related Parameters	Refer to Page
4	AU	Terminal 4 input selection	Pr. 267	137
5	JOG	Jog operation selection	Pr. 15, Pr. 16	80
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	120
		Commercial power supply-inverter switchover function	Pr. 57, Pr. 58 Pr. 135 to Pr. 139, Pr. 159	206
7	OH	External thermal relay input *2	Pr. 9	89
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	78
10	X10	Inverter operation enable signal (FR-HC, MT-HC/FR-CV connection)	Pr. 30	94
11	X11	FR-HC or MT-HC connection, instantaneous power failure detection	Pr. 30	94
12	X12	PU operation external interlock	Pr. 79	155
13	X13	External DC injection brake operation start	Pr. 11, Pr. 12	92
14	X14	PID control valid terminal	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	198
16	X16	PU-external operation switchover (external operation when X16 turns on)	Pr. 79, Pr. 340	161
24	MRS	Output stop	Pr. 17	98
		Commercial power supply-inverter switchover function	Pr. 57, Pr. 58 Pr. 135 to Pr. 139, Pr. 159	206
25	STOP	Start self-holding selection	—	100
37	X37	Traverse function selection	Pr. 592 to Pr. 597	220
60	STF	Forward rotation command (assigned to STF terminal *(Pr. 178)* only)	—	100
61	STR	Reverse rotation command (assigned to STR terminal *(Pr. 179)* only)	—	100
62	RES	Inverter reset	—	—
63	PTC	PTC thermistor input (assigned to AU terminal *(Pr. 184)* only)	Pr. 9	89
64	X64	PID forward/reverse action switchover	Pr. 127 to Pr. 134	198
65	X65	PU-NET operation switchover (PU operation when X65 turns on)	Pr. 79, Pr. 340	163
66	X66	External-NET operation switchover (NET operation when X66 turns on)	Pr. 79, Pr. 340	163
67	X67	Command source switchover (Pr.338 and Pr.339 commands are valid when X67 turns on)	Pr. 338, Pr. 339	164
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 The OH signal turns on when the relay contact "opens".

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 (FR-HC, MT-HC, FR-CV 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" (FR-HC/MT-HC/FR-CV 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	O	×	Within 2ms	—	Invalid
	×	O	—	Within 2ms	—
	O	O	Within 20ms	Within 2ms	Valid
Other than 2	O	×	Within 20ms	—	Valid
	×	O	—	—	—
	O	O	Within 20ms	—	Valid

4

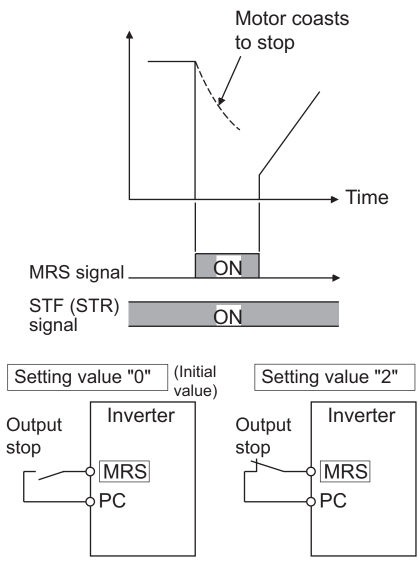
PARAMETERS

4.10.2 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	Open input always
			2	Close input always (NC contact input specifications)

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*



(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)*

· 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 RT 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 96*

4.10.3 Condition selection of function validity by the second function selection signal (RT) (RT signal, Pr. 155)

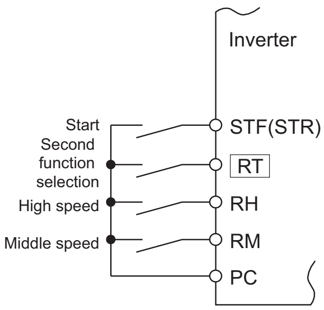
You can select the second function using the external terminal (RT signal).
You can also set the RT signal operation condition (reflection time).

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

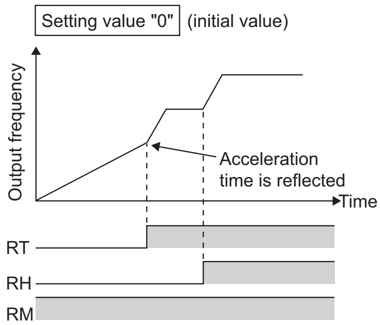
The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

- When the RT signal turns on, the second function becomes valid.
- The second function has the following applications.
  (a)Switching between normal use and emergency use
  (b)Switching between heavy load and light load
  (c)Changing of acceleration/deceleration time by broken line acceleration/deceleration
  (d)Switching of characteristic between main motor and sub motor

Second function connection diagram



Second acceleration/deceleration time example



- Functions that can be set as second functions

Function	First Function Parameter Number	Second Function Parameter Number	Refer to Page
Torque boost	Pr. 0	Pr. 46	63
Base Frequency	Pr. 3	Pr. 47	74
Acceleration time	Pr. 7	Pr. 44	85
Deceleration time	Pr. 8	Pr. 44, Pr. 45	85
Electronic thermal relay function	Pr. 9	Pr. 51	89
Stall prevention	Pr. 22	Pr. 48, Pr. 49	66
Output frequency detection	Pr. 42(Pr. 43)	Pr. 50	106

REMARKS

- The RT signal is assigned to the RT terminal in the initial setting. By setting "3" to 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 signal is on, the other functions such as the second acceleration/deceleration time 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 96*

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

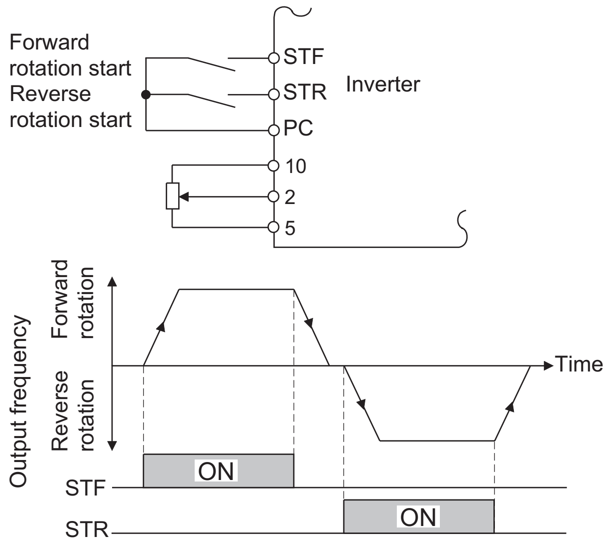
You can select the operation of the start signal (STF/STR).
Used to select the stopping method (deceleration to a stop or coasting) when the start signal turns off.
Used to stop the motor with a mechanical brake, etc. together with switching off of the start signal.
(Refer to *page 95* for stop selection)

Parameter Number	Name	Initial Value	Setting Range	Description: Start Signal (STF/STR)	Description: Stop Operation *(Refer to page 95)*
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	

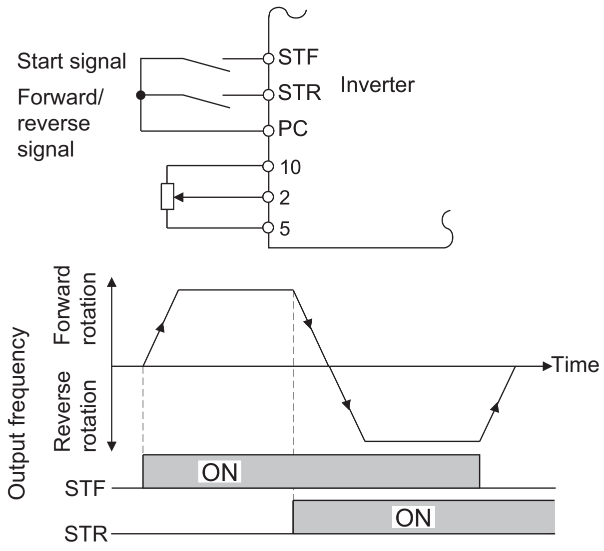
The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(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 78*)
· 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")



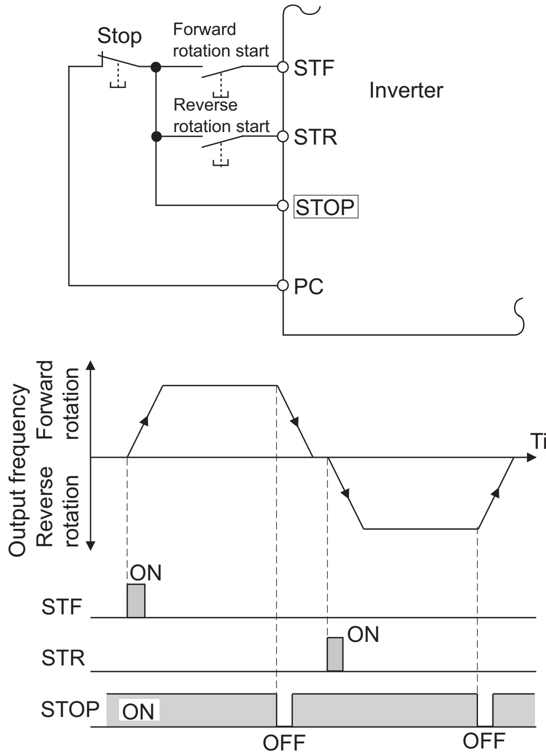
2-wire connection example (*Pr. 250* = "8888")

REMARKS

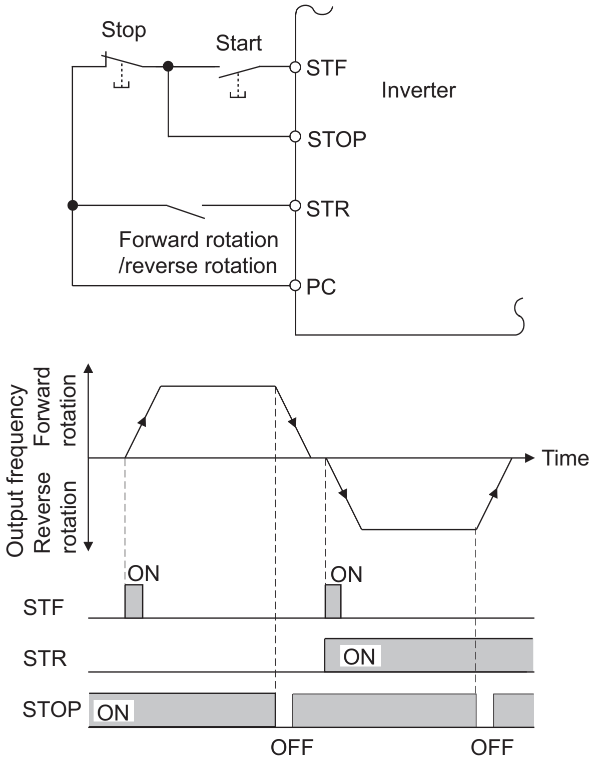
· When *Pr. 250* is set to any of "0 to 100, 1000 to 1100", the motor coasts to a stop if the start command is turned off. *(Refer to page 95)*
· The STF and STR signals are assigned to the STF and STR terminals in the initial setting. The STF signal can be assigned to *Pr. 178 STF terminal function selection* and the STR signal to *Pr. 179 STR terminal function selection* only.

(2) 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 78*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 96*

4.10.5 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
190	**RUN terminal function selection**	**Open collector output terminal**	0	RUN (inverter running)	0 to 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70 to 78, 90 to 96, 98, 99, 100 to 105, 107, 108, 110 to 116, 125, 126, 145 to 147, 164, 170, 190 to 196, 198, 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 5, 7, 8, 10 to 19, 25, 26, 45 to 47, 64, 70 to 78, 90, 91, 94 to 96, 98, 99, 100 to 105, 107, 108, 110 to 116, 125, 126, 145 to 147, 164, 170, 190, 191, 194 to 196, 198, 199, 9999
196	**ABC2 terminal function selection**		9999	No function	

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(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: Positive Logic	Setting: Negative Logic	Signal Name	Function	Operation	Related Parameters	Refer to Page
0	100	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above *Pr. 13 Starting frequency*.	—	104
1	101	SU	Up to frequency *1	Output when the output frequency is reached to the set frequency.	Pr. 41	106
2	102	IPF	Instantaneous power failure/undervoltage	Output at occurrence of an instantaneous power failure or when undervoltage protection is activated.	Pr. 57	120
3	103	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66, Pr. 148, Pr. 149, Pr. 154	66
4	104	FU	Output frequency detection	Output when the output frequency reaches the frequency setting in *Pr. 42* (*Pr. 43* for reverse rotation).	Pr. 42, Pr. 43	106
5	105	FU2	Second output frequency detection	Output when the output frequency reaches the frequency setting in *Pr. 50*.	Pr. 50	106
7	107	RBP	Regenerative brake prealarm	Output when 85% of the regenerative brake duty set in *Pr. 70* is reached. Setting can be made for the 01800 or more.	Pr. 70	94
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) actirates, when the value reached 100%.)	Pr. 9	90
10	110	PU	PU operation mode	Output when the PU operation mode is selected.	Pr. 79	155
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).	—	104
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	107
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	107

Setting		Signal Name	Function	Operation	Related Parameters	Refer to Page
Positive Logic	Negative Logic					
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	198
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.		
17	—	MC1	Commercial power-supply switchover MC1	Used when the commercial power supply-inverter switchover function is used.	Pr. 135 to Pr. 139, Pr. 159	206
18	—	MC2	Commercial power-supply switchover MC2			
19	—	MC3	Commercial power-supply switchover MC3			
25	125	FAN	Fan fault output	Output at the time of a fan fault.	Pr. 244	224
26	126	FIN	Heatsink overheat pre-alarm	Output when the heatsink temperature reaches about 85% of the heatsink overheat protection providing temperature.	—	250
45	145	RUN3	During inverter running and start command is on	Output when the inverter running and start commands are on.	—	104
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	124
47	147	PID	During PID control activated	Output during PID control.	Pr. 127 to Pr. 134, Pr. 575 to Pr. 577	198
64	164	Y64	During retry	Output during retry processing.	Pr. 65 to Pr. 69	126
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	198
71	—	RO1	Commercial-power supply side motor 1 connection RO1	Used when using advanced PID control (pump function).	Pr. 575 to Pr. 591	211
72	—	RO2	Commercial-power supply side motor 2 connection RO2			
73	—	RO3	Commercial-power supply side motor 3 connection RO3			
74	—	RO4	Commercial-power supply side motor 4 connection RO4			
75	—	RIO1	Inverter side motor 1 connection RIO1			
76	—	RIO2	Inverter side motor 2 connection RIO2			
77	—	RIO3	Inverter side motor 3 connection RIO3			
78	—	RIO4	Inverter side motor 4 connection RIO4			
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	225
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.	—	105
92	192	Y92	Power 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	131
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	228

Setting		Signal Name	Function	Operation	Related Parameters	Refer to Page
Positive Logic	Negative Logic					
94	194	ALM2	Alarm output 2	Output when the inverter's 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	—	105
95	195	Y95	Maintenance timer signal	Output when *Pr. 503* rises to or above the *Pr. 504* setting.	Pr. 503, Pr. 504	227
96	196	REM	Remote output	Output to the terminal when a value is set to the parameter.	Pr. 495 to Pr. 497	109
98	198	LF	Minor fault output	Output when a minor fault (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244	174, 224
99	199	ALM	Alarm output	Output when the inverter's protective function is activated to stop the output (major fault). The signal output is stopped when a reset turns on.	—	105
9999		—	No function	—	—	—

*1 Note that when the frequency setting is varied using an analog signal or [dial] 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.

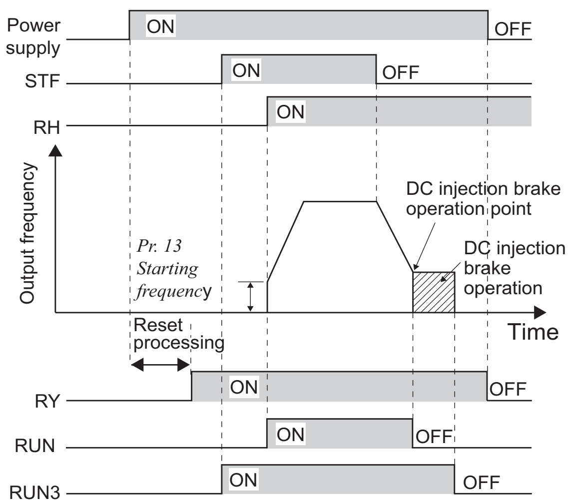
REMARKS

- 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 signal (RUN) is turned on. During an inverter stop or DC injection brake operation, the output is off.
- The output of the RUN3 signal is on when the inverter running and start signals are 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.
- When using the RY, RUN and RUN3 signals, assign functions to *Pr. 190 to Pr. 196 (output terminal selection function)* referring to the table below.

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

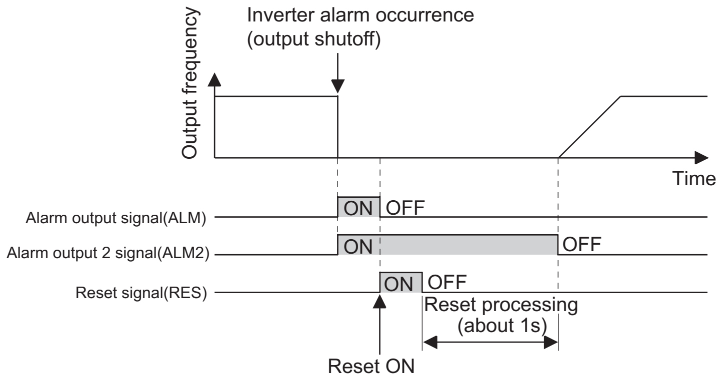
Inverter Status / Output Signal	Start Signal is OFF (during stop)	Start Signal is ON (during stop)	Start Signal is ON (during running)	Under DC Injection Brake	At Alarm Occurrence or MRS Signal is on (output shutoff)		Automatic Restart after Instantaneous Power Failure		
							Coasting		Restarting
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

REMARKS

· 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 244* 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 244* for the alarm description.)

No.	Alarm Definition
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 fault overcurrent protection(E.GF)
10	Output phase failure (E.LF)
11	Opposite rotation deceleration error (E.BE)

♦ Parameters referred to ♦

Pr. 13 Starting frequency ☞ *Refer to page 87 .*
Pr. 76 Alarm code output selection ☞ *Refer to page 128*

4

PARAMETERS

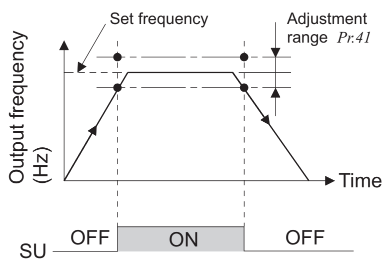
4.10.6 Detection of output frequency (SU, FU, FU2 signal, Pr. 41 to Pr. 43, Pr. 50)

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

Parameter Number	Name	Initial Value	Setting Range	Description
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 400Hz	Set the frequency where the FU signal turns on.
43	**Output frequency detection for reverse rotation**	9999	0 to 400Hz	Set the frequency where the FU signal turns on in reverse rotation.
			9999	Same as *Pr. 42* setting
50	**Second output frequency detection**	30Hz	0 to 400Hz	Set the frequency where the FU2 signal turns on.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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



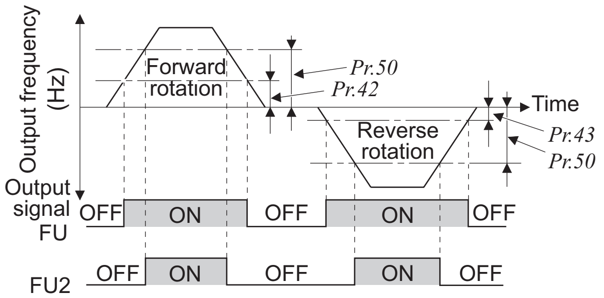
· When the output frequency reaches the set frequency, the up-to-frequency signal (SU) is output.
· The *Pr. 41* value can be adjusted within the range ±1% to ±100% on the assumption that the set frequency is 100%.
· This parameter can be used to ensure that the set frequency has been reached to provide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

REMARKS

The output frequency compared with the set frequency changes depending on the control method.

Control Method	Compared Output Frequency
V/F control	Output frequency
Simple magnetic flux vector control	Output frequency before slip compensation

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



Parameter Number	Output Signals	*Pr. 190 to Pr. 196* Setting	
		Positive logic	Negative logic
42, 43	FU	4	104
50	FU2	5	105

· 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.
· 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 vertical lift 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*. The FU2 signalis 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 left table.

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 102*

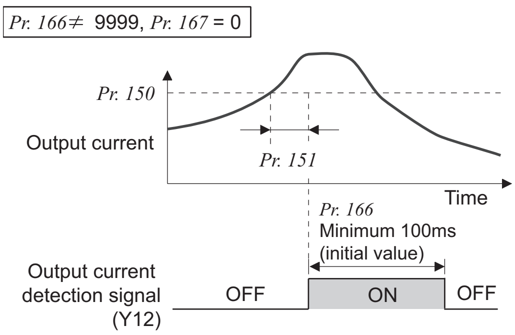
4.10.7 Output current detection function (Y12 signal, Y13 signal, Pr. 150 to Pr. 153, Pr. 166, Pr. 167)

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**	110%*	0 to 120%*	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 150%	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)

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

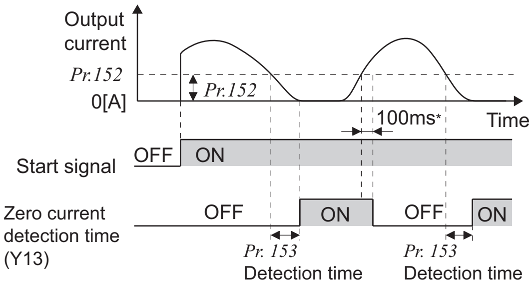
* When *Pr. 570 Multiple rating setting* = "1", performing parameter clear changes the initial value and setting range. *(Refer to page 71.)*



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

- The output power 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.
- For the X12 signal, set "12 (positive logic)" or "112 (negative logic)" in any of *Pr. 190 to Pr. 196 (output terminal function selection)* and assign the function to the output terminal.

4
PARAMETERS



* 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 output current zero signal (Y13) can be output from the inverter to close the mechanical brake when the output current has fallen to "zero".
- For the Y13 signal, set "13 (positive logic)" or "113 (negative logic)" in any of *Pr. 190 to Pr. 196 (output terminal function selection)* to 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 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 ♦

Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 102*

4.10.8 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
			1	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 can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

* 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

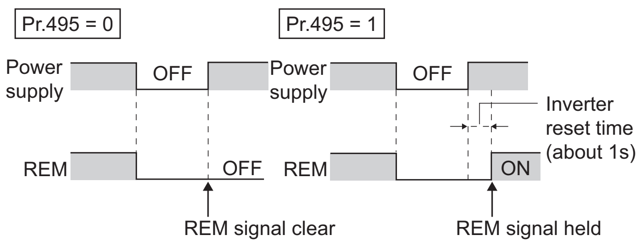
b11											b0
*1	*1	RA3 *3	RA2 *3	RA1 *3	Y6 *2	Y5 *2	Y4 *2	Y3 *2	Y2 *2	Y1 *2	Y0 *2

*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 left diagram 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 to *Pr. 190 RUN terminal function selection* and "1" (H01) is set to *Pr. 496*, the terminal RUN turns on.

ON/OFF example for positive logic



- When *Pr. 495* = "0" (initial value), performing a power supply reset (including a power failure) clears the REM signal output. (The ON/OFF states 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", 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)

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", however, they are the settings at power supply-off. (The settings are stored at power supply-off.)

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 102*

4.11 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	110
Change PU monitor display data	DU/PU main display data selection Cumulative monitor clear	Pr. 52, Pr. 170, Pr. 171, Pr. 268, Pr. 891	111
Change of the monitor output from terminal CA and AM	Terminal CA, AM function selection	Pr. 54, Pr. 158, Pr. 867, Pr. 869	116
Set the reference of the monitor output from terminal CA and AM	Setting of reference of terminal CA and AM	Pr. 55, Pr. 56, Pr. 867	116
Adjust terminal CA, AM outputs	Terminal CA, AM calibration	Pr. 900, Pr. 901, Pr. 930, Pr. 931	117

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

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 *1	Set the machine speed at 60Hz.
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.

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

$$Pr.37 \text{ (set maximum value)} < \frac{65535 \times 60 \text{ (Hz)}}{Pr.1 \text{(Hz)}}$$

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

*2 The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

· To display the machine speed, set in *Pr. 37* the machine speed for 60Hz operation.
· 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) to *Pr. 144*.
· When both *Pr. 37* and *Pr. 144* have been set, their priorities are as given below.
Pr. 144, 102 to 110 > *Pr. 37*, 1 to 9998 > *Pr. 144*, 2 to 10
· 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 *3	Hz
	2 to 10	Hz	Hz	r/min *3	Hz
	102 to 110	r/min *3	r/min *3	r/min *3	r/min *3
1 to 9998	0	Hz	Hz	Machine speed *3	Hz
	2 to 10	Machine speed *3	Machine speed *3	Machine speed *3	Machine speed *3
	102 to 110	Hz	Hz	r/min *3	Hz

*3 Motor speed r/min conversion formula............ frequency × 120/number of motor poles (*Pr. 144*)
Machine speed conversion formula.................. *Pr. 37* × frequency/60Hz
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.
*4 The increments for Hz are 0.01Hz, machine speed are 1m/min, and r/min are 1r/min.

CAUTION

· In the V/F control mode, 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.
· 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 "----".

⚠ 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 111*

4.11.2 DU/PU 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.

Parameter Number	Name	Initial Value	Setting Range	Description
52	**DU/PU main display data selection**	0 (output frequency)	0, 5, 6, 8 to 14, 17, 20, 23 to 25, 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	**CA terminal function selection**	1 (output frequency)	1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53	Select the monitor output to terminal CA.
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 can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

* 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 CA (pulse train output) in *Pr. 54 CA terminal function selection*.
· Set the monitor to be output to the terminal AM (analog 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* Parameter Setting Value		*Pr. 54* (CA) *Pr. 158* (AM) Parameter Setting Value	Full-scale value of the terminal CA 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 *5	0/100		2	*Pr. 56*	Displays the inverter output current effective value.
Output voltage	0.1V	0/100		3	400V	Displays the inverter output voltage.
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 110 .)*

Types of Monitor	Increments	*Pr. 52* Parameter Setting Value		*Pr. 54* (CA) *Pr. 158* (AM) Parameter Setting Value	Full-scale value of the terminal CA and AM	Description
		DU LED	PU main monitor			
Converter output voltage	0.1V	8	*1	8	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* (Setting can be made for the 01800 or more.)
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 *5	11	*1	11	*Pr. 56*	Retain the peak value of the output current monitor and display (clears at every start)
Converter output voltage peak value	0.1V	12	*1	12	400V class:800V	Retain the peak value of the DC bus voltage value and display (clears at every start)
Input power	0.01kW/ 0.1kW *5	13	*1	13	Rated inverter power × 2	Displays power of the inverter input side
Output power	0.01kW/ 0.1kW *5	14	*1	14	Rated inverter power × 2	Displays power of the inverter output side
Load meter	0.1%	17		17	100%	Torque current is displayed in % on the assumption that the *Pr. 56* setting is 100%
Cumulative energization time *2	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 CA:1440 pulse/s is output Terminal AM: 10V is output
Actual operation time *2*3	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 115 .)*
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 = Ioutput current monitor value/rated inverter current × 100 [%]
Cumulative power	0.01kWh/ 0.1kWh *4, *5	25		×	—	Cumulative power amount is displayed according to the output power monitor Use *Pr. 170* to clear the value. *(Refer to page 115.)*
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 132.)*
Cumulative saving power		51		×	—	
PID set point	0.1%	52		52	100%	Displays the set point, measured value and deviation during PID control *(For details, refer to page 203.)*
PID measured value	0.1%	53		53	100%	
PID deviation	0.1%	54		×	—	
Input terminal status	—	55	*1	×	—	ON/OFF status of the input terminal is displayed on the PU *(Refer to page 114 for DU display)*
Output terminal status	—		*1	×	—	ON/OFF status of the output terminal is displayed on the PU *(Refer to page 114 for DU display)*
Option input terminal status	—	56	×	×	—	ON/OFF status of the input terminal of the digital input option (FR-A7AX) is displayed on the DU *(refer to page 114 for details)*
Option output terminal status	—	57	×	×	—	ON/OFF status of the output terminal of the digital output option (FR-A7AY) and relay output option (FR-A7AR) is displayed on the DU *(refer to page 114 for details)*

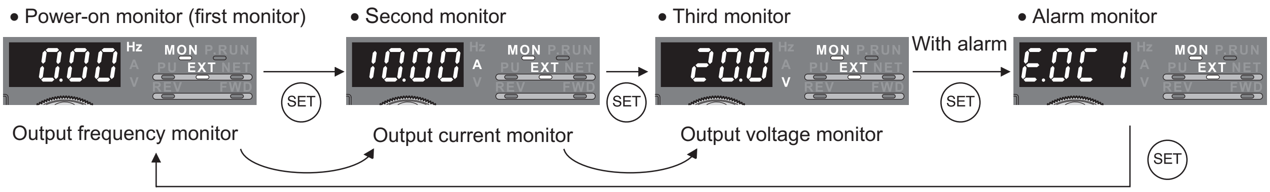
*1 Frequency setting to output terminal status on the PU main monitor are selected by "other monitor selection" of the parameter unit (FR-PU04, FR-PU07).
*2 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0. When 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.
*3 The actual operation time is not added up if the cumulative operation time before power supply-off is less than 1h.
*4 When using the parameter unit (FR-PU04/FR-PU07), "kW" is displayed.
*5 The setting depends on capacities. 01160 or less/01800 or more)

REMARKS

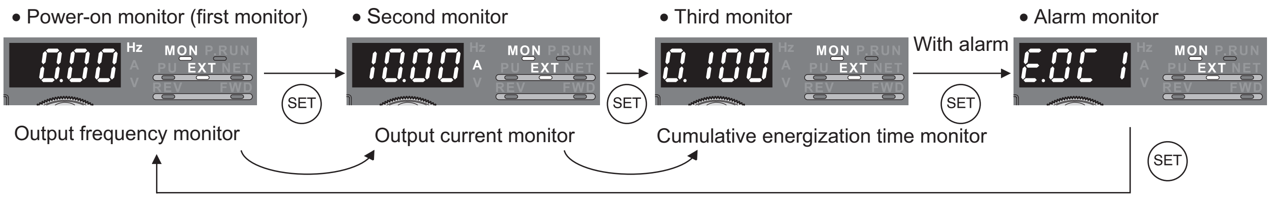
· By setting "0" in *Pr. 52*, the monitoring of output speed to alarm display can be selected in sequence by (SET).
· When the operation panel (FR-DU07) is used, the displayed units are Hz, V and A only and the others are not displayed.
· The monitor set in *Pr. 52* is displayed in the third monitor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



(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.)
When *Pr.52*="100", the set frequency displayed at a stop indicates frequency to be output when the start command is on.
Different from the frequency setting based on displayed when *Pr.52*="5", the value maximum/minimum frequency and frequency jump is displayed.

	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.

4

PARAMETERS

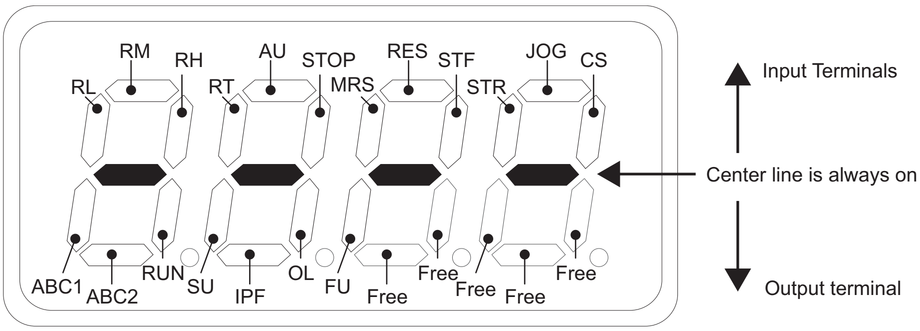
(3) Operation panel (FR-DU07) I/O terminal monitor *(Pr. 52)*

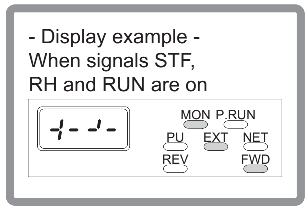
- When *Pr. 52* is set to any of "55 to 57", the I/O terminal states can be monitored on the operation panel (FR-DU07).
- The I/O terminal monitor is displayed on the third monitor.
- The LED is on when the terminal is on, and the LED is off when the terminal is off. The center line of LED is always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

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

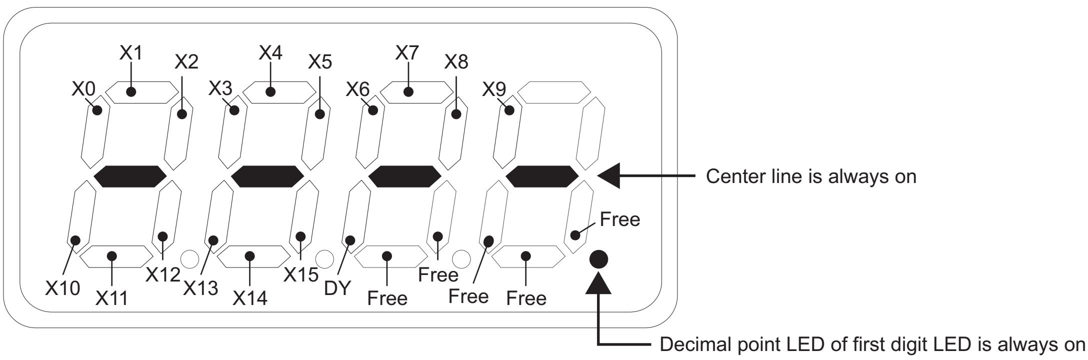
* You can set "56" or "57" even if the option is not fitted. When the option is not fitted, the monitor displays are all off.

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

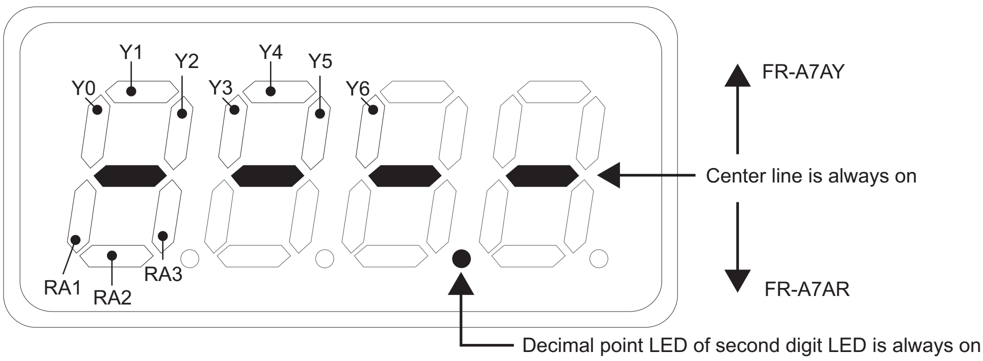




- On the input option terminal monitor (*Pr. 52*= "56"), the decimal point LED of the first digit LED is on.



- 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 units and display ranges are as indicated below.

Operation Panel *1		Parameter Unit *2		Communication		
Range	Unit	Range	Unit	Range		Unit
				Pr. 170 = 10	*Pr. 170* = 9999	
0 to 99.99kWh	0.01kWh	0 to 999.99kWh	0.01kWh	0 to 9999kWh	0 to 65535kWh (initial value)	1kWh
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 110*
Pr. 55 Frequency monitoring reference, Pr. 56 Current monitoring reference ☞ *Refer to page 116*

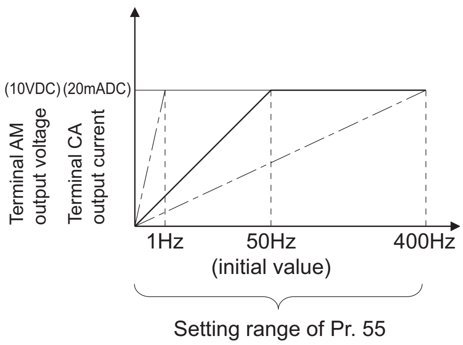
4.11.3 CA, AM terminal function selection (Pr.55, Pr.56, Pr.867, Pr.869)

For signal output, two different output terminals are available: analog current output terminal CA and analog output terminal AM.
You can select the signals output to the terminals CA, AM.

Parameter Number	Name	Initial Value	Setting Range		Description
55 *	**Frequency monitoring reference**	50Hz	0 to 400Hz		Set the full-scale value to output the output frequency monitor value to terminal CA and AM.
56 *	**Current monitoring reference**	Rated inverter current	01160 or less	0 to 500A	Set the full-scale value to output the output current monitor value to terminal CA and AM.
			01800 or more	0 to 3600A	
867	**AM output filter**	0.01s	0 to 5s		Set the output filter of terminal AM.
869	**Current output filter**	0.02s	0 to 5s		Adjust response level of current output.

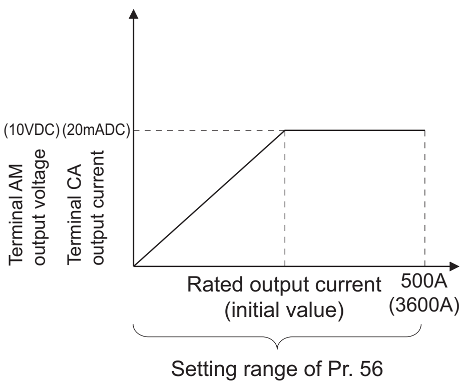
The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*
* The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

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



- Set the frequency to be referenced when the frequency monitor (output frequency/set frequency) is selected for the terminal CA and terminal AM display.
- Set the frequency when the current output at terminal CA is 20mADC.
  The analog current output and inverter output frequency at terminal CA are proportional. (The maximum output current is 20mADC.)
- Set the frequency (output frequency/set frequency) when the voltage output at terminal AM is 10VDC.
  The analog voltage output and frequency at terminal AM are proportional. (The maximum output voltage is 10VDC.)

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



- Set the current to be referenced when the current monitor (inverter output current, etc.) is selected for the terminal CA and terminal AM display.
- Set the current value when the current output at terminal CA is 20mADC.
  The analog current output and current value at terminal CA are proportional. (The maximum output current is 20mADC.)
- Set the current value when the voltage output at terminal AM is 10VDC.
  The analog voltage output and current value at terminal AM are proportional. (The maximum output voltage is 10VDC.)

(3) 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 7ms)

(4) Adjustment of response level of terminal CA *(Pr.869)*

- The response level of the output current of the terminal CA can be adjusted between 0 and 5s with Pr. 869.
- Increasing the setting stabilizes the terminal CA output more but reduces the response level. (Setting "0" sets the response level to about 7ms.)

♦ **Parameters referred to** ♦

Pr. 37 Speed display ☞ *Refer to page 110*

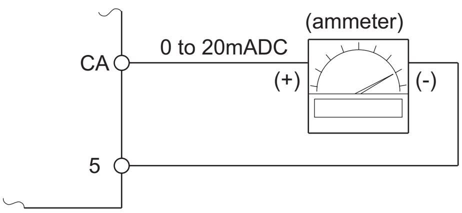
4.11.4 Terminal CA, AM calibration (Calibration parameter C0 (Pr. 900), C1 (Pr. 901), C8 (pr.930) to C11 (Pr. 931))

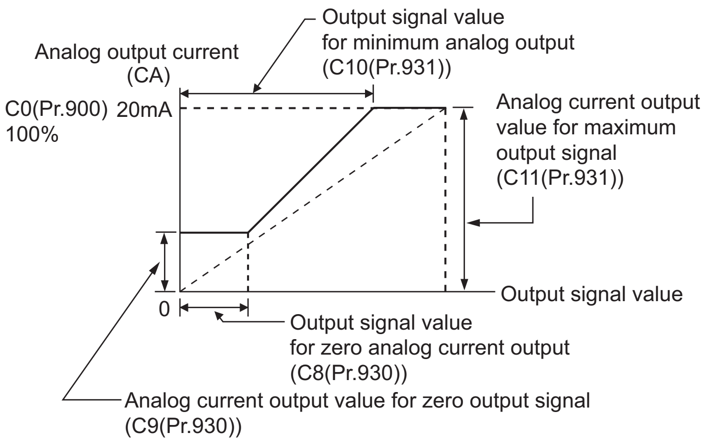
By using the operation panel or parameter unit, you can calibrate terminal CA and terminal AM to full scale deflection.

Parameter Number	Name	Initial Value	Setting Range	Description
C0(900)	**CA terminal calibration**	—	—	Calibrate the scale of the meter connected to terminal CA.
C1(901)	**AM terminal calibration**	—	—	Calibrate the scale of the analog meter connected to terminal AM.
C8(930)	**Current output bias signal**	0%	0 to 100%	Output signal value for minimum analog current output
C9(930)	**Current output bias current**	0%	0 to 100%	Output current value for minimum analog current output
C10(931)	**Current output gain signal**	100%	0 to 100%	Output signal value for maximum analog current output
C11(931)	**Current output gain current**	100%	0 to 100%	Output current value for maximum analog current output

*1 The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*
*2 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).
*3 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) CA terminal calibration (*C0(Pr. 900), C8(Pr. 930) to C11(Pr. 931)*)



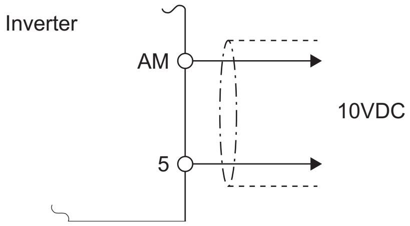


· Terminal CA is factory-set to provide a 20mADC output in the full-scale status of the corresponding monitor item. Calibration parameter *C0 (Pr. 900)* allows the output current ratios (gains) to be adjusted according to the meter scale. Note that the maximum output current is 20mADC.
· Use calibration parameters *C8(Pr. 930)* and *C9(Pr. 930)* to set a value for zero analog current output (meter points zero) . In addition, use calibration parameters *C10(Pr. 931)* and *C11(Pr. 931)* to set a value for maximum analog current output.
· Use calibration parameters *C8(Pr. 930)* and *C10(Pr.931)* to set output signal values (monitor output set in *Pr. 54*) when the current output at terminal CA is zero or maximum. At this time, the full-scale of each monitor is 100%. *(Refer to page 111)*
· Use calibration parameters *C9(Pr. 930)* and *C11(Pr.931)* to set the current output values at terminal CA when the output signal value (monitor output set in *Pr. 54*) is zero or maximum. At this time, the current output calibrated using calibration parameter *C0(Pr.900)* is 100%.

· Calibrate CA terminal in the following procedure.
1)Connect a 0-20mADC meter (DC ammeter) to across inverter terminals CA-5. (Note the polarity.Terminal CA is plus.)
2)Set calibration parameters *C8(Pr. 930)* to *C11 (Pr. 931)* to initial values. (When the meter needle does not point to 0, calibrate using *C8(Pr. 930)* and *C9(Pr. 930)*)
3)Refer to the monitor description list *(page 111)* to set *Pr. 54*.
When running frequency, inverter output current or the like has been selected as the monitor, preset in *Pr. 55* or *Pr. 56* the running frequency or current value at which the output signal is 20mA.
4)Run the inverter. (The inverter may be run in either the PU or external operation mode.)
5)Use calibration parameter *C0(Pr.900)* to set the meter needle to point to full-scale.

Remarks
· When outputting the item that cannot achieve a 100% value easily by operation, e.g. output current, set "21" (reference voltage output) in *Pr. 54* and perform calibration. (20mADC is output at terminal CA.)
· Even when calibration parameters are set as C8(Pr.930) ≥ C10(Pr.931) and C9(Pr.930) ≥ C11(Pr.931), current can be output at terminal CA.

(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 111)* and set *Pr. 158*.
  When you selected the running frequency or inverter output current as the monitor, preset the running frequency or current value, at which the output signal will be 10V, to *Pr. 55* or *Pr. 56*.
  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.

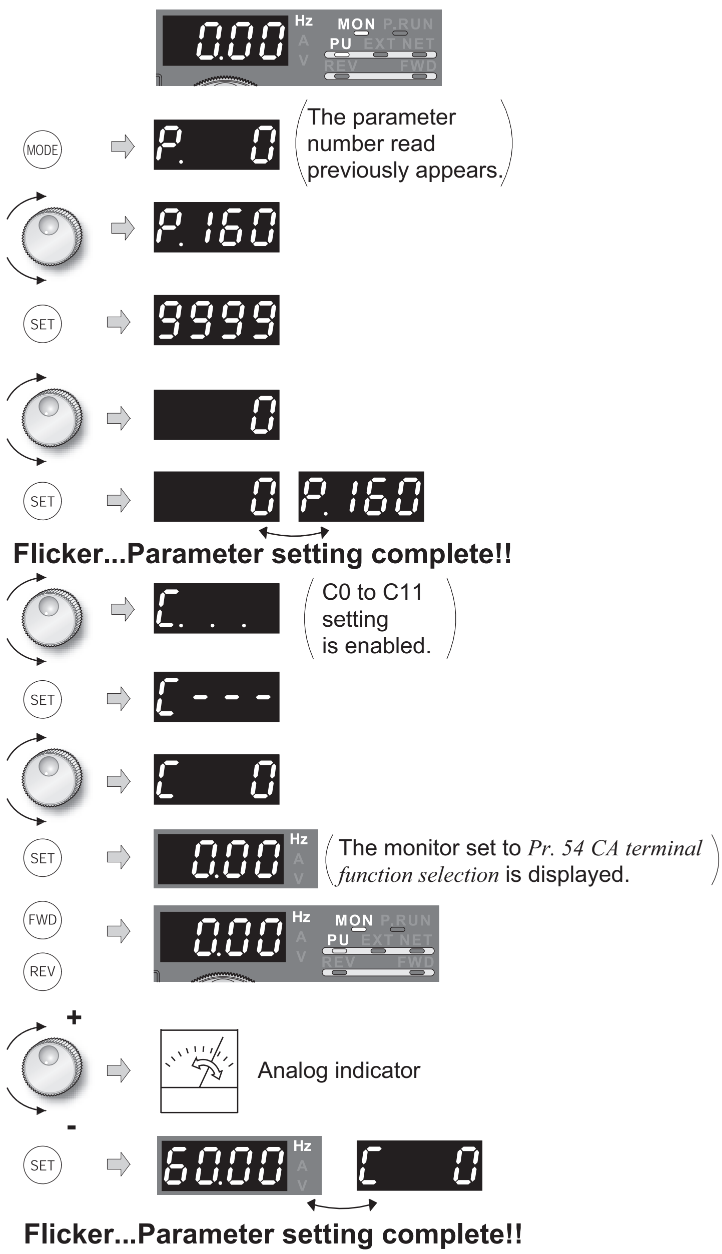
(3) How to calibrate the terminal CA when using the operation panel (FR-DU07)

Operation

1. Confirmation of the RUN indication and operation mode indication
2. Press MODE to choose the parameter setting mode.
3. Turn the setting dial until P.160 appears.
4. Press SET to read the currently set value. "9999" (initial value) appears.
5. Turn the setting dial to change it to the setting value of "0".
6. Press SET to set.
7. Turn the setting dial until C... appears.
8. Press SET to display C---.
9. Turn the setting dial until C 0 appears. Set to *C0 CA terminal calibration*.
10. Press SET to enable setting.
11. If the inverter is at a stop, (press FWD or REV) to start the inverter. (Motor needs not be connected.)
12. Turn the setting dial to adjust the indicator needle to the desired position.
13. Press SET. Setting is complete.

Display

(When Pr. 54=1)



- By turning the setting dial, you can read another parameter.
- Press SET to return to the C--- indication (step 8).
- Press SET twice to show the next parameter (Pr.CL).

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 CA terminal function selection ☞ *Refer to page 116*
Pr. 55 Frequency monitoring reference ☞ *Refer to page 116*
Pr.56 Current monitoring reference ☞ *Refer to page 116*
Pr.158 AM terminal function selection ☞ *Refer to page 116*

4.12 Operation selection at power failure and instantaneous power failure

<table>
<tr><th>Purpose</th><th colspan="2">Parameter that must be Set</th><th>Refer to Page</th></tr>
<tr><td>At instantaneous power failure occurrence, restart inverter without stopping motor</td><td>Automatic restart operation after instantaneous power failure / flying start</td><td>Pr. 57, Pr. 58, Pr. 162 to Pr. 165, Pr. 299, Pr. 611</td><td>120</td></tr>
<tr><td>When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.</td><td>Power failure-time deceleration-to-stop function</td><td>Pr. 261 to Pr. 266</td><td>124</td></tr>
</table>

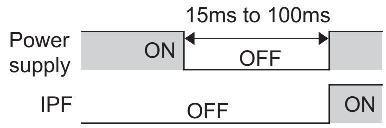
4.12.1 Automatic restart after instantaneous power failure / flying start (Pr. 57, Pr. 58, Pr. 162 to Pr. 165, Pr. 299, Pr. 611)

You can restart the inverter without stopping the motor in the following cases.
- when commercial power supply operation is switched to inverter operation
- when power comes back on after an instantaneous power failure
- when motor is coasting at start

<table>
<tr><th>Parameter Number</th><th>Name</th><th colspan="2">Initial Value</th><th colspan="2">Setting Range</th><th>Description</th></tr>
<tr><td rowspan="4">57</td><td rowspan="4">Restart coasting time</td><td rowspan="4" colspan="2">9999</td><td colspan="2">0</td><td>00038 or less 0.5s,
00052 to 00170..............................1s,
00250 to 01160 ....3.0s,
01800 or more 5.0s
The above times are coasting time.</td></tr>
<tr><td>01160 or less</td><td>0.1 to 5s</td><td rowspan="2">Set the waiting time for inverter-triggered restart after an instantaneous power failure.</td></tr>
<tr><td>01800 or more</td><td>0.1 to 30s</td></tr>
<tr><td colspan="2">9999</td><td>No restart</td></tr>
<tr><td>58</td><td>Restart cushion time</td><td colspan="2">1s</td><td colspan="2">0 to 60s</td><td>Set a voltage starting time at restart.</td></tr>
<tr><td rowspan="4">162</td><td rowspan="4">Automatic restart after instantaneous power failure selection</td><td rowspan="4" colspan="2">0</td><td colspan="2">0</td><td>With frequency search</td></tr>
<tr><td colspan="2">1</td><td>Without frequency search (Reduced voltage system)</td></tr>
<tr><td colspan="2">10</td><td>Frequency search at every start</td></tr>
<tr><td colspan="2">11</td><td>Reduced voltage system at every start</td></tr>
<tr><td>163</td><td>First cushion time for restart</td><td colspan="2">0s</td><td colspan="2">0 to 20s</td><td rowspan="2">Set a voltage starting time at restart.
Consider using these parameters according to the load (moment of inertia, torque) magnitude.</td></tr>
<tr><td>164</td><td>First cushion voltage for restart</td><td colspan="2">0%</td><td colspan="2">0 to 100%</td></tr>
<tr><td>165</td><td>Stall prevention operation level for restart</td><td colspan="2">110%*1</td><td colspan="2">0 to 120%*1</td><td>Consider the rated inverter current as 100% and set the stall prevention operation level during restart operation.</td></tr>
<tr><td rowspan="3">299</td><td rowspan="3">Rotation direction detection selection at restarting</td><td rowspan="3" colspan="2">9999</td><td colspan="2">0</td><td>Without rotation direction detection</td></tr>
<tr><td colspan="2">1</td><td>With rotation direction detection</td></tr>
<tr><td colspan="2">9999</td><td>When Pr. 78="0", the rotation direction is detected.
When Pr. 78="1","2", the rotation direction is not detected.</td></tr>
<tr><td rowspan="2">611</td><td rowspan="2">Acceleration time at a restart</td><td>01160 or less</td><td>5s</td><td rowspan="2" colspan="2">0 to 3600s, 9999</td><td rowspan="2">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.</td></tr>
<tr><td>01800 or more</td><td>15s</td></tr>
</table>

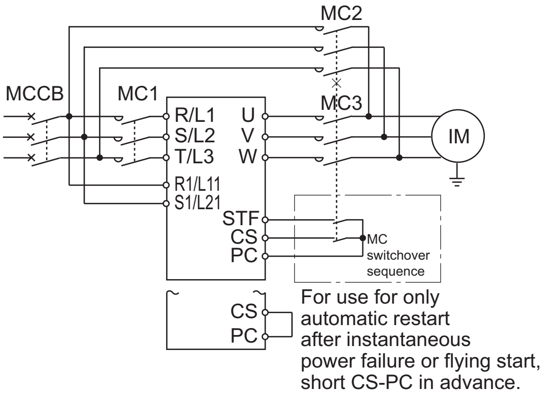
The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

*1 When *Pr. 570 Multiple rating setting* = "1", performing parameter clear changes the initial value and setting range. *(Refer to page 71.)*



(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 250* 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 and under voltage. (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)*.



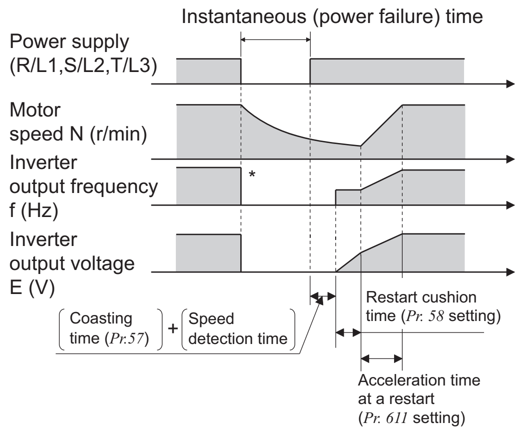
(2) Connection (CS signal)

- 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.

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



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

(3) Automatic restart operation selection *(Pr. 162, Pr. 299)*

- **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*.

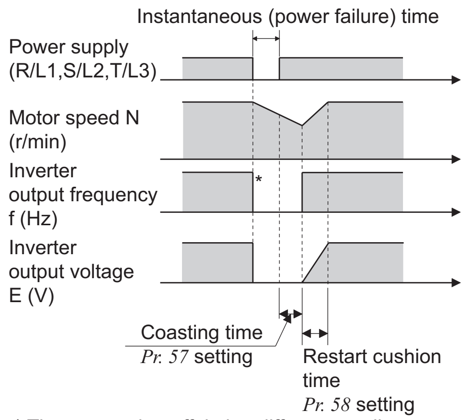
Pr.299 Setting	*Pr.78* Setting		
	0	1	2
9999 (initial value)	○	×	×
0	×	×	×
1	○	○	○

○:with rotation direction detection
×:with rotation direction detection

REMARKS

- When the inverter capacity is two rank or more larger than the motor capacity, the inverter may not start due to overcurrent (OCT) alarm.
- 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 inertia moment (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.

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



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

● **Without frequency search**

When *Pr. 162* = "1, 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.

●**Restart operation at every start**

When *Pr. 162* = "10" or "11", automatic restart operation is also performed every start, in addition to the automatic restart after instantaneous power failure. When *Pr. 162* = "0", automatic restart operation is performed at the first start after power supply-on, but not performed at the second time or later.

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

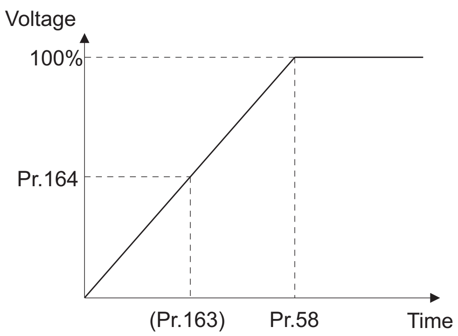
· Coasting time is the time from when the motor speed is detected until automatic restart control is started.
· Set *Pr. 57* to "0" to perform automatic restart operation. The coasting time is automatically set to the value below. Generally this setting will pose no problems.

400V class	00038 or less	00052 to 00170	00250 to 01160	01800 or more
Coasting time	0.5s	1s	3s	5s

· Operation may not be performed well depending on the magnitude of the moment of inertia(J) of the load or operation 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 of inertia(J) of the load or torque magnitude.



(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

· The 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.
· When automatic restart operation is selected, undervotage protection (E.UVT) and instantaneous power failure protection (E.IPF) among the alarm outut 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.

⚠ CAUTION

⚠ Provide mechanical interlocks for MC1 and MC2. The inverter will be damaged if the power supply is input to the inverter output section.

⚠ 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 installation guideline.

♦ Parameters referred to ♦

Pr. 7 Acceleration time, Pr. 21 Acceleration/deceleration time increments ☞ *Refer to page 85*
Pr. 13 Starting frequency ☞ *Refer to page 87*
Pr. 65, Pr. 67 to Pr. 69 Retry function ☞ *Refer to page 126*
Pr. 78 Reverse rotation prevention selection ☞ *Refer to page 153*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 96*

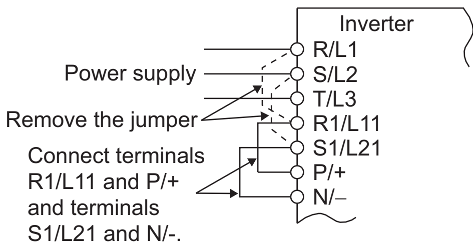
4.12.2 Power failure-time deceleration-to-stop function (Pr. 261 to Pr. 266)

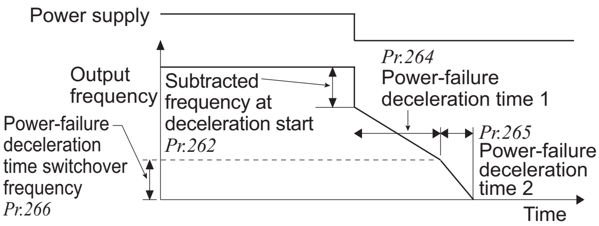
When a power failure or undervoltage occurs, the inverter can be decelerated to a stop or can be decelerated and re-accelerated to the set frequency.

Parameter Number	Name	Initial Value	Setting Range	Description
261	**Power failure stop selection**	0	0	Coasting to stop When undervoltage or power failure occurs, the inverter output is shut off.
			1	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.
			2	When undervoltage or a power failure occurs, the inverter can be decelerated to a stop. If power is restored during a power failure, the inverter accelerates again.
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**	50Hz	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 *	Set a deceleration slope down to the frequency set in *Pr. 266*.
265	**Power-failure deceleration time 2**	9999	0 to 3600/ 360s *	Set a deceleration slope below the frequency set in *Pr. 266*.
			9999	Same slope as in *Pr. 264*
266	**Power failure deceleration time switchover frequency**	50Hz	0 to 400Hz	Set the frequency at which the deceleration slope is switched from the *Pr. 264* setting to the *Pr. 265* setting.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

* 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"



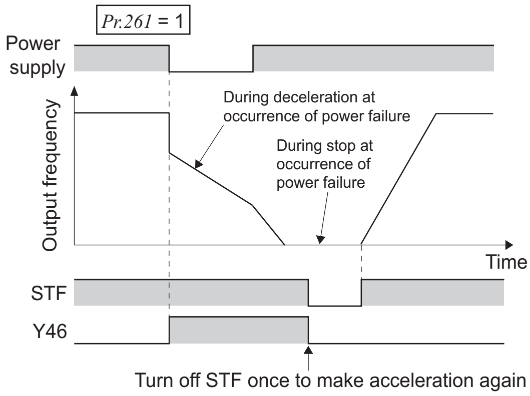


(1) Connection and parameter setting

- 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

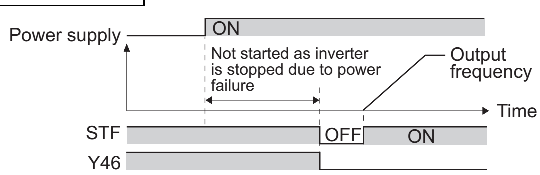
- If an undervoltage or power failure occurs, the output frequency is dropped by the frequency set in *Pr. 262* .
- Deceleration is made in the deceleration time set in *Pr. 264*. (The deceleration time setting is the time required from *Pr. 20 Acceleration/deceleration reference frequency* to a stop.)
- 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")

- 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.

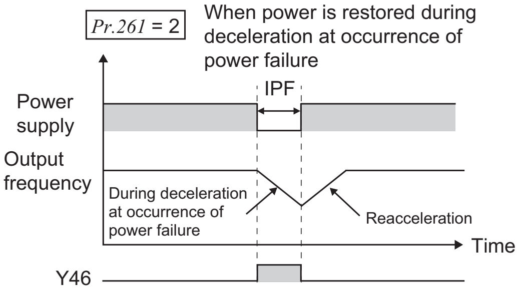
REMARKS

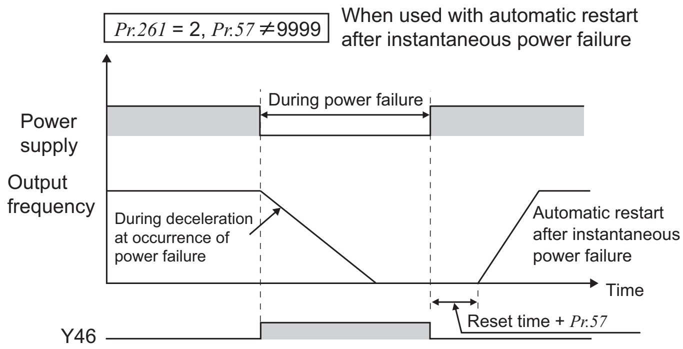


- When automatic restart after instantaneous power failure is selected (*Pr. 57* ≠ "9999"), deceleration to stop function is invalid and the restart after instantaneous power failure operation is performed.
- After a power failure stop, the inverter will not start if the power supply is switched on with 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")

- 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) 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 (forward action)" or "146 (reverse action)" 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" (FR-HC, MT-HC, FR-CV 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 terminals. 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 92*
Pr. 20 Acceleration/deceleration reference frequency, Pr. 21 Acceleration/deceleration time increments ☞ *Refer to page 85*
Pr. 30 Regenerative function selection ☞ *Refer to page 94*
Pr. 57 Restart coasting time ☞ *Refer to page 120*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 102*
Pr. 872 Input phase failure protection selection ☞ *Refer to page 129*

4.13 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**	126
Output alarm code from terminal	**Alarm code output function**	**Pr. 76**	128
Do not input/output phase failure alarm	**Input/output phase failure protection selection**	**Pr. 251, Pr. 872**	129

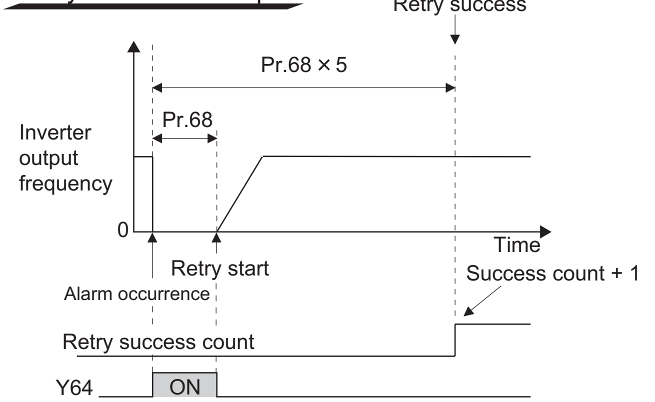
4.13.1 Retry function (Pr. 65, Pr. 67 to Pr. 69)

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 120* for the restart function.)

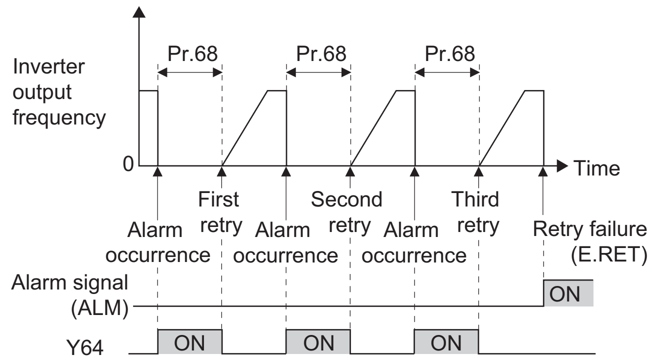
Parameter Number	Name	Initial Value	Setting Range	Description
65	**Retry selection**	0	0 to 5	An alarm for retry can be selected. *(Refer to the next page)*
67	**Number of retries at alarm occurrence**	0	0	No retry function
			1 to 10	Set the number of retries at alarm occurrence. An alarm output is 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.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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.
- 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 operation)" or "164 (negative operation)" 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 244* 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	●				●	

Alarm Display for Retry	*Pr. 65* Setting 0	1	2	3	4	5
E. GF	●				●	
E.OHT	●					
E.OLT	●				●	
E.OPT	●				●	
E.OP1	●				●	
E. PE	●				●	
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.

♦ Parameters referred to ♦

Pr. 57 Restart coasting time ☞ *Refer to page 120*

4.13.2 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)*

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

· 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.OP1	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 outut signals of *Pr. 190 to Pr. 196*.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 102*

4.13.3 Input/output phase failure protection selection (Pr. 251, Pr. 872)

You can disable the output phase protection failure 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 selection 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

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(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 124*

4.14 Energy saving operation and energy saving monitor

Purpose	Parameter that must be Set		Refer to Page
Energy saving operation	**Energy saving operation and optimum excitation control**	**Pr. 60**	130
How much energy can be saved	**Energy saving monitor**	**Pr. 52, Pr. 54, Pr. 158, Pr. 891 to Pr. 899**	131

4.14.1 Energy saving control and optimum excitation control (Pr. 60)

Without a fine parameter setting, the inverter automatically performs energy saving control.
This inverter is optimum for fan and pump applications.

Parameter Number	Name	Initial Value	Setting Range	Description
60	**Energy saving control selection ***	0	0	Normal operation mode
			4	Energy saving operation mode
			9	Optimum excitation control mode

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

(1) Energy saving operation mode (Setting "4")

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

REMARKS

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

(2) Optimum excitation control mode (Setting "9")

· When "9" is set in *Pr. 60*, the inverter operates in the optimum excitation control mode.
· The optimum excitation control mode is a control method which controls excitation current to improve the motor efficiency to maximum and determines output voltage as an energy saving method.

REMARKS

· When the motor capacity is too small as compared to the inverter capacity or two or more motors are connected to the inverter, the energy saving effect is not expected.

CAUTION

· When the energy saving mode and optimum excitation control mode are selected, deceleration time may be longer than the setting value. Since overvoltage alarm tends to occur as compared to the constant torque load characteristics, set a longer deceleration time.
· The energy saving operation mode and optimum excitation control function only under V/F control. When a value other than "9999" is set in *Pr. 80 Motor capacity(simple magnetic flux vector control)*, the energy saving mode and optimum excitation control are invalid.
· Since output voltage is controlled in energy saving operation mode and by optimum excitation control, output current may slightly increase.

♦ Parameters referred to

Pr. 80 Motor capacity(simple magnetic flux vector control) ☞ *Refer to page 64*

4.14.2 Energy saving monitor (Pr. 891 to Pr. 899)

From the power consumption estimated value during commercial power supply operation, the energy saving effect by use of the inverter can be monitored/output.

Parameter Number	Name	Initial Value	Setting Range		Description
52	**DU/PU main display data selection**	0 (output frequency)	0, 5, 6, 8 to 14, 17, 20, 23 to 25, 50 to 57, 100		50:Power saving monitor 51:Cumulative saving power monitor
54	**CA terminal function selection**	1 (output frequency)	1 to 3, 5, 6, 8 to 14, 17, 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 134)* during commercial power supply operation.
893	**Energy saving monitor reference (motor capacity)**	SLD/LD value of Applied motor Capacity	01160 or less	0.1 to 55kW	Set the motor capacity (pump capacity). Set when calculating power saving rate, power saving rate average value, commercial operation power.
			01800 or more	0 to 3600kW	
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 can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*
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) 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 CA) and *Pr. 158* (terminal AM))

	Energy Saving Monitor Item	Description and Formula	Unit	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% $\dfrac{\textbf{1) Power saving}}{\textbf{Power during commercial power supply operation}} \times 100$	0.1%	0			
		Ratio of power saving on the assumption that *Pr. 893* is 100% $\dfrac{\textbf{1) Power saving}}{Pr.\ 893} \times 100$		1			
3)	**Power saving average value**	Average value of power saving amount per hour during predetermined time (*Pr. 897*) $\dfrac{\Sigma(\textbf{1) Power saving} \times \Delta t)}{Pr.\ 897}$	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% $\dfrac{\Sigma(\textbf{2) Power saving rate} \times \Delta t)}{Pr.\ 897} \times 100$	0.1%	0			
		Ratio of power saving average value on the assumption that *Pr. 893* is 100% $\dfrac{\textbf{3) Power saving average value}}{Pr.\ 893} \times 100$		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	Unit	Parameter Setting			
				Pr. 895	*Pr. 896*	*Pr. 897*	*Pr. 899*
6)	**Power saving amount**	Power saving is added up per hour. $\Sigma(\textbf{1) Power saving} \times \Delta t)$	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 $\dfrac{\textbf{6) Power saving amount}}{\textbf{Operation time during accumulation of power saving amount}} \times 24 \times 365 \times \dfrac{Pr.\ 899}{100}$	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. (01160 or less/01800 or more)

REMARKS

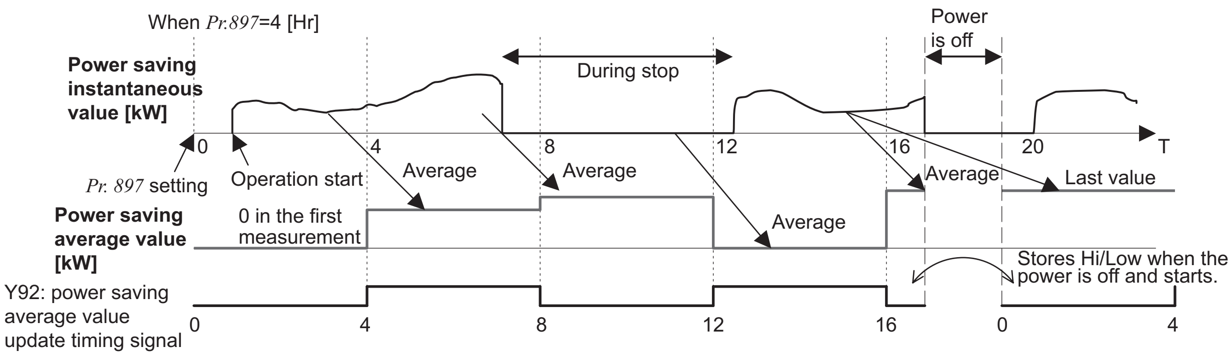
- As the operation panel (FR-DU07) is 4-digit display, it displays in 0.1 increments since a carry occurs, e.g. "100.0", when a monitor value in 0.01 increments exceeds "99.99". The maximum display is "9999".
- As the operation panel (FR-PU04/FR-PU07) is 5-digit display, it displays in 0.1 increments 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

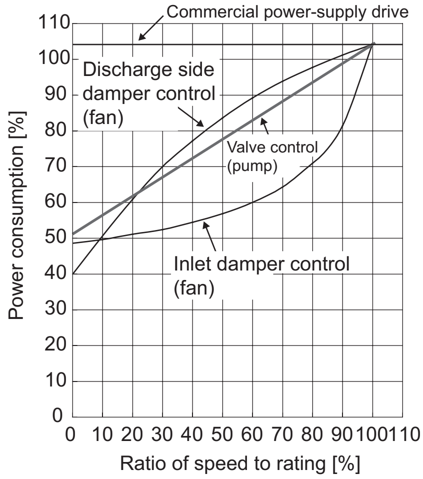
- The cumulative saving power monitor value is stored every hour. Hence, when the power supply is switched on again within one hour after it was switched off, the previously stored monitor value is displayed and totalization starts. (The cumulative monitor value may decrease)

4

PARAMETERS

(5) Power estimated value of commercial power supply operation *(Pr. 892, Pr. 893, Pr. 894)*

- Select the commercial power supply operation pattern from among the four patterns of discharge damper control (fan), inlet damper control (fan), valve control (pump) and commercial power supply drive, and set it to *Pr. 894 Control selection during commercial power-supply operation*.
- Set the motor capacity (pump capacity) in *Pr. 893 Energy saving monitor reference (motor capacity)*.
- The power consumption rate (%) during commercial power supply operation is estimated from the operation pattern and the ratio of speed to rating (current output frequency/*Pr. 3 Base frequency*) 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

$$= Pr.\ 893\ (\text{kW}) \times \frac{\text{Power consumption (\%)}}{100} \times \frac{Pr.\ 892\ (\%)}{100}$$

REMARKS

- Since the speed does not increase above the power supply frequency in commercial power supply operation, it becomes constant when the output frequency rises to or above *Pr. 3 Base frequency*.

(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*.

$$\textbf{Operation time rate (\%)} = \frac{\textbf{Annual operation time (h/year)}}{\textbf{24 (h/day) x 365 (days/year)}} \times \textbf{100(\%)}$$

REMARKS

- Operation time rate setting example: When operation is performed for about 21 hours per day and the monthly average operation days are 16 days
  Annual operation time = 21 (h/day) × 16 (days/month) × 12 months = 4032 (h/year)

  $$\text{Operation time rate (\%)} = \frac{\text{4032 (h/year)}}{\text{24 (h/day)} \times \text{365 (days/year)}} \times 100(\%) = \underline{46.03\%}$$

  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

$$\textbf{Annual power saving amount (kWh/year)} = \begin{array}{c}\textbf{Power saving average value}\\ \textbf{(kW) during totalization}\\ \textbf{when } \textit{Pr. 898} \textbf{ = 10 or 9999}\end{array} \times \textbf{24h} \times \textbf{365 days} \times \frac{\textit{Pr. 899}}{\textbf{100}}$$

- 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. 3 Base frequency ☞ *Refer to page 74*
Pr. 52 DU/PU main display data selection ☞ *Refer to page 111*
Pr. 54 CA terminal function selection ☞ *Refer to page 116*
Pr. 158 AM terminal function selection ☞ *Refer to page 116*

4.15 Motor noise, noise reduction

4.15.1 PWM carrier frequency and Soft-PWM control (Pr. 72, Pr. 240, Pr. 260)

You can change the motor sound.

Parameter Number	Name	Initial Value	Setting Range		Description
72 *	PWM frequency selection	2	01160 or less	0 to 15	PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz, 15 indicates 14.5kHz and 25 indicates 2.5kHz. (25 is exclusively for a sine wave filter.)
			01800 or more	0 to 6, 25	
240 *	Soft-PWM operation selection	1	0		Soft-PWM is invalid
			1		When *Pr. 72* = "0 to 5" ("0 to 4" for 01800 or more), soft-PWM is valid.
260	PWM frequency automatic switchover	1	0		PWM carrier frequency is constant independently of load. When the carrier frequency is set to 3kHz or more (*Pr. 72* ≥ "3"), perform continuous operation at less than 85% of the rated inverter current.
			1		Decreases PWM carrier frequency automatically when load increases.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*
* 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) PWM carrier frequency changing *(Pr. 72)*

· You can change the PWM carrier frequency of the inverter.
· Changing the PWM carrier frequency produces an effect on avoiding the resonance frequency of a mechanical system or motor or on reducing noise or leakage current generated from the inverter.
· When using an option sine wave filter (MT-BSL/BSC) for the 01800 or more, set "25"(2.5kHz) in *Pr. 72*.

(2) Soft-PWM control *(Pr. 240)*

· Soft-PWM control is a control method that changes the motor noise from a metallic tone into an unoffending complex tone.

(3) PWM carrier frequency automatic reduction function *(Pr. 260)*

· When continuous operation is performed at 85% or more of the inverter rated current (the parenthesized value of the rated output current on *page 274* or more) with the carrier frequency of the inverter set to 3kHz or more (*Pr. 72* ≥ "3"), the carrier frequency is automatically reduced to 2kHz to protect the output transistor of the inverter. (Motor noise increases, but it is not a failure)
· When *Pr. 260* is set to"0", the carrier frequency becomes constant (*Pr. 72* setting) independently of the load, making the motor sound uniform.
Note that continuous operation should be performed at less than 85% of the inverter rating.

CAUTION

· Decreasing the PWM carrier frequency reduces inverter-generated noise and leakage current, but increases motor noise.
· When *Pr. 570* = "0" (initial value), functions of *Pr. 260* become invalid. PWM carrier frequency automatically decreases when load increases. *(Refer to page 71.)*
· When PWM carrier frequency is set to 1kHz or less (*Pr.72*≤1), fast response current limit may function prior to stall prevention operation due to increase in harmonic currents depending on the motor, resulting in insufficient torque. In such case, set fast-response current limit operation invalid using *Pr.156 Stall prevention operation selection*.

♦ Parameters referred to ♦

Pr.156 Stall prevention operation selection ☞ *Refer to page 66*

4.16 Frequency setting by analog input (terminal 1, 2, 4)

Purpose	Parameter that must be Set		Refer to Page
Selection of voltage/current input (terminal 1, 2, 4) Perform forward/ reverse rotation by analog input.	**Analog input selection**	**Pr. 73, Pr. 267**	137
Adjust the main speed by analog auxiliary input.	**Analog auxiliary input and compensation (added compensation and override function)**	**Pr. 73, Pr. 242, Pr. 243, Pr. 252, Pr. 253**	140
Noise elimination at the analog input	**Input filter**	**Pr. 74**	141
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)**	142

4.16.1 Analog input selection (Pr. 73, Pr. 267)

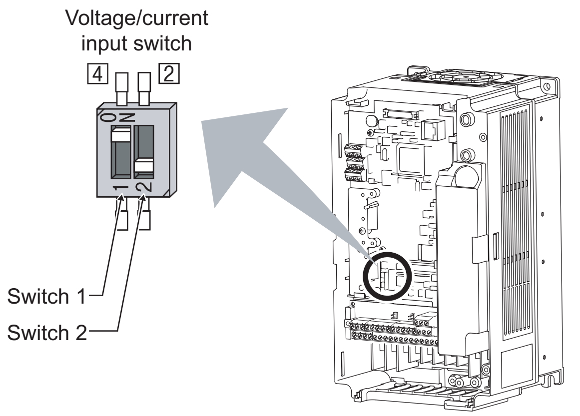
You can select the function that switches between forward rotation and reverse rotation according to the analog input terminal selection specifications, the override function and the input signal polarity.

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 ±5V, 0 to ±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

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(1) Selection of analog input selection

- For the terminals 2, 4 used for analog input, voltage input (0 to 5V, 0 to 10V) or current input (4 to 20mA) can be selected. Change parameters (*Pr.73, Pr.267*) and a voltage/current input switch (switch 1, 2) to change input specifications.



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)s

- Rated specifications of terminal 2 and 4 change according to the voltage/current input switch setting.
  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)

4

PARAMETERS

· 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 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	When the AU signal is on According to *Pr. 267* setting 0: 4 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.

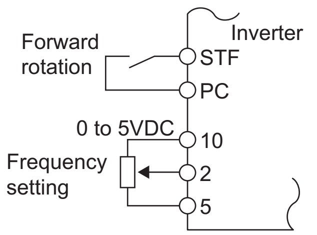
Terminal 2 Input Specifications	*Pr. 73* Setting	Switch 2
Voltage input (0 to 10V)	0, 2, 4, 10, 12, 14	OFF
Voltage input (0 to 5V)	1 (initial value), 3, 5, 11, 13, 15	OFF
Current input (0 to 20mA)	6, 7, 16, 17	ON

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

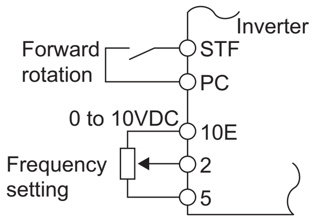
indicates an initial value.

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. 22 Stall prevention operation level* = "9999", the value of the terminal 1 is as set to the stall prevention operation level.



Connection diagram using terminal 2 (0 to 5VDC)



Connection diagram using terminal 2 (0 to 10VDC)

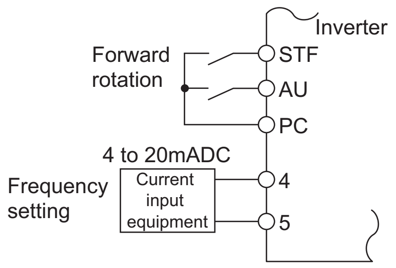
(2) Perform operation by analog input voltage

- 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	0.024/50Hz	0 to 5VDC input
10E	10VDC	0.012/50Hz	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* changes the terminal 4 to the voltage input specification. When the AU signal turns on, the terminal 4 input becomes valid.

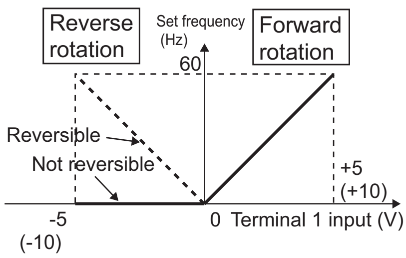
REMARKS
The wiring length of the terminal 10, 2, 5 should be 30m maximum.



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 4 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* 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 66*
Pr. 125 Terminal 2 frequency setting gain frequency, Pr. 126 Terminal 4 frequency setting gain frequency ☞ *Refer to page 142*
Pr. 252, Pr. 253 Override bias/gain ☞ *Refer to page 140*

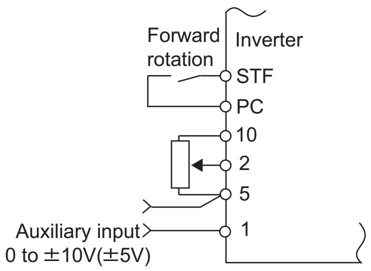
4.16.2 Analog input compensation (Pr. 73, Pr. 242, Pr. 243, Pr. 252, Pr. 253)

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.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(1) Added compensation *(Pr. 242, Pr. 243)*



Added compensation connection example

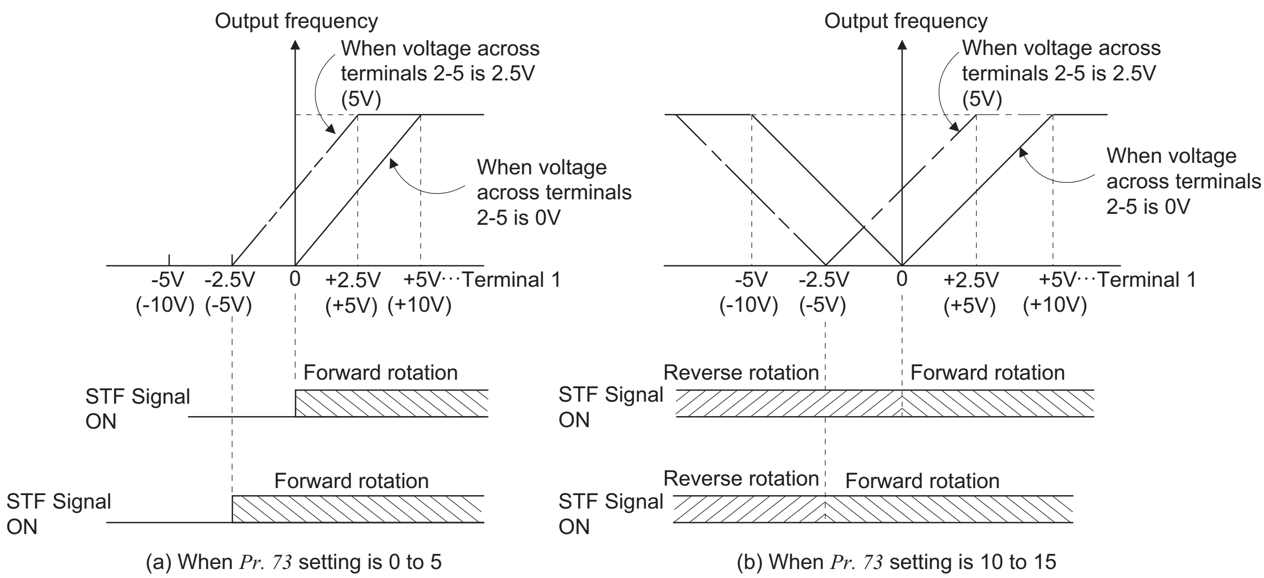
- The compensation signal can be input for the main speed setting for synchronous/continuous speed control operation, etc.
- Setting any of "0 to 3, 6, 7, 10 to 13, 16, 17" in *Pr. 73* adds the voltage across terminals 1-5 to the voltage signal across terminals 2-5.
- If the result of addition is negative, 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

$$= \text{Terminal 2 input} + \text{Terminal 1 input} \times \frac{Pr.\ 242}{100(\%)}$$

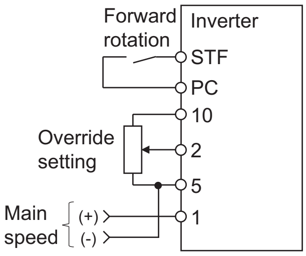
Analog command value using terminal 4

$$= \text{Terminal 4 input} + \text{Terminal 1 input} \times \frac{Pr.\ 243}{100(\%)}$$



Auxiliary input characteristics

(2) Override function *(Pr. 252, Pr. 253)*

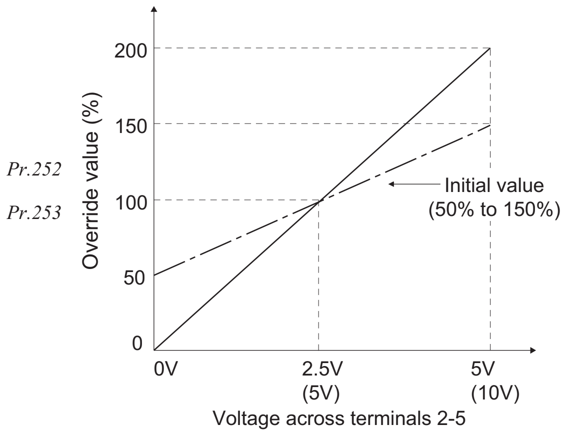


Override connection diagram

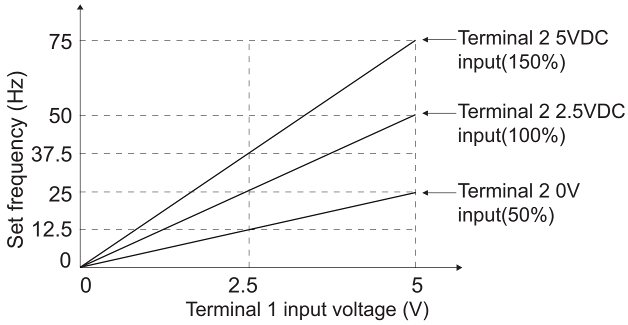
- Use the override function to change the main speed at a fixed ratio.
- Set any of "4, 5, 14, 15" in *Pr. 73* to select an override.
- When an override is selected, the terminal 1 or terminal 4 is used for the main speed setting and the terminal 2 for the override signal. (When the main speed of the 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 137* 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) to *Pr. 28 Multi-speed input compensation selection*. (Initial value is "0")

♦ Parameters referred to ♦

Pr. 28 Multi-speed input compensation selection ☞ *Refer to page 82*
Pr. 73 Analog input selection ☞ *Refer to page 137*

4.16.3 Response level of analog input and noise elimination (Pr. 74)

The time constant of the primary delay filter relative to external frequency command (analog input (terminal 1, 2, 4) signal) can be set.

Parameter Number	Name	Initial Value	Setting Range	Description
74	**Input filter time constant**	1	0 to 8	Set the primary delay filter time constant for the analog input. A larger setting results in slower response.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

- 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.)

4

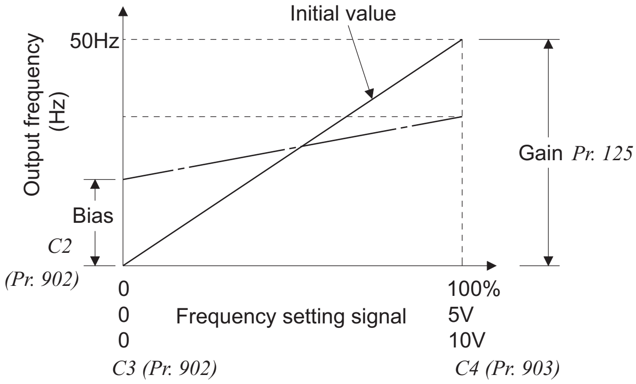
PARAMETERS

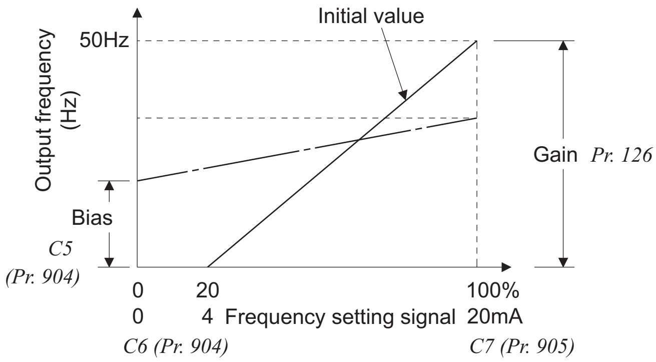
4.16.4 Bias and gain of frequency setting voltage (current) (Pr. 125, Pr. 126, Pr. 241, C2(Pr. 902) to C7(Pr. 905))

You can set the magnitude (slope) of the output frequency as desired in relation to the frequency setting signal (0 to 5V, 0 to 10V or 4 to 20mADC).
Set *Pr. 73* and *Pr. 267* to switch between 0 to 5VDC, 0 to 10VDC and 4 to 20mADC. *(Refer to page 137)*

Parameter Number	Name	Initial Value	Setting Range	Description	
125	**Terminal 2 frequency setting gain frequency**	50Hz	0 to 400Hz	Set the frequency of terminal 2 input gain (maximum).	
126	**Terminal 4 frequency setting gain frequency**	50Hz	0 to 400Hz	Set the frequency of terminal 4 input gain (maximum).	
241 *1, 3	**Analog input display unit switchover**	0	0	Displayed in %	Select the unit of analog input display.
			1	Displayed in V/mA	
C2(902) *1, 2	**Terminal 2 frequency setting bias frequency**	0Hz	0 to 400Hz	Set the frequency on the bias side of terminal 2 input.	
C3(902) *1, 2	**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, 2	**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, 2	**Terminal 4 frequency setting bias frequency**	0Hz	0 to 400Hz	Set the frequency on the bias side of terminal 4 input.	
C6(904) *1, 2	**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, 2	**Terminal 4 frequency setting gain**	100%	0 to 300%	Set the converted % of the gain side current (voltage) of terminal 4 input.	

*1 The parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*
*2 The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/FR-PU07).
*3 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) 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)

(2) Analog input bias/gain calibration (*C2(Pr. 902) to C7(Pr. 905)*,)

· The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the inverter to set the output frequency, e.g. 0 to 5V, 0 to 10V or 0 to 20mADC, and the output frequency.
· Set the bias frequency of the terminal 2 input using *C2 (Pr. 902)*. (initial 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)*. (initial set to the frequency at 4mA)
· Using *Pr. 126*, set the output frequency relative to 20mA of the frequency command current (0 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 144*
(b) Method to adjust any point without application of a voltage (current) to across terminals 2-5(4-5). ☞ *page 145*
(c) Adjusting only the frequency without adjusting the voltage (current). ☞ *page 146*

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* and *Pr. 267*, be sure to make calibration.

(3) Analog input display unit changing *(Pr. 241)*

· You can change the analog input display unit (%/V/mA) for analog input bias/gain calibration.
· Depending on the terminal input specification set to *Pr. 73* and *Pr. 267*, 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*)	*Pr. 241* = 0 (initial value)	*Pr. 241* = 1
0 to 5V input	0 to 5V → 0 to 100%(0.1%) is desplayed.	0 to 100% → 0 to 5V(0.01V) is desplayed.
0 to 10V input	0 to 10V → 0 to 100%(0.1%) is desplayed.	0 to 100% → 0 to 10V(0.01V) is desplayed.
4 to 20mA input	0 to 20mA → 0 to 100%(0.1%) is desplayed.	0 to 100% → 0 to 20mA(0.01mA) is desplayed.

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.
· Set "0" (initial value is 0% display) in *Pr. 241* to use.

If the gain and bias frequency settings are too close, an error (Er3) may be displayed at the time of write.

(4) Frequency setting signal (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 PU
2. Press MODE to choose the parameter setting mode.	MODE ⇨ P. 0 (The parameter number read previously appears.)
3. Turn the setting dial until P. 160 appears.	⇨ P. 160
4. Press SET to read the currently set value. "9999" (initial value) appears.	SET ⇨ 9999
5. Turn the setting dial to change it to the setting value of "0".	⇨ 0
6. Press SET to set.	SET ⇨ 0 ⇄ P. 160 Flicker...Parameter setting complete!!
7. Turn the setting dial until C. . . appears.	⇨ C. . .
8. Press SET to display C - - -.	SET ⇨ C - - - (C0 to C7 setting is enabled.)
9. Turn the setting dial until C. 4 (C. 7) appears. Set to C4 Terminal 2 frequency setting gain.	⇨ C 4 Voltage input / C 7 Current input
10. Press SET to display the analog voltage (current) value (%).	SET ⇨ 0.0 (Analog voltage (current) value (%) across terminals 2-5 (across terminals 4-5))
11. Apply a 5V (20mA) voltage (current). (Turn the external potentiomerter 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 10, do not touch the setting dial until completion of calibration.

Operation	Display
12. 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 the setting dial, you can read another parameter.
- Press SET to return to the C - - - indication (step 8).
- Press SET twice to show the next parameter (Pr.CL).

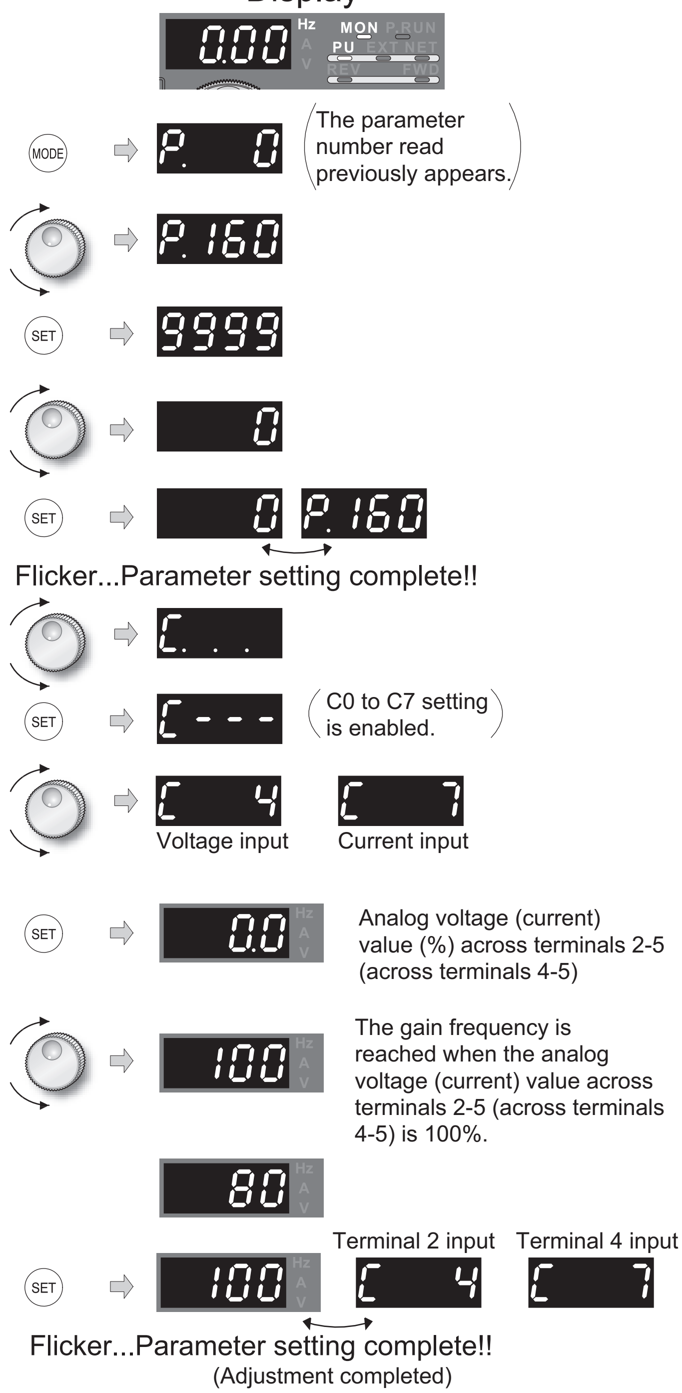
(b) Method to adjust any point without application of a voltage (current) to across terminals 2-5(4-5).
(To change from 4V (80%) to 5V (100%))

Operation

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)
2. Press MODE to choose the parameter setting mode.
3. Turn the setting dial until P. 160 appears.
4. Press SET to read the currently set value. "9999" (initial value) appears.
5. Turn the setting dial to change it to the setting value of "0".
6. Press SET to set.
7. Turn the setting dial until C. . . appears.
8. Press SET to display C - - -.
9. Turn the setting dial until C. 4 (C. 7) appears. Set to C4 Terminal 2 frequency setting gain.
10. Press SET to display the analog voltage (current) value (%).
11. Turn the setting 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 setting dial is displayed.
12. Press SET to set.

Display



- By turning the setting dial, you can read another parameter.
- Press SET to return to the C - - - indication (step 8).
- Press SET twice to show the next parameter (Pr.CL).

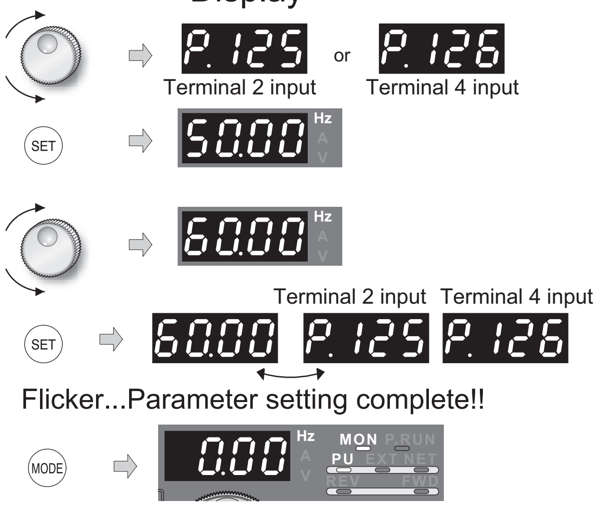
REMARKS

By pressing the setting dial after step 10, you can confirm the current frequency setting bias/gain setting.
It cannot be confirmed after execution of step 11.

(c) Method to adjust only the frequency without adjustment of a gain voltage (current).
(When changing the gain frequency from 50Hz to 60Hz)

Operation | **Display**

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. (50.00Hz)
3. Turn the setting dial to change the set value to "60.00". (60.00Hz)
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 60Hz.



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 speed setting signal.
- For the operating procedure using the parameter unit (FR-PU04/FR-PU07), refer to the FR-PU04/FR-PU07 instruction manual.
- When setting the value to 120Hz or more, it is necessary to set *Pr. 18 High speed maximum frequency* to 120Hz or more. *(Refer to page 72)*
- Make the bias frequency setting using *calibration parameter C2 (Pr. 902) or C5 (Pr. 904). (Refer to page 143)*

⚠ 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 ♦

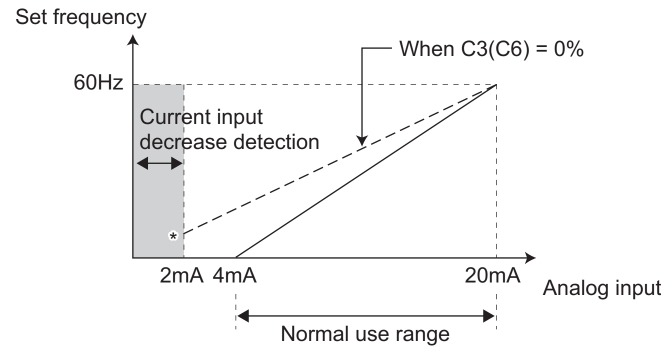
Pr. 20 Acceleration/deceleration reference frequency ☞ *Refer to page 85*
Pr. 73 Analog input selection, Pr. 267 Terminal 4 input selection ☞ *Refer to page 137*
Pr. 79 Operation mode selection ☞ *Refer to page 155*

4.16.5 4mA input check of current input (Pr. 573)

When inputting 4 to 20mA current to terminal 2 or terminal 4, decrease in analog current input is detected to enable continuous operation even if input has decreased.

Parameter Number	Name	Initial Value	Setting Range	Description
573	**4mA input check selection**	9999	1	When the current input drops to or below 2mA, the LF signal is output and inverter continues operation at the frequency (average value) just before current reaches 2mA.
			9999	4mA input is not checked.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*

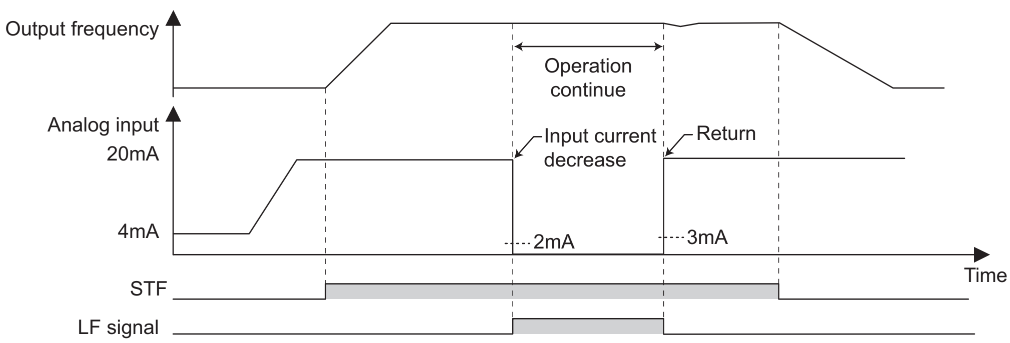


* When Pr.573 = "1", input decrease is detected (LF signal output) even if the analog input value to bias frequency of terminal 2 or terminal 4 is set to 2mA or less using C2 (Pr. 902) or C5 (Pr. 904) and the value is not as bias frequency settings.

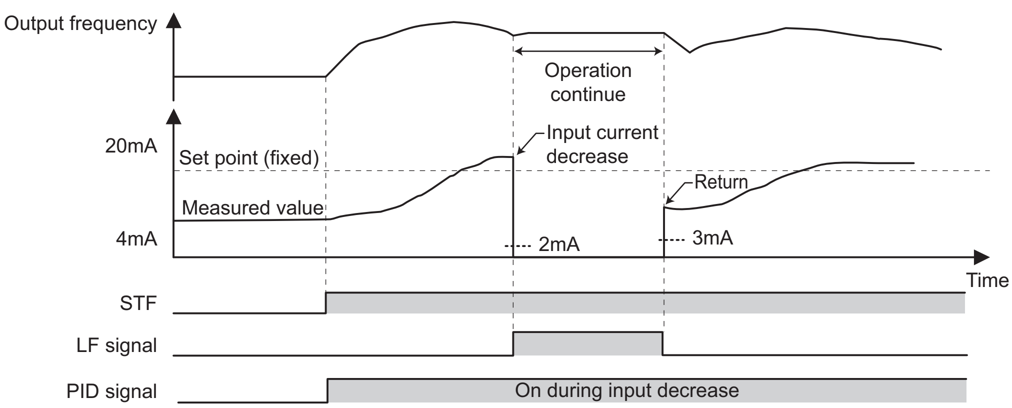
(1) Operation at a current input decrease continues (Pr. 573 = "1")

- When the input current of terminal 4 (terminal 2) falls 2mA or below, output minor fault signal (LF) is output.
- When the current falls below 2mA, the output frequency (average value) before detection is retained and operation at the retained frequency continues.
- When the current input increases above 3mA, the LF signal output is turned off and the inverter operates according to the current input.
- For the LF signal, set "98 (positive logic) or 198 (negative logic)" in Pr. 190 to Pr. 196 (output terminal function selection) and assign functions to the output terminal.
- Since turning off the start command clears the retained frequency, the inverter does not operate at the retained frequency even if restarted.

During external operation (Pr. 573=1)



During PID control (reverse action) (Pr. 573=1)



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) Function related to 4mA input check

Function	Operation (Pr. 573 = 1)	Refer to page
Minimum frequency	Even if the input current decreases, minimum frequency setting clamp is valid.	72
Multi-speed operation	Operation by multiple speed signal has precedence even if input current decreases. (Frequency is not retained when the input current decreases.) Operation stops when a multi-speed signal turns off.	78
Jog operation	The Jog signal has precedence even during decrease in input current. (Frequency is not retained when the input current decreases.) Operation stops when the jog signal is turned off during decrease in input current. PU/jog operation is enabled during PID control. At this time, PU/jog operation has precedence during decrease in input current.	80
MRS	Output is shut off by the MRS signal even if input current decreases. (The inverter stops when the MRS signal is turned off.)	98
Remote setting	The retained frequency will not change even if remote acceleration/deceleration and clear are performed during decrease in input current. Reflected at restoration.	83
Retry	When retry was successful at error occurrence during decrease in input current, retained frequency was not cleared and operation continues.	126
Added compensation, override function	Operation of added compensation (terminal 1) and override compensation (terminal 2) are invalid during decrease in input current.	140
Input filter time constant	The value before filtering is detected. When input current decreases, frequency after filtering (average value) is retained.	141
Forward/reverse rotation prevention	Motor rotation direction can be restricted independently of 4mA input check setting.	153
PID control	Although PID operation is stopped when input current decreases, the X14 signal remains on. (PID operation is valid.)	198
Power failure stop	Even if input current decreases when undervoltage or power failure occurs, the motor stops according to the setting of power-failure deceleration stop function	124
Pump function	If auxiliary motor switchover conditions of pump function is satisfied even when input current decreases, motor connection/release operation is performed.	211
Traverse function	When input current decreases, traverse operation is performed using retained frequency as reference.	220
Switch-over	When the switchover function is operated, frequency is the same as that of the retained frequency. Note that if 4mA input is made invalid once in switchover mode, the frequency is not retained next time.	155

♦ Parameters referred to ♦

Pr. 73 Analog input selection ☞ *Refer to page 140*
Pr. 267 Terminal 4 input selection ☞ *Refer to page 137*

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**	149
Prevention of parameter rewrite	**Parameter write selection**	**Pr. 77**	152
Prevention of reverse rotation of the motor	**Reverse rotation prevention selection**	**Pr. 78**	153
Display necessary parameters	**Display of applied parameters and user group function**	**Pr. 160, Pr. 172 to Pr. 174**	153
Control of parameter write by communication	**EEPROM write selection**	**Pr. 342**	175

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	01160 or less	0 to 3, 14 to 17	For the initial value, reset always enabled, without disconnected PU detection, and with PU stop function are set.
			01800 or more	0 to 3, 14 to 17, 100 to 103, 114 to117	

·The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*
·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	Reset Limit (01800 or more)
0	Reset input always 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.	Not function
1	Reset input enabled only when the protective function is activated			
2	Reset input always 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 always 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 always enabled	When the PU is disconnected, the inverter output is shut off.		
17	Reset input enabled only when the protective function is activated			
100	Reset input always 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.	Function
101	Reset input enabled only when the protective function is activated			
102	Reset input always enabled	When the PU is disconnected, the inverter output is shut off.		
103	Reset input enabled only when the protective function is activated			
114	Reset input always 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.	
115	Reset input enabled only when the protective function is activated			
116	Reset input always enabled	When the PU is disconnected, the inverter output is shut off.		
117	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, 101, 103, 115, 117", 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 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, 100, 101, 114, 115", 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.

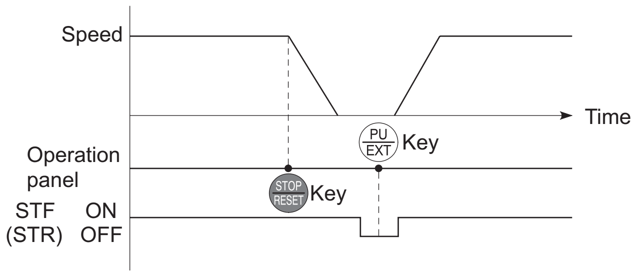
(3) PU stop selection

- 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, 100 to 103", 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.

(5) Reset limit

- Setting can be made for the 01800 or more.
- You can set *Pr. 75* to disable reset operation until the thermal cumulative amount reaches 0 when a thermal trip (THM, THT) or an overcurrent trip (OC1 to OC3) occurs consecutively twice.
- When *Pr. 75* = "100 to 103, 114 to 117", reset limit is made valid.

REMARKS

When the power-on reset (no control power is supplied) is made, the thermal cumulative amount is cleared.

♦ Parameters referred to ♦

Pr. 250 Stop selection ☞ *Refer to page 95*

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.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*
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 parameters marked in the parameter list *(page 51)* 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 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
19	Base frequency voltage
23	Stall prevention operation level compensation factor at double speed
48	Second stall prevention operation current
49	Second stall prevention operation frequency
60	Energy saving control selection
66	Stall prevention operation reduction starting frequency
71	Applied motor
79	Operation mode selection
80	Motor capacity(simple magnetic flux vector control)
90	Motor constant (R1)
100 to 109	(Adjustable 5 points V/F parameter)
135	Commercial power-supply switchover sequence output terminal selection
136	MC switchover interlock time
137	Start waiting time
138	Commercial power-supply operation switchover selection at an alarm
139	Automatic switchover frequency between inverter and commercial power-supply operation
178 to 196	(I/O terminal function selection)
255	Life alarm status display
256	Inrush current limit circuit life display
257	Control circuit capacitor life display
258	Main circuit capacitor life display
329	Digital input increments selection (Parameter for the plug-in option FR-A7AX)
343	Communication error count
563	Energization time carrying-over times
564	Operating time carrying-over times
570	Multiple rating setting

♦ Parameters referred to ♦

Pr. 79 Operation mode selection ☞ *Refer to page 155*

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

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*

- 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), 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.
In the initial setting, only the simple mode parameters are displayed.

Parameter Number	Name	Initial Value	Setting Range	Description
160	User group read selection	9999	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 *1	User group registered display/ batch clear	0	(0 to 16)	Displays the number of cases registered as a user group (Read only)
			9999	Batch clear the user group registration
173 *1, 2	User group registration	9999	0 to 999, 9999	Set the parameter numbers to be registered to the user group.
174 *1, 2	User group clear	9999	0 to 999, 9999	Set the parameter numbers to be cleared from the user group.

*1 They can be set when *Pr. 160 User group read selection* = "0".
*2 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" (initial value), 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 51 to 60*, for the simple mode parameters.)
- Setting "0" to *Pr. 160* enables the display of the simple mode parameters and extended parameters.

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. 551PU 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.

4
PARAMETERS

(2) User group function (*Pr. 160, Pr. 172 to Pr. 174*)

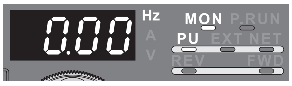
- The user group function is designed to display only the parameters necessary for setting.
- From among all parameters, a maximum of 16 parameters can be registered to a user group. When *Pr. 160* is set to "1", only the parameters registered to the user group can be accessed. (Reading of parameters 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*)

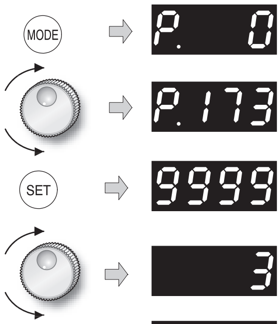
When registering *Pr. 3* to user group

Operation / **Indication**

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 the dial until P. 173 appears.
4. Press SET to display. "9999"
5. Turn the dial until *Pr. 3* appears.



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.

6. Press SET to set. " P. 173 " and " 3 " are displayed alternately.

   To continue parameter registration, repeat steps 3 to 6.

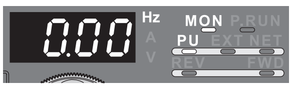
Flicker ··· Registration of *Pr. 3* to user group completed!!

(4) Deletion of parameter from user group (*Pr. 174*)

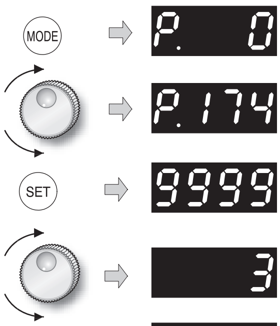
When deleting *Pr. 3* from user group

Operation / **Indication**

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 the dial until P. 174 appears.
4. Press SET to display. "9999"
5. Turn the dial until *Pr. 3* appears.



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.

6. Press SET to clear. " P. 174 " and " 3 " are displayed alternately.

   To continue parameter registration, repeat steps 3 to 6.

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 164*
Pr. 551 PU mode operation command source selection ☞ *Refer to page 164*

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**	155
Started in network operation mode	**Operation mode at power on**	**Pr. 79, Pr. 340**	163
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**	164

4.18.1 Operation mode selection (Pr. 79)

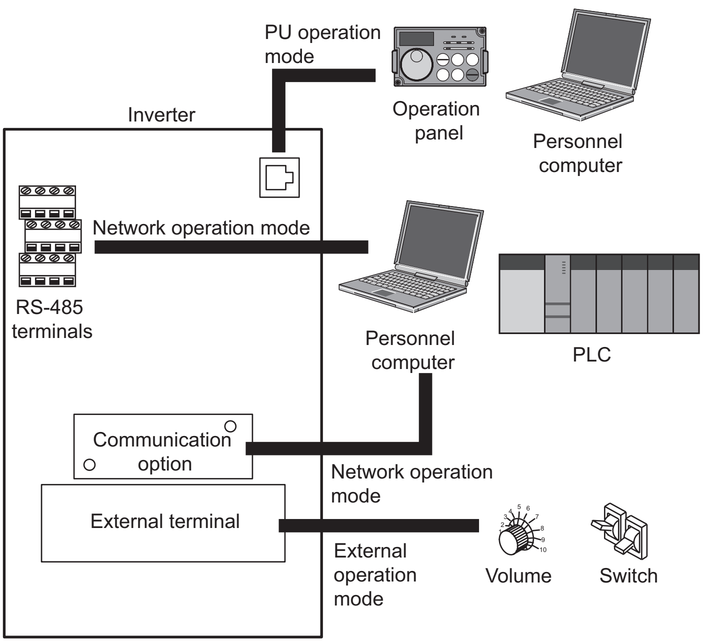
Used to select the operation mode of the inverter.
Mode can be changed as desired between operation using external signals (external operation), operation from the PU (FR-DU07/FR-PU04/FR-PU07), combined operation of PU operation and external operation (external/PU combined operation, and network operation (when RS-485 terminals or a communication option is used).

Parameter Number	Name	Initial Value	Setting Range	Description	LED Indication : Off : On
79	**Operation mode selection**	0	0	Use external/PU switchover mode (press PU/EXT to switch between the PU and external operation mode. At power on, the inverter is placed in the external operation mode.	External operation mode PU EXT NET PU operation mode PU EXT NET
			1	Fixed to PU operation mode	PU EXT NET
			2	Fixed to external operation mode Operation can be performed by switching between the external and Net operation mode.	External operation mode PU EXT NET NET operation mode PU EXT NET
			3	External/PU combined operation mode 1 **Running frequency**: 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)). **Start signal**: External signal input (terminal STF, STR)	PU EXT NET
			4	External/PU combined operation mode 2 **Running frequency**: External signal input (Terminal 2, 4, 1, JOG, multi-speed selection, etc.) **Start signal**: Input from the PU (FR-DU07/FR-PU04/FR-PU07) (FWD, REV)	
			6	Switch-over mode Switch among PU operation, external operation, and NET operation while keeping the same operating status.	PU operation mode PU EXT NET External operation mode PU EXT NET NET operation mode PU EXT NET
			7	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.	PU operation mode PU EXT NET External operation mode PU EXT NET

The above parameters can be changed during a stop in any operation mode.

4
PARAMETERS

(1) Operation mode basics

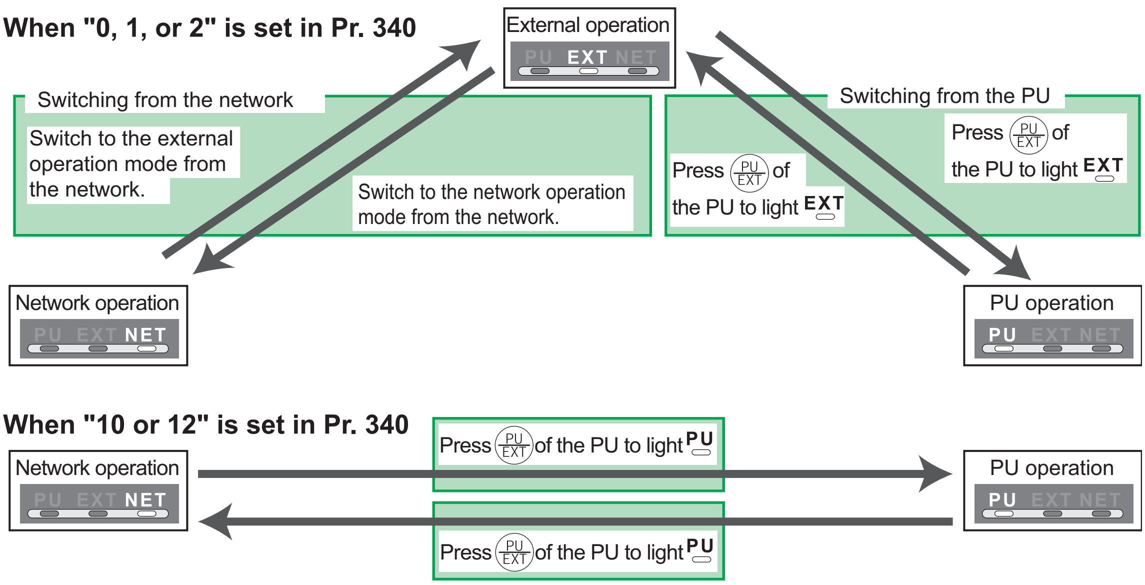


- The operation mode is to specify the source of inputting the start command and set frequency of the inverter.
- Select the "external operation mode" when performing operation by basically using the control circuit terminals and providing potentiometers, switches, etc. externally, select the "PU operation 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 149.)*

(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 160*
PU-external operation switch-over signal (X16) ☞ *page 161*
PU-NET operation switchover signal (X65), External-NET operation switchover signal (X66) ☞ *page 162*
Pr. 340 Communication startup mode selection ☞ *page 163*

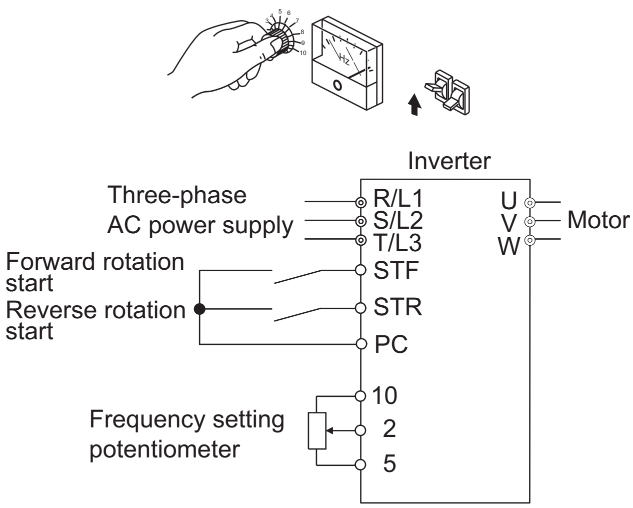
(3) Operation mode selection flow

In the following flowchart, select the basic parameter setting and terminal connection related to the operation mode.

START — **Connection** — **Parameter setting** — **Operation**

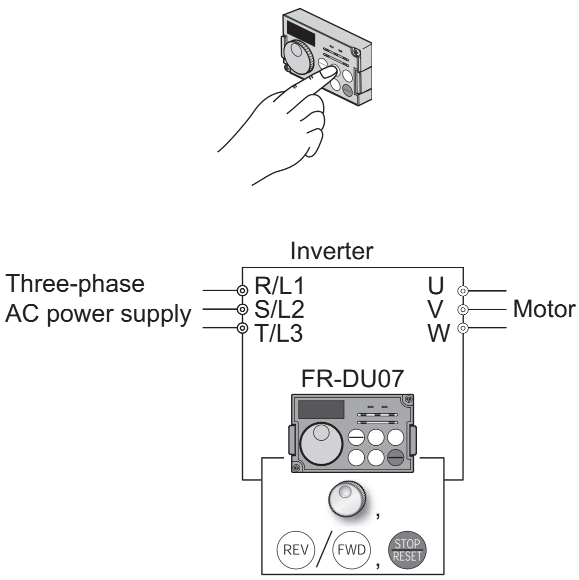
- **Where is the start command source?**
  - **From external** (STF/STR terminal)
    - **Where is the frequency set?**
      - **From external** (Terminal 2, 4, JOG, multi-speed, etc.)
        - Connection: STF (forward rotation)/STR (reverse rotation) -PC *(Refer to page 96.)* Terminal 2, 4-5 (analog), RL, RM, RH, JOG-SD, etc.
        - Operation: Frequency setting terminal ON, STF(STR) ON
      - **From PU** (Digital setting)
        - Connection: STF (forward rotation)/STR (reverse rotation) -PC *(Refer to page 96.)*
        - Parameter setting: *Pr. 79* = "3" (External/PU combined operation 1)
        - Operation: DU digital setting, STF(STR) ON
      - **From communication** (RS-485 terminals/communication option)
        - **RS-485 terminals or communication option?**
          - **RS-485 terminals**
            - Connection: STF (forward rotation)/STR (reverse rotation) -PC *(Refer to page 96.)* Connection of RS-485 terminals *(Refer to page 171.)*
            - Parameter setting: *Pr. 338* = "1", *Pr. 340* = "1, 2"
            - Operation: Communication frequency setting command sending, STF(STR) ON
          - **Communication option**
            - Connection: Connection of communication option (Refer to the corresponding communication option instruction manual)
            - Parameter setting: *Pr. 338* = "1", *Pr. 340* = "1"
            - Operation: Communication frequency setting command sending, STF(STR) ON
  - **From PU** (FWD/REV key)
    - **Where is the frequency set?**
      - **From external** (Terminal 2, 4, JOG, multi-speed, etc.)
        - Connection: Terminal 2, 4-5 (analog), RL, RM, RH, JOG-PC, etc.
        - Parameter setting: *Pr. 79* = "4" (External/PU combined operation 2)
        - Operation: Frequency setting terminal ON, FWD/REV key ON
      - **From PU** (Digital setting)
        - Parameter setting: *Pr. 79* = "1" (Fixed to PU operation)
        - Operation: Digital setting, FWD/REV key ON
      - **From communication** (RS-485 terminals/communication option)
        - Disabled
  - **From communication** (RS-485 terminals/communication option)
    - **RS-485 terminals or communication option?**
      - **RS-485 terminals**
        - **Where is the frequency set?**
          - **From external** (Terminal 2, 4, JOG, multi-speed, etc.)
            - Connection: Connection of RS-485 terminals *(Refer to page 171.)* Terminal 2, 4-5 (analog), RL, RM, RH, JOG-PC, etc.
            - Parameter setting: *Pr. 339* = "1", *Pr. 340* = "1, 2"
            - Operation: Frequency setting terminal ON, Communication start command sending
          - **From PU** (Digital setting)
            - Disabled
          - **From communication** RS-485 terminals
            - Connection: Connection of RS-485 terminals *(Refer to page 171.)*
            - Parameter setting: *Pr. 340* = "1, 2"
            - Operation: Communication frequency setting command sending, Communication start command sending
      - **Communication option**
        - **Where is the frequency set?**
          - **From external** (Terminal 2, 4, JOG, multi-speed, etc.)
            - Connection: Connection of communication option (Refer to the corresponding communication option instruction manual) Terminal 2, 4-5 (analog), RL, RM, RH, JOG-PC, etc.
            - Parameter setting: *Pr. 339* = "1", *Pr. 340* = "1"
            - Operation: Frequency setting terminal ON, Communication start command sending
          - **From PU** (Digital setting)
            - Disabled
          - **From communication** (communication option)
            - Connection: Connection of communication option (Refer to the corresponding communication option instruction manual)
            - Parameter setting: *Pr. 340* = "1"
            - Operation: Communication frequency setting command sending, Communication start command sending

(4) External operation mode (setting "0" (initial value), "2")



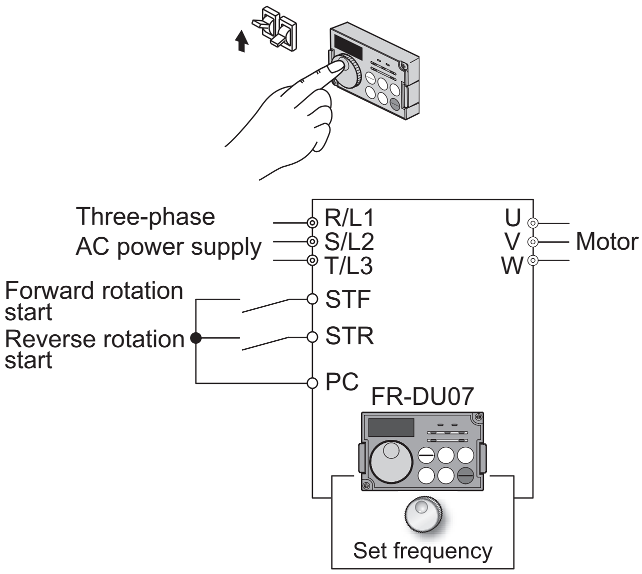
- Select the external operation mode when performing operation by providing a frequency setting potentiometer, start switch, etc. externally and connecting them to the control circuit terminals of the inverter.
- Basically, parameter changing is disabled in external operation mode. (Some parameters can be changed. Refer to *page 51* 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 163*.)
- 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")



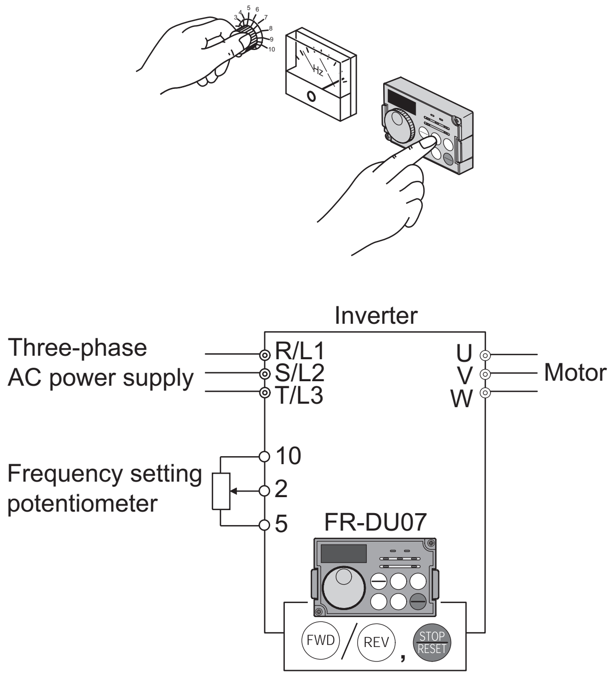
- Select the PU operation mode when performing operation by only the key operation of the operation panel (FR-DU07) or parameter unit (FR-PU04/FR-PU07). Also select the PU operation mode when making communication using the PU connector.
- When "1" is selected for *Pr. 79*, the inverter enters the PU 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 volume. *(Pr. 161 Frequency setting/key lock operation selection, refer to page 231.)*
- 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)*.

(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) or like is used unchanged. (Note that the setting will disappear when power is switched off or the inverter is reset.)
External operation → NET operation	Send the mode change command to 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 96* for *Pr. 178 to Pr. 189*.)
· When the X 12 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 51* 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	Enable
		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 states of the X65 and X66 signals. (For details, refer to *page 162*.)
- 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 PU-NET 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		Remarks
			ON (PU)	OFF (NET)	
10, 12	0 (initial value)		PU operation mode *1	NET operation mode *2	Cannot be switched to external operation mode
	1		PU operation mode		Fixed to PU operation mode
	2		NET operation mode		Fixed to NET operation mode
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		PU operation mode *1	NET operation mode *2	Operation mode can be switched with operation continued Cannot be switched to external operation mode
	7	X12(MRS)ON	PU operation mode *1	NET operation mode *2, 3	Output stop in external operation mode
		X12(MRS)OFF	External operation mode		Forcibly switched to external operation mode

*1 NET operation mode when the X66 signal is on.
*2 PU operation mode when the X16 signal is off. 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 external-NET 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		Remarks
			ON (NET)	OFF(external)	
0 (initial value), 1, 2	0 (initial value)		NET operation mode *1	External operation mode *2	
	1		PU operation mode		Fixed to PU operation mode
	2		NET operation mode *1	External operation mode	Cannot be switched to PU operation mode
	3, 4		External/PU combined operation mode		External/PU combined mode fixed
	6		NET operation mode *1	External operation mode *2	Operation mode can be switched with operation continued
	7	X12(MRS)ON	NET operation mode *1	External operation mode *2	Output stop in external operation mode
		X12(MRS)OFF	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 80.
Pr. 4 to 6, Pr. 24 to 27, Pr. 232 to Pr. 239 Multi-speed operation ☞ Refer to page 78.
Pr. 75 Reset selection/disconnected PU detection/PU stop selection ☞ Refer to page 149.
Pr. 161 Frequency setting/key lock operation selection ☞ Refer to page 231.
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ Refer to page 96.
Pr. 190 to Pr. 196 (Output terminal function selection) ☞ Refer to page 102.
Pr. 340 Communication startup mode selection ☞ Refer to page 163.
Pr. 550 NET mode operation command source selection ☞ Refer to page 164.

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 157.)*
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 when *Pr. 160 User group read selection* = "0". However, the parameters can be set whenever the communication option is connected. *(Refer to page 153.)*.

(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 with operation continued
	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 with operation continued *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 120.
Pr. 79 Operation mode selection ☞ Refer to page 155.

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.

The above parameters can be set when *Pr. 160 User group read selection* = "0". However, the parameters can be set whenever the communication option is connected. *(Refer to page 153.)*
* *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 or RS-485 terminals can be specified as the source of control in the PU operation mode.
· When performing parameter write, giving start command and setting frequency from communication with the RS-485 terminals in PU operation mode, set "1" in *Pr. 551*.

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.

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	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.

(3) Controllability through communcation

<table>
<tr><th>Operation Location</th><th>Condition (Pr. 551 Setting)</th><th>Operation Mode / Item</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) *6</th><th>NET Operation (when communication option is used) *7</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 164)*
*2 At occurrence of RS-485 communication error, the inverter cannot be reset from the computer.
*3 Enabled only when stopped by the PU. At a PU stop, PS is displayed on the operation panel. As set in *Pr. 75 PU stop selection* . *(Refer to page 149)*
*4 Some parameters may be write-disabled according to the *Pr. 77 Parameter write selection* setting and operating status. *(Refer to page 152)*
*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 51* 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* or *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

(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	NET	External		NET	External		*Pr. 59* = "0" (multi-speeds) *Pr. 59* = "1 , 2" (remote)
		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	NET			External			
		4	AU	Terminal 4 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)
		10	X10	Inverter operation enable signal	External						
		11	X11	FR-HC or MT-HC connection, instantaneous power failure detection	External						
		12	X12	PU operation external interlock	External						
		13	X13	External DC injection brake operation is started	NET			External			
		14	X14	PID control valid terminal	NET	External		NET	External		
		16	X16	PU-external operation switchover	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			
		37	X37	Traverse function selection	NET			External			
		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 : Operation is valid only from external terminal signal.
NET : Control only from communication is valid
Combined : Operation is valid from either of external terminal and communication.
— : Operation 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*.

4

PARAMETERS

(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" to 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 82.*
Pr. 59 Remote function selection ☞ *Refer to page 83.*
Pr. 79 Operation mode selection ☞ *Refer to page 155.*

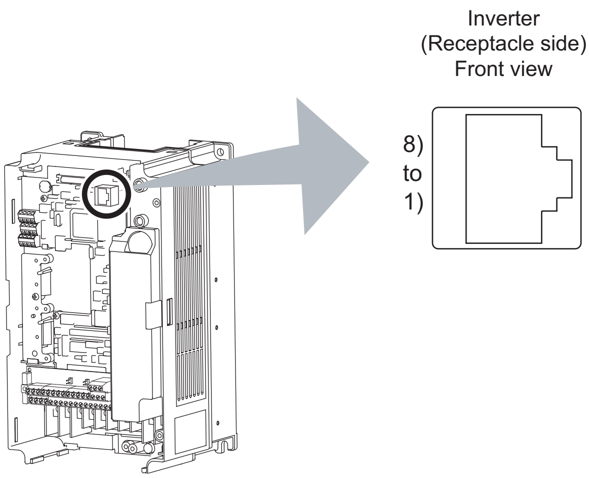
4.19 Communication operation and setting

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**	174
Communication operation from RS-485 terminals	**Initial setting of computer link communication (RS-485 terminals)**	**Pr. 331 to Pr. 337, Pr. 341**	174
	Modbus-RTU communication specifications	**Pr. 331, Pr. 332, Pr. 334, Pr. 343, Pr. 549**	186
Restrictions on parameter write through communication	**Communication EEPROM write selection**	**Pr. 342**	175

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



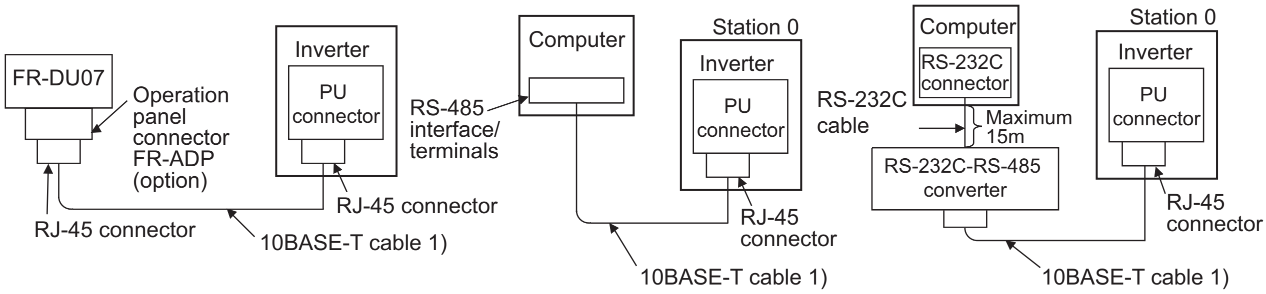
Pin Number	Name	Description
1)	SG	Earth (connected to terminal 5)
2)	—	Operation panel power supply
3)	RDA	Inverter receive+
4)	SDB	Inverter send-
5)	SDA	Inverter send+
6)	RDB	Inverter receive-
7)	SG	Earth (connected to terminal 5)
8)	—	Operation panel power supply

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

Computer Side Terminals: Signal name	Computer Side Terminals: Description	Cable connection and signal direction (10BASE-T cable)	Inverter: PU connector RS-485 terminal
RDA	Receive data	←	SDA
RDB	Receive data	←	SDB
SDA	Send data	→	RDA
SDB	Send data	→	RDB
RSA	Request to send	*	
RSB	Request to send	*	
CSA	Clear to send	*	
CSB	Clear to send	*	
SG	Signal ground	← 0.2mm² or more	SG
FG	Frame ground		

* 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.

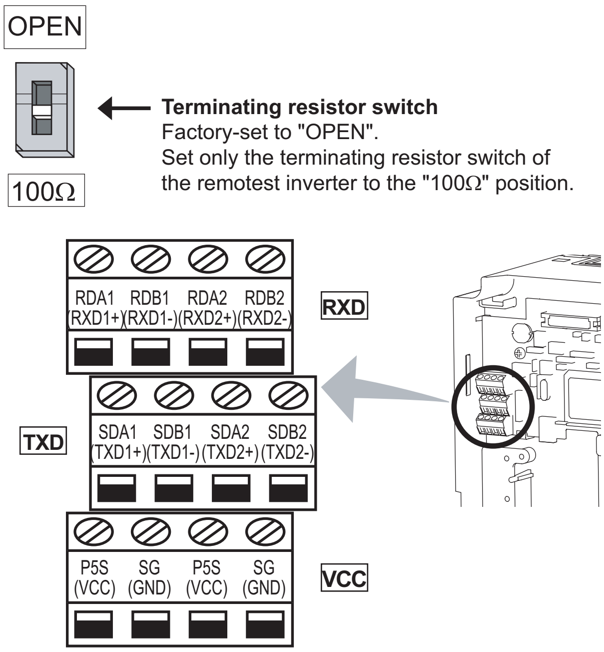
* Do not use pins No. 2, 8 of the 10- BASE-T cable.

CAUTION

When performing RS-485 communication with multiple inverters, use the RS-485 terminals. *(Refer to page 172)*

4.19.2 Wiring and arrangement of RS-485 terminals

(1) RS-485 terminal layout



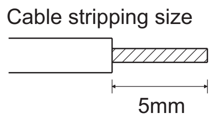
Name	Description
RDA1 (RXD1+)	Inverter receive+
RDB1 (RXD1-)	Inverter receive-
RDA2 (RXD2+)	Inverter receive+ (for branch)
RDB2 (RXD2-)	Inverter receive- (for branch)
SDA1 (TXD1+)	Inverter send+
SDB1 (TXD1-)	Inverter send-
SDA2 (TXD2+)	Inverter send+ (for branch)
SDB2 (TXD2-)	Inverter send- (for branch)
P5S (VCC)	5V Permissible load current 100mA
SG (GND)	Earth (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.



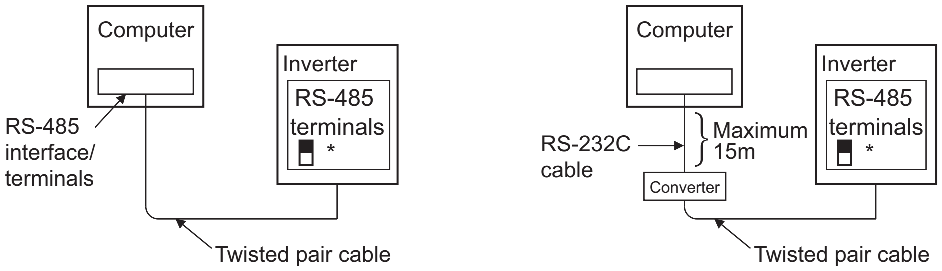
Use a bar terminal as necessary.

CAUTION

Undertightening can cause signal loss or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.

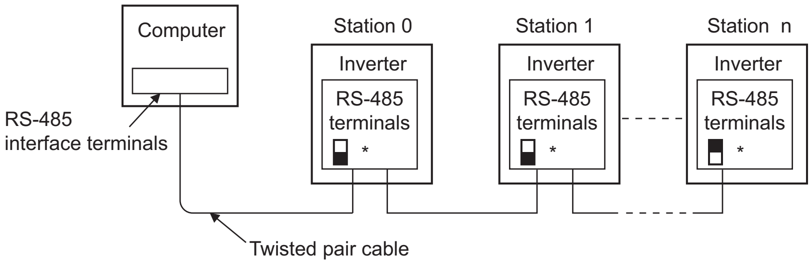
(3) RS-485 terminal system configuration

● Connection of a computer to the inverter (1:1 connection)

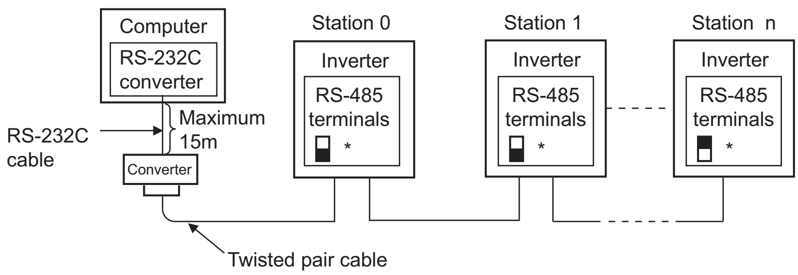


*Set the terminating resistor switch to the "100Ω" position.

● Combination of computer and multiple inverters (1:n connection)



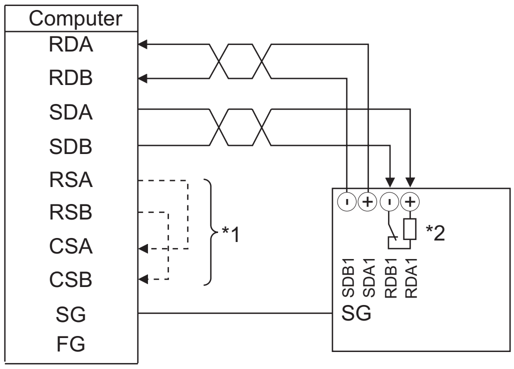
*Set only the terminating resistor switch of the remotest inverter to the "100Ω" position.



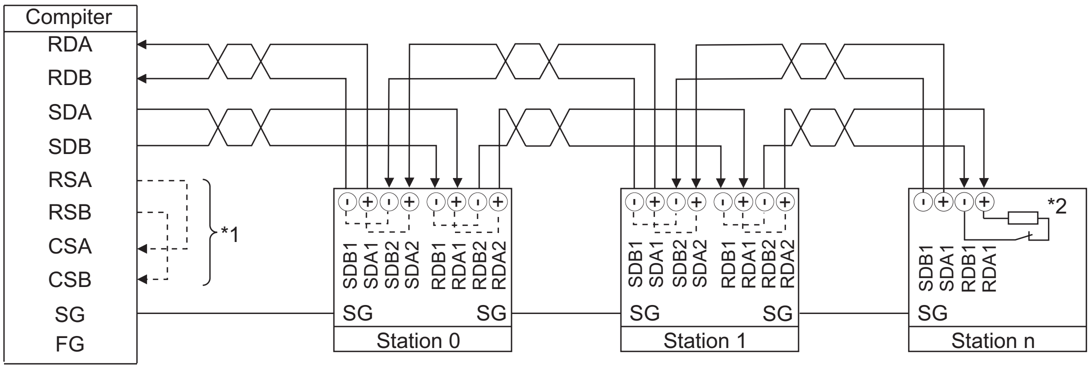
*Set only the terminating resistor switch of the remotest inverter to the "100Ω" position.

(4) RS-485 terminal wiring method

● Wiring of one RS-485 computer and one inverter



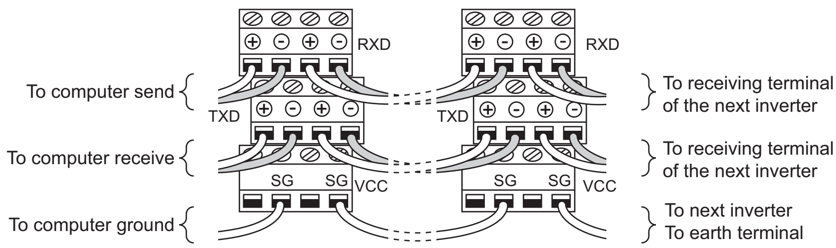
● Wiring of one RS-485 computer and "n" inverters (several inverters)



*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).

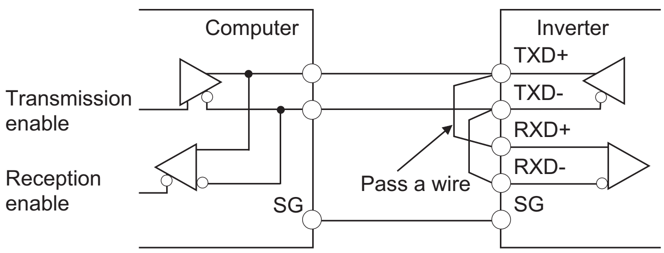
REMARKS

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</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 presence/absence 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>

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

[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
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 186)*
*3 The Modbus-RTU protocol becomes invalid.
*4 The Modbus-RTU protocol is valid for only communication from the RS-485 terminals.
*5 The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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 more to *Pr. 336*. (The setting depends on the computer side program.) *(Refer to page 180)*
- 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 when *Pr. 160 User group read selection* = "0". However, it can be set any time when the communication option is connected. *(Refer to page 153)*

- 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

PARAMETERS

4.19.5 Mitsubishi inverter protocol (computer link communication)

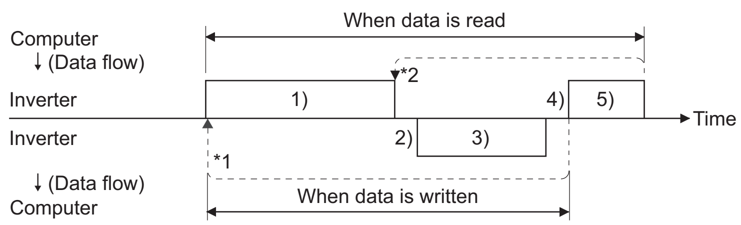
You can perform parameter setting, monitor, etc. from the PU connector or RS-485 terminals of the inverter using the Mitsubishi inverter protocol (computer link communication).

(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 property.)

*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 178)*
*2 The inverter response to the inverter reset request can be selected. *(Refer to page 182)*

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 presence/absence selection)*.

(4) Data definitions

1) Control codes

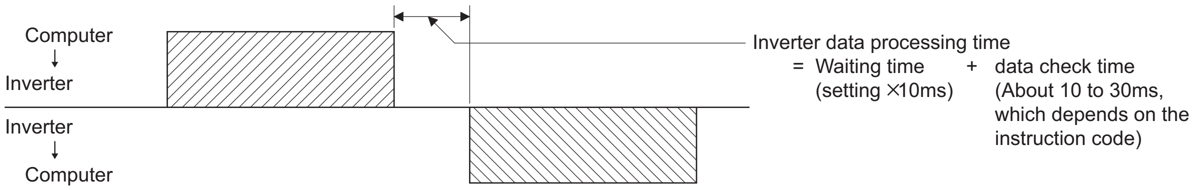
Signal Name	ASCII Code	Description
STX	H02	Start Of Text (start of data)
ETX	H03	End Of Text (end of data)
ENQ	H05	Enquiry (communication request)
ACK	H06	Acknowledge (no data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (data error detected)

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 51)*

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 51)*

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 179)*

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

(Example 1)

Computer→ Inverter	ENQ	Station number		Instruction code		*Waiting time	Data				Sum check code		
		0	1	E	1	1	0	7	A	D	F	4	←Binary code
ASCII Code →	H05	H30	H31	H45	H31	H31	H30	H37	H41	H44	H46	H34	

H30 + H31 + H45 + H31 + H31 + H30 + H37 + H41 + H44
= H1F4
Sum

* When the Pr. 123 "waiting time setting" ≠ "9999", create the communication request data without "waiting time" in the data format. (The number of characters decreases by 1.)

(Example 2)

Inverter → Computer	STX	Station number		Data read				ETX	Sum check code		
		0	1	1	7	7	0		3	0	←Binary code
ASCII Code →	H02	H30	H31	H31	H37	H37	H30	H03	H33	H30	

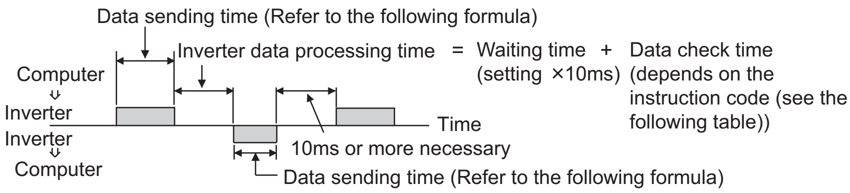
H30 + H31 + H31 + H37 + H37 + H30
= H130
Sum

7) Error Code

If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code.

Error Code	Error Item	Error Definition	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]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters} \times \text{Communication specifications (total number of bits)} = \text{Data send time (s)}$$

Number of data characters: *(Refer to page 177)* — Communication specifications: (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

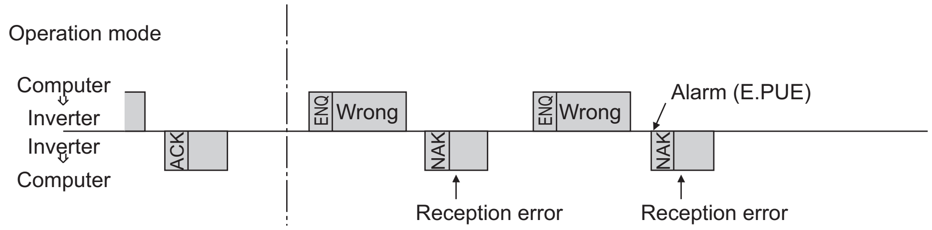
●Data check time

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

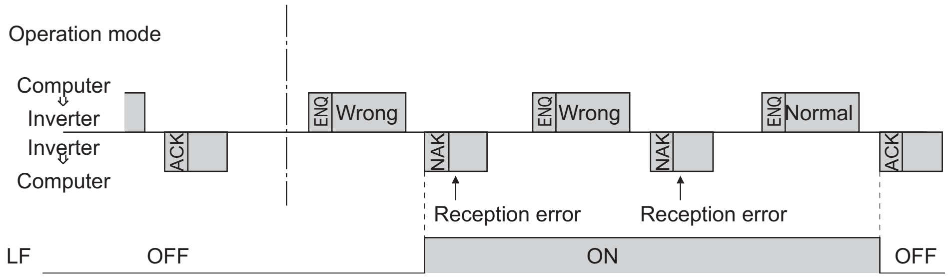
(6) Retry count setting (*Pr. 121, Pr. 335*)

- Set the permissible number of retries at occurrence of a data receive error.(Refer to *page 179* 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)



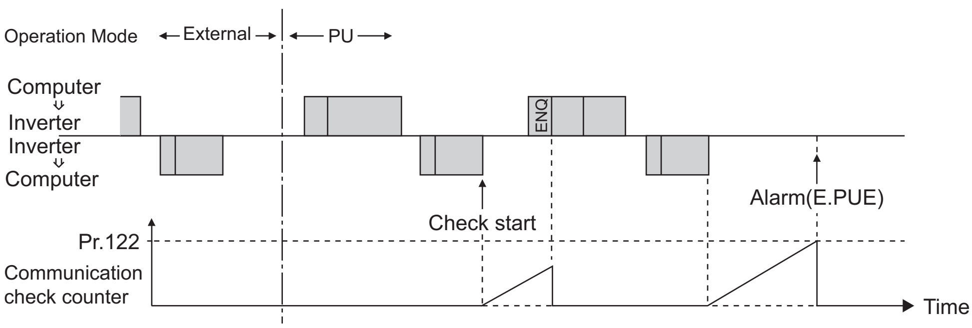
Example: PU connector communication, *Pr. 121* = "9999"



(7) Signal loss detection *(Pr. 122, Pr. 336 RS-485 communication check time interval)*

- If disconnection (communication stop) is detected between the inverter and computer as a result of 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.
- 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 178*) 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).
- When the setting is "9999", communication check (disconnection 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.

Example: PU connector communication, *Pr. 122* = "0.1 to 999.8s"

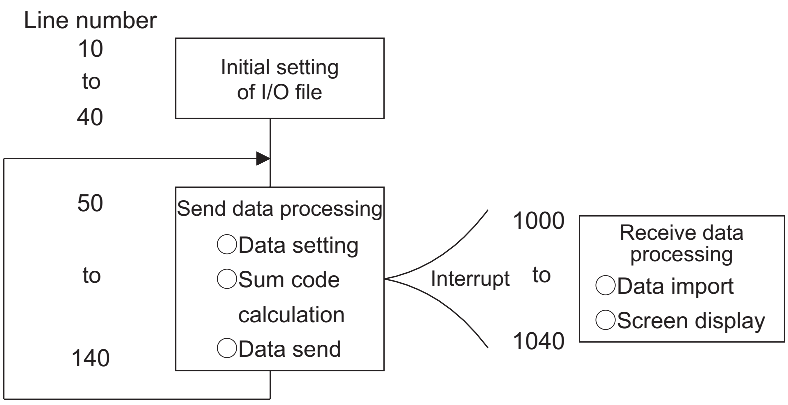


(8) Instructions for the program

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 (01160 or less) / 0.1A increments (01800 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 H36: Monitor selection data Refer to the special monitor No. table *(page 184)*	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 184)*	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 185* 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 states of the output signals such as forward rotation, reverse rotation and inverter running (RUN). (*Refer to page 185* 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)			H6E		
	Set frequency (RAM)		Write	HED	Write the set frequency/speed into the RAM or EEPROM. H0000 to H9C40 (0 to 400.00Hz) : 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)			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)
					H9666: Resets the inverter. · When data is sent normally, ACK is returned to the computer and then the inverter is reset.	4 digits (A,D)

Refer to *page 177* 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>7</td><td>Alarm definition all clear</td><td>Write</td><td>HF4</td><td>H9696: Alarm history batch clear</td><td>4 digits (A,C/D)</td></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 174, 175.
*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 292) and write and/or read the values as required.
When setting Pr.100 and later, link parameter expansion 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 292).</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)</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 177* 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 No. 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	Instruction code Write	Instruction code 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
C8 (930)	Current output bias signal	1E	9E	9
C9 (930)	Current output bias current	1E	9E	9
C10 (931)	Current output gain signal	1F	9F	9
C11 (931)	Current output gain current	1F	9F	9

[Special monitor selection No.]

Refer to *page 111* for details of the monitor description.

Data	Description	Unit
H01	Output frequency	0.01Hz
H02	Output current	0.01A/0.1A *3
H03	Output voltage	0.1V
H05	Frequency setting	0.01Hz
H06	Running speed	1r/min
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 *3
H0C	Converter output voltage peak value	0.1V
H0D	Input power	0.01kW/ 0.1kW *3
H0E	Output power	0.01kW/ 0.1kW *3
H0F	Input terminal status *1	—
H10	Output terminal status *2	—
H11	Load meter	0.1%
H14	Cumulative energization time	1h
H17	Actual operation time	1h
H18	Motor load factor	0.1%
H19	Cumulative power	1kWh
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%

*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 The setting depends on capacities. (01160 or less/01800 or more)

[Alarm data]

Refer to *page 243* for details of alarm description.

Data	Description	Data	Description	Data	Description
H00	No alarm	H60	OLT	HC1	CTE
H10	OC1	H70	BE	HC2	P24
H11	OC2	H80	GF	HC4	CDO
H12	OC3	H81	LF	HC5	IOH
H20	OV1	H90	OHT	HC6	SER
H21	OV2	H91	PTC	HC7	AIE
H22	OV3	HA0	OPT	HF1	E.1
H30	THT	HA1	OP1	HF6	E.6
H31	THM	HB0	PE	HF7	E.7
H40	FIN	HB1	PUE	HFD	E.13
H50	IPF	HB2	RET		
H51	UVT	HB3	PE2		
H52	ILF	HC0	CPU		

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

$\underbrace{b15 \ldots b8}_{\text{Previous alarm (H30)}}$ $\underbrace{b7 \ldots b0}_{\text{Latest alarm (HA0)}}$

[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 96)*.

*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 102)*. (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)*.

4.19.6 Modbus-RTU communication specifications (Pr. 331, Pr. 332, Pr. 334, Pr. 343, 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

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

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*.
Some functions are invalid for broadcast communication. *(Refer to page 188.)*

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 164)*

(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	—

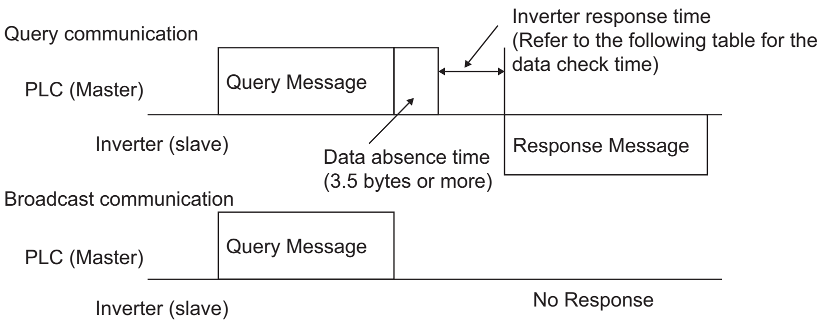
(2) Outline

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

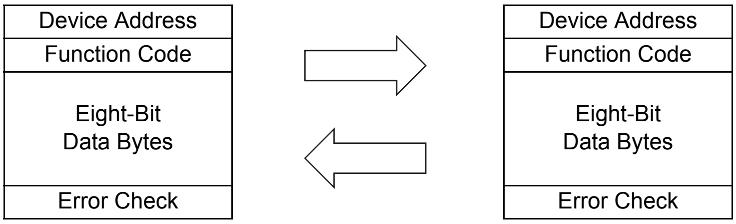
The slave executes the function independently of the inverter station number setting (*Pr. 331*) during broadcast communication.

(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>Is 1 byte long (8 bits), and can be set to any of 0 to 247. 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 can be set to any of 1 to 255. 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 page189). 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 188* 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 194)*).

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)

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 194)*).

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)	... ($n \times 2 \times$ 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 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 96)*.
Each assigned signal is valid or invalid depending on NET. *(Refer to page 164)*
*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 102)*.

<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 111* for details of the monitor description.

Register	Description	Increments
40201	Output frequency	0.01Hz
40202	Output current	0.01A/0.1A*3
40203	Output voltage	0.1V
40205	Frequency setting	0.01Hz
40206	Running speed	1r/min
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*3
40212	Converter output voltage peak value	0.1V
40213	Input power	0.01kW/ 0.1kW *3

Register	Description	Increments
40214	Output power	0.01kW/ 0.1kW *3
40215	Input terminal status *1	—
40216	Output terminal status *2	—
40217	Load meter	0.1%
40220	Cumulative energization time	1h
40223	Actual operation time	1h
40224	Motor load factor	0.1%
40225	Cumulative power	1kWh
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%

*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 The setting depends on capacities. (01160 or less/01800 or more)

- Parameter

Parameters	Register	Parameter Name	Read/Write	Remarks
0 to 999	**41000 to 41999**	Refer to the parameter list *(page 51)* 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.
C8(930)	**41930**	Current output bias signal	Read/write	
C9(930)	**42120**	Current output bias current	Read/write	
C10(931)	**41931**	Current output gain signal	Read/write	
C11(931)	**42121**	Current output gain current	Read/write	

- 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	Data	Description	Data	Description
H00	No alarm	H52	ILF	HB3	PE2
H10	OC1	H60	OLT	HC0	CPU
H11	OC2	H70	BE	HC1	CTE
H12	OC3	H80	GF	HC2	P24
H20	OV1	H81	LF	HC4	CDO
H21	OV2	H90	OHT	HC5	IOH
H22	OV3	H91	PTC	HC6	SER
H30	THT	HA0	OPT	HC7	AIE
H31	THM	HA1	OP1	HF1	E.1
H40	FIN	HB0	PE	HF6	E.6
H50	IPF	HB1	PUE	HF7	E.7
H51	UVT	HB2	RET	HFD	E.13

(7) Pr. 343 Communication error count

You can check the cumulative number of communication errors.

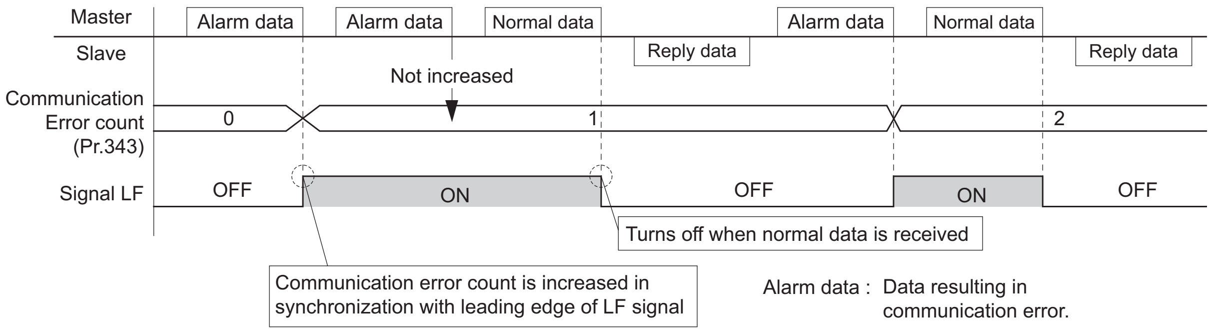
Parameters	Setting Range	Minimum Setting Range	Initial Value
343	(Read only)	1	0

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.

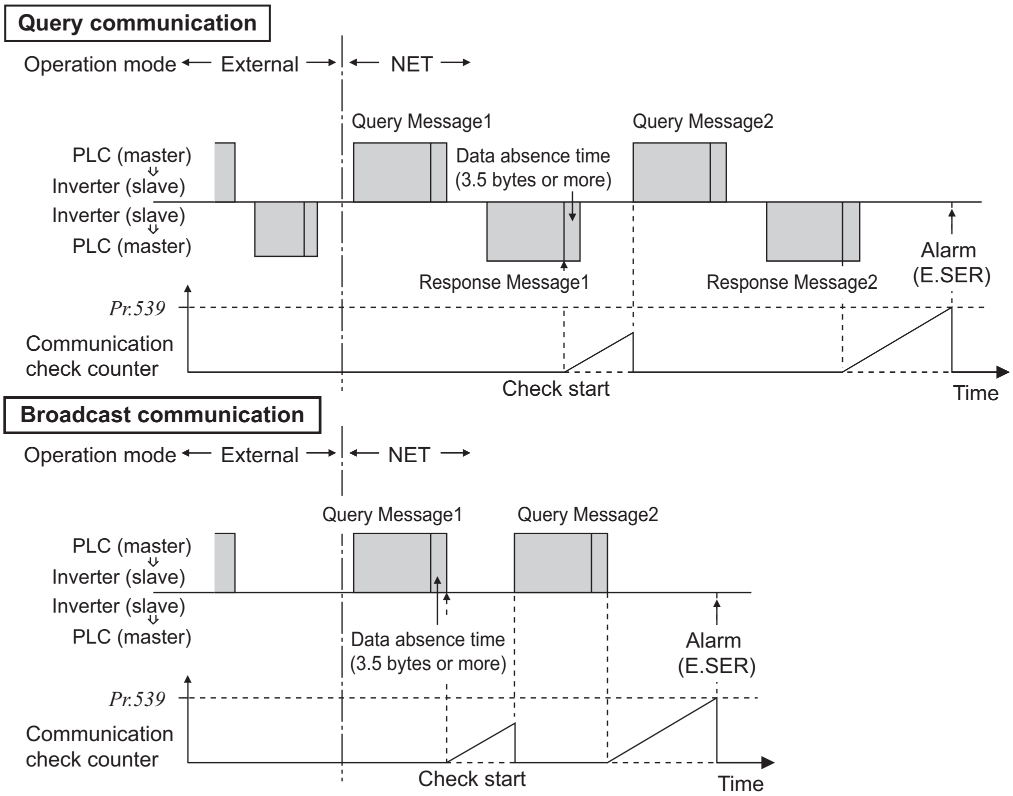
· When the setting value is "0", monitor, parameter read, etc. can be performed. However, a communication error (E.SER) occurs as soon as the inverter is switched to the network operation mode.

· 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 command 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**	198
Pump function by multiple motors	**Advanced PID function**	**Pr. 575 to Pr. 591**	211
Traverse function	**Traverse function**	**Pr. 592 to Pr. 597**	220
Switch between the inverter operation and bypass operation to operate.	**Bypass-inverter switchover function**	**Pr. 135 to Pr. 139, Pr. 159**	206
Avoid overvoltage alarm due to regeneration by automatic adjustment of output frequency	**Regeneration avoidance function**	**Pr. 882 to Pr. 886**	222

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.

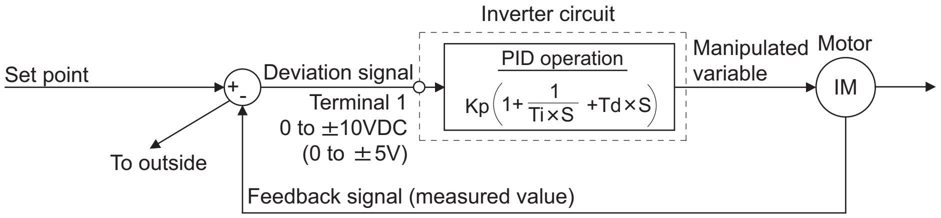
Parameter Number	Name	Initial Value	Setting Range	Description	
127	**PID control automatic switchover frequency**	9999	0 to 400Hz	Set the frequency at which the control is automatically changed to PID control.	
			9999	Without PID automatic switchover function	
128	**PID action selection**	10	10	PID 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.	
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.	

Parameter Number	Name	Initial Value	Setting Range	Description
575	**Output interruption detection time**	1s	0 to 3600s	The inverter stops operation if the output frequency after PID operation remains at less than the *Pr. 576* setting for longer than the time set in *Pr. 575*.
			9999	Without output interruption function
576	**Output interruption detection level**	0Hz	0 to 400Hz	Set the frequency at which the output interruption processing is performed.
577	**Output interruption cancel level**	1000%	900 to 1100%	Set the level (*Pr. 577* minus 1000%) to release the PID output interruption function.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*
*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.

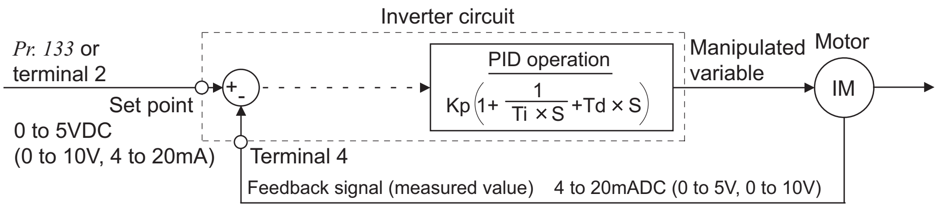
(1) PID control basic configuration

· *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

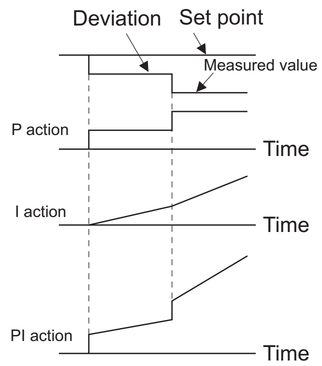
(2) PID action overview

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.

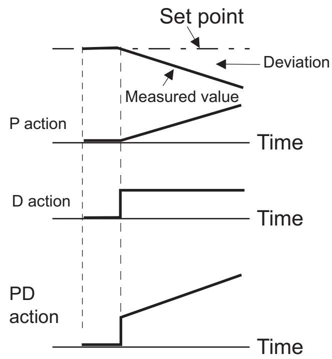


2) PD action

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]

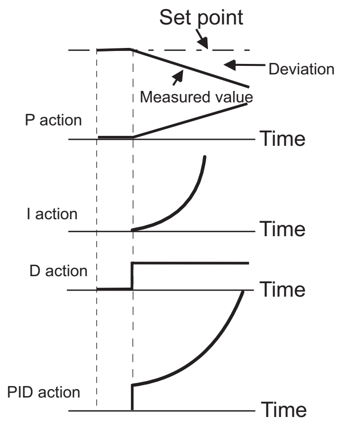
(Note) PD action is the sum of P and D actions.



3) PID action

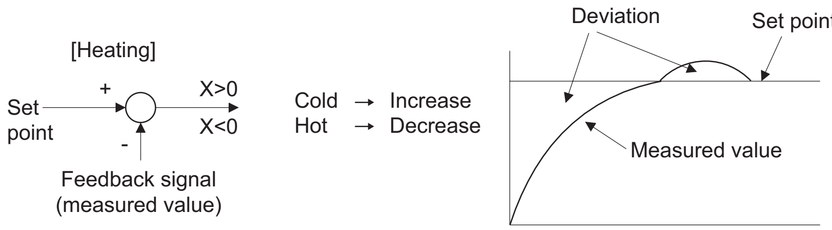
The PI action and PD action are combined to utilize the advantages of both actions for control.

(Note) PID action is the sum of P, I and D actions.



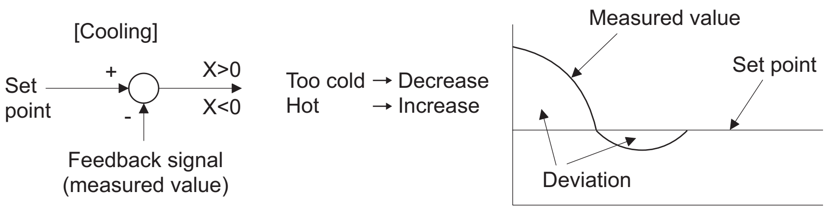
4)Reverse action

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.

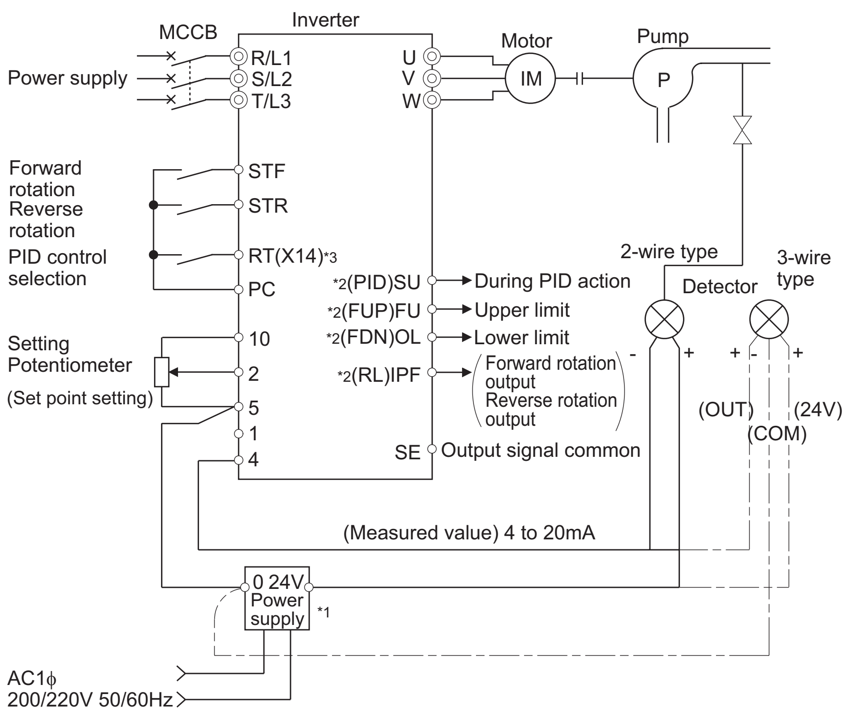


Relationships between deviation and manipulated variable (output frequency)

	Deviation	
	Positive	Negative
Reverse action	↗	↘
Forward action	↘	↗

(3) Connection diagram

- Source 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.

(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 to any of *Pr. 178 to Pr. 189*.
Input	X64	Depending on *Pr. 178 to Pr. 189*	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 to any of *Pr. 178 to Pr. 189*.
Input	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
Input	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%
Input	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
Input	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
Input	Communication *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 to any of *Pr. 190 to Pr. 196*. *3
Output	FDN	Depending on *Pr. 190 to Pr. 196*	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 to any of *Pr. 190 to Pr. 196*. *3
Output	RL	Depending on *Pr. 190 to Pr. 196*	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 to any of *Pr. 190 to Pr. 196*. *3
Output	PID	Depending on *Pr. 190 to Pr. 196*	During PID control activated	Turns on during PID control.	Set 47 or 147 to any of *Pr. 190 to Pr. 196*. *3
Output	SLEEP	Depending on *Pr. 190 to Pr. 196*	PID output interruption	Turns on when the PID output interruption function is performed.	*Pr. 575* ≠ 9999 Set 70 or 170 to any of *Pr. 190 to Pr. 196*. *3
Output	SE	SE	Output terminal common	Common terminal for terminals FUP, FDN, RL, PID and SLEEP	

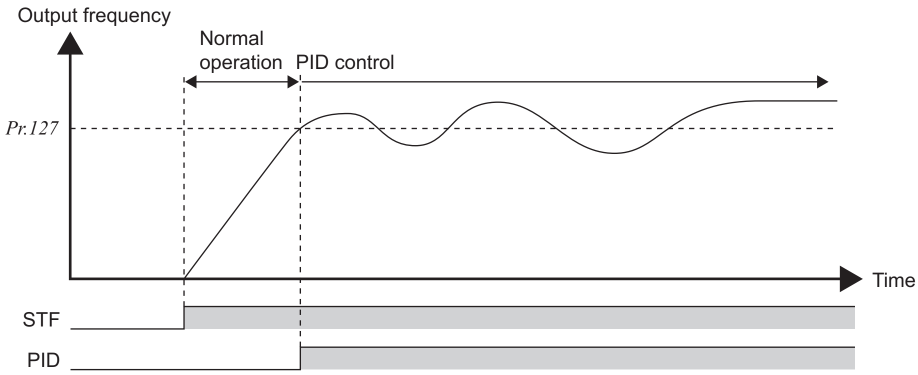
*1 The shaded area indicates the parameter initial value.
*2 For the setting method via LONWORKS communication, refer to the LONWORKS communication option (FR-A7NL) instruction manual.
For the setting method via CC-Link communication, refer to the CC-Link communication option (FR-A7NC) instruction manual.
*3 When 100 or larger value is set to any of *Pr. 190 to Pr. 196 (output terminal function selection)*, the terminal output has negative logic. *(Refer to page 102 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.

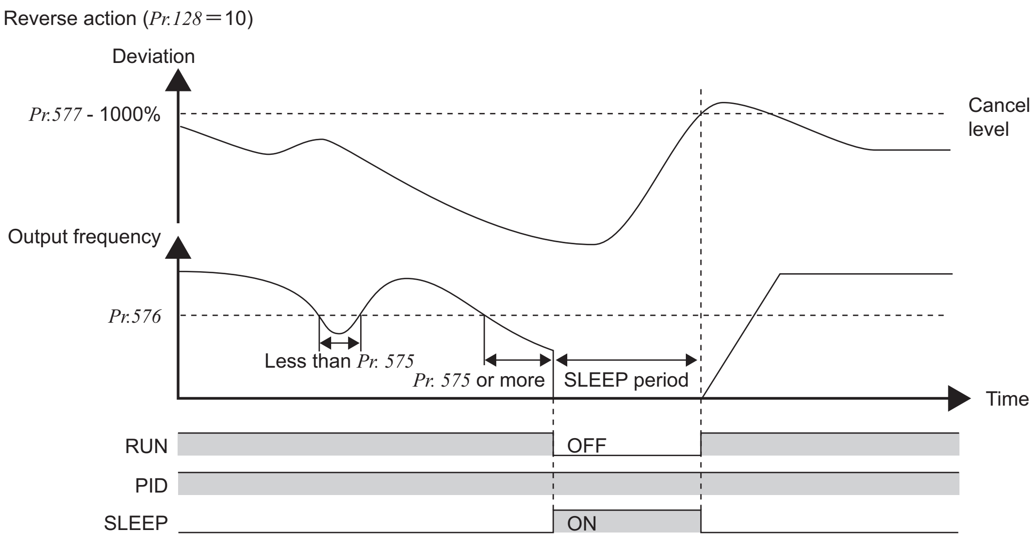
(5) PID control automatic switchover control *(Pr. 127)*

- 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 CA, 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 CA, AM.)
- For the monitors, set the following values in *Pr. 52 DU/PU main display data selection*, *Pr. 54 CA terminal function selection*, and *Pr. 158 AM terminal function selection*.

Setting	Monitor Description	Minimum Increments	Terminal CA, 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.

(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%) to 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?

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.

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. → Parameter optimization

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. 50Hz).
6. In *C4 (Pr. 903)*, set the voltage value at 100%.

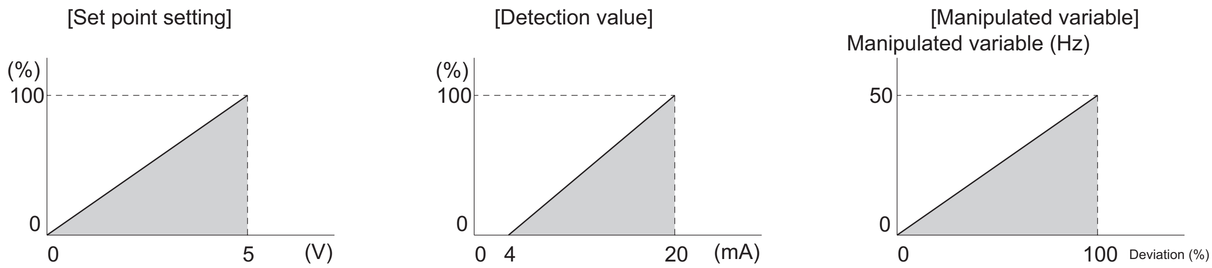
<Detector output calibration>

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. 22 Stall prevention operation level = "9999" (analog variable)
Pr. 79 Operation mode selection = "6" (switchover mode))
· 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.
· 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 83*
Pr. 73 Analog input selection ☞ *Refer to page 137*
Pr. 79 Operation mode selection ☞ *Refer to page 155*
Pr. 178 to Pr. 189 (input terminal function selection) ☞ *Refer to page 96*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 102*
C2 (Pr. 902) to C7 (Pr. 905) Frequency setting voltage (current) bias/gain ☞ *Refer to page 142*

4.20.2 Bypass-inverter switchover function (Pr. 135 to Pr. 139, Pr. 159)

The complicated sequence circuit for bypass-inverter switchover is built in the inverter. Hence, merely inputting the start, stop or automatic switchover selection signal facilitates the interlock operation of the switchover magnetic contactor.

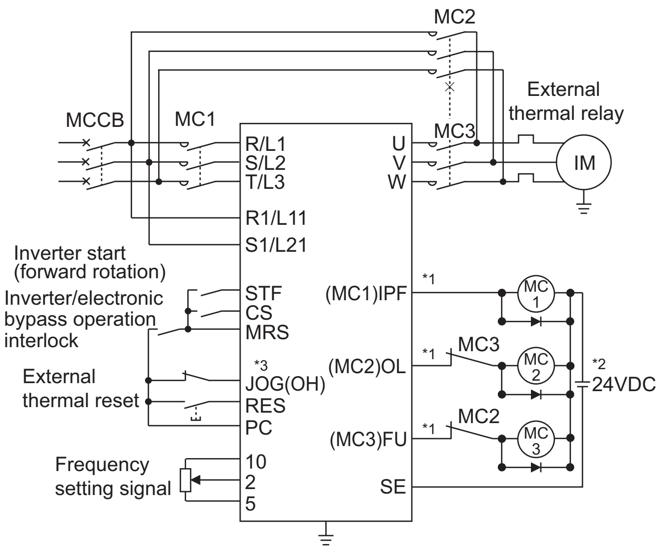
Parameter Number	Name	Initial Value	Setting Range	Description
135	**Electronic bypass sequence selection**	0	0	Without electronic bypass sequence
			1	With electronic bypass sequence
136	**MC switchover interlock time**	1s	0 to 100s	Set the operation interlock time of MC2 and MC3.
137	**Start waiting time**	0.5s	0 to 100s	Set the time slightly longer (0.3 to 0.5s or so) than the time from when the ON signal enters MC3 until it actually turns on.
138	**Bypass selection at an alarm**	0	0	Inverter output is stopped (motor coast) at inverter fault.
			1	Operation is automatically switched to bypass operation at inverter fault (Not switched when an external thermal error occurs)
139	**Automatic switchover frequency from inverter to bypass operation**	9999	0 to 60Hz	Set the frequency to switch inverter operation to bypass operation. Inverter operation is performed from a start until *Pr. 139* is reached, and when the output frequency is at or above *Pr. 139*, inverter operation is automatically switched to bypass operation.
			9999	Without automatic switchover
159	**Automatic switchover frequency range from bypass to inverter operation**	9999	0 to 10Hz	Valid during automatic switchover operation (*Pr. 139* ≠ 9999) When the frequency command decreases below (*Pr. 139* to *Pr. 159*) after operation is switched from inverter operation to bypass operation, the inverter automatically switches operation to inverter operation and operates at the frequency of frequency command. When the inverter start command (STF/STR) is turned off, operation is switched to inverter operation also.
			9999	Valid during automatic switchover operation (*Pr. 139* ≠ 9999) When the inverter start command (STF/STR) is turned off after operation is switched from inverter operation to bypass inverter operation, operation is switched to inverter operation and the motor decelerates to stop.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*

- When the motor is operated at 60Hz (or 50Hz), more efficient operation can be performed by the commercial power supply than by the inverter. When the motor cannot be stopped for a long time for the maintenance/inspection of the inverter, it is recommended to provide the commercial power supply circuit.
- To switch between inverter operation and bypass operation, an interlock must be provided to stop the motor once and then start it by the inverter in order to prevent the inverter from resulting in an overcurrent alarm. Using the electronic bypass sequence function that outputs the timing signal for operation of the magnetic contactor, a complicated commercial power supply switchover interlock can be provided by the inverter.

(1) Connection diagram

· The following shows the connection diagram of a typical electronic bypass sequence. Sink logic, *Pr. 185* = "7", *Pr. 192* = "17", *Pr. 193* = "18", *Pr. 194* = "19"



Electronic bypass sequence connection diagram

*1 Take caution for the capacity of the sequence output terminal.
The used terminal changes depending on the setting of *Pr. 190 to Pr. 196 (output terminal function selection)*.

Output Terminal Capacity	Output Terminal Permissble Load
Inverter open collector output (RUN, SU, IPF, OL, FU)	24VDC 0.1A
Inverter relay output (A1-C1, B1-C1, A2-B2, B2-C2) Relay output option (FR-A7AR)	230VAC 0.3A 30VDC 0.3A

*2 When connecting a DC power supply, insert a protective diode. When connecting an AC power supply, connect a relay output option (FR-A7AR) and use a contact output.

*3 The used terminal changes depending on the setting of *Pr. 180 to Pr. 189 (input terminal function selection)*.

CAUTION

- Use the electronic bypass operation function in external operation mode. Be sure to connect the other power supply since the function is not performed normally unless the connection terminals R1/L11, S1/L21 are not connected to the other power supply (power supply that does not pass MC1).
- Be sure to provide mechanical interlocks for MC2 and MC3.

· Operations of magnetic contactors (MC1, MC2, MC3)

Magnetic Contactor	Installation Place	Operation (○: Shorted, ×: Open)		
		Bypass operation	During inverter operation	At an inverter alarm occurrence
MC1	Between power supply and inverter input	○	○	× (Shorted by reset)
MC2	Between power supply and motor	○	×	× (Can be selected using *Pr. 138*, always open when external thermal relay is on)
MC3	Between inverter output and motor	×	○	×

· The input signals are as indicated below.

Signal	Terminal Used	Function	Operation	MC Operation *6		
				MC1 *5	MC2	MC3
MRS	MRS	Operation enable/disable selection *1	ON ..... Bypass-inverter operation enabled	○	—	—
			OFF ... Bypass-inverter operation disabled	○	×	No change
CS	CS	Inverter/electronic bypass *2	ON...... Inverter operation	○	×	○
			OFF ... Bypass operation	○	○	×
STF (STR)	STF(STR)	Inverter operation command (Invalid for bypass) *3	ON...... Forward rotation (reverse rotation)	○	×	○
			OFF.... Stop	○	×	○
OH	Set "7 in any of *Pr. 180 to Pr. 189*.	External thermal relay input	ON ..... Motor normal	○	—	—
			OFF.... Motor abnormal	×	×	×
RES	RES	Operating status initialization *4	ON...... Initialization	No change	×	No change
			OFF.... Normal operation	○	—	—

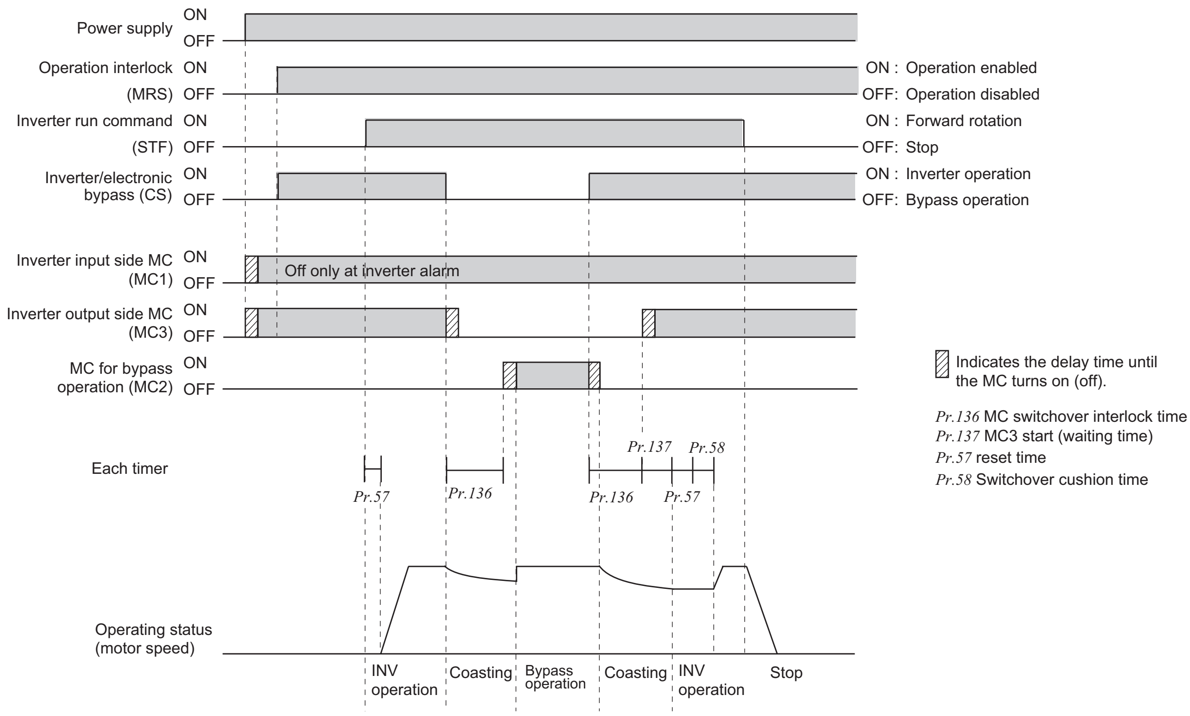
*1 Unless the MRS signal is turned on, neither bypass operation nor inverter operation can be performed.
*2 The CS signal functions only when the MRS signal is on.
*3 STF (STR) functions only when both the MRS signal and CS signal are on.
*4 The RES signal enables reset input acceptance selection using *Pr. 75 Reset selection/disconnected PU detection/PU stop selection*.
*5 MC1 turns off when an inverter alarm occurs.
*6 MC operation
○ : MC-ON
× : MC-OFF
— : Inverter operation.. MC2 is off and MC3 is on
Bypass operation .... MC2 is on and MC3 is off
No change : The status before the signal turns on or off is held.

· The output signals are as indicated below.

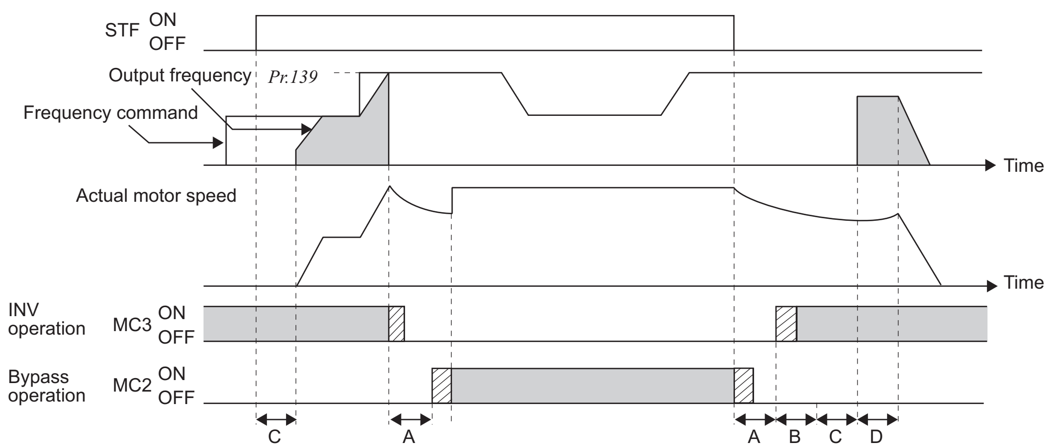
Signal	Terminal Used (*Pr. 190 to Pr. 196* setting)	Description
MC1	17	Control signal output of inverter input side magnetic contactor MC1
MC2	18	Control signal output of bypass operation magnetic contactor MC2
MC3	19	Control signal output of inverter output side magnetic contactor MC3

(2) Electronic bypass operation sequence

· Operation sequence example when there is no automatic switchover sequence (*Pr. 139* = "9999")

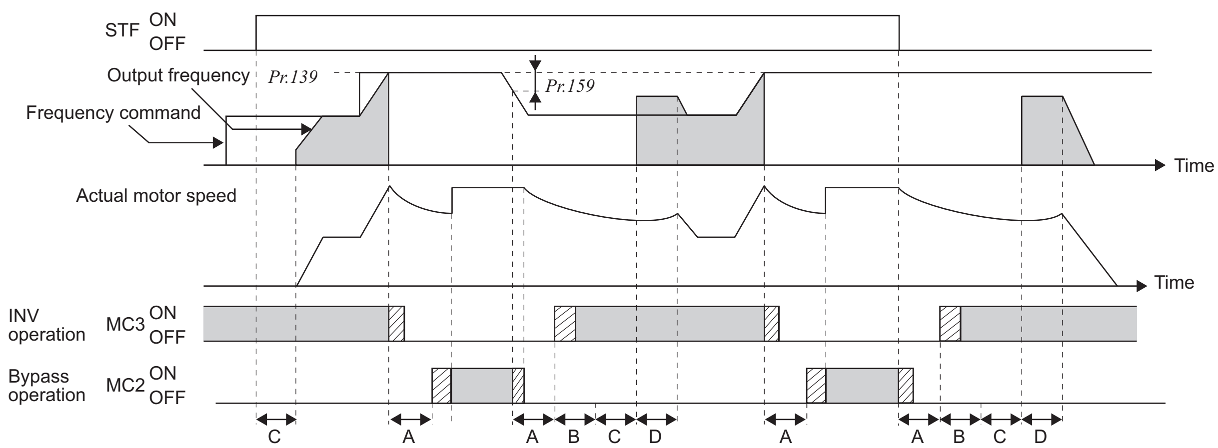


· Operation sequence example when there is automatic switchover sequence (*Pr. 139* ≠ "9999", *Pr. 159* = "9999")



A : *Pr.136* MC switchover interlock time B : *Pr.137* Start waiting time
C : *Pr.57* Restart coasting time D : *Pr.58* Restart cushion time

· Operation sequence example when there is automatic switchover sequence (*Pr. 139* ≠ "9999", *Pr. 159* ≠ "9999")



A : *Pr.136* MC switchover interlock time B : *Pr.137* Start waiting time
C : *Pr.57* Restart coasting time D : *Pr.58* Restart cushion time

4

PARAMETERS

(3) Operating procedure

· Procedure for operation
Operation pattern

Power supply ON
↓
Setting the parameters
↓
Start inverter operation
↓
Constant-speed bypass operation
↓
Deceleration (stop) inverter operation

· *Pr. 135* = "1" (open collector output terminal of inverter)
· *Pr. 136* = "2.0s"
· *Pr. 137* = "1.0s" (Set the time longer than the time from when MC3 actually turns on until the inverter and motor are connected. If the time is short, a restart may not function properly.)
· *Pr. 57* = "0.5s"
· *Pr. 58* = "0.5s" (Be sure to set this parameter when bypass operation is switched to inverter operation.)

2)Signal ON/OFF after parameter setting

	MRS	CS	STF	MC1	MC2	MC3	Remarks
Power supply ON	OFF (OFF)	OFF (OFF)	OFF (OFF)	OFF → ON (OFF → ON)	OFF (OFF)	OFF → ON (OFF → ON)	External operation mode (PU operation mode)
At start (inverter)	OFF → ON	OFF → ON	OFF → ON	ON	OFF	ON	
At constant speed (commercial power supply)	ON	ON → OFF	ON	ON	OFF → ON	ON → OFF	MC2 turns on after MC3 turns off (coasting status during this period) Waiting time 2s
Switched to inverter for deceleration (inverter)	ON	OFF → ON	ON	ON	ON → OFF	OFF → ON	MC3 turns on after MC2 turns off (coasting status during this period) Waiting time 4s
Stop	ON	ON	ON → OFF	ON	OFF	ON	

CAUTION

· Connect the control power supply (R1/L11, S1/L21) in front of input side MC1. If the control power supply is connected behind input side MC1, the electronic bypass sequence function is not executed.
· The electronic bypass sequence function is valid only when *Pr. 135* = "1" in the external operation or combined operation mode (PU speed command, external operation command *Pr. 79* = "3"). When *Pr. 135* = "1" in the operation mode other than the above, MC1 and MC3 turn on.
· When the MRS and CS signals are on and the STF (STR) signal is off, MC3 is on, but when the motor was coasted to a stop from bypass operation last time, a start is made after the time set to *Pr. 137* has elapsed.
· Inverter operation can be performed when the MRS, STF (STR) and CS signals turn on. In any other case (MRS signal - ON), bypass operation is performed.
· When the CS signal is turned off, the motor switches to bypass operation. However, when the STF (STR) signal is turned off, the motor is decelerated to a stop in the inverter operation mode.
· When both MC2 and MC3 are off and either MC2 or MC3 is then turned on, there is a waiting time set in *Pr. 136*.
· If electronic bypass sequence is made valid (*Pr. 135* = "1"), the *Pr. 136 and Pr. 137* settings are ignored in the PU operation mode. The input terminals (STF, CS, MRS, OH) of the inverter return to their normal functions.
· When the electronic bypass sequence function (*Pr. 135* = "1") and PU operation interlock function (*Pr. 79* = "7") are used simultaneously, the MRS signal is shared by the PU operation external interlock signal unless the X12 signal is assigned. (When the MRS and CS signals turn on, inverter operation is enabled)
· 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.

♦ Parameters referred to ♦

Pr. 11 DC injection brake operation time ☞ *Refer to page 92*
Pr. 57 Restart coasting time ☞ *Refer to page 120*
Pr. 58 Restart cushion time ☞ *Refer to page 120*
Pr. 79 Operation mode selection ☞ *Refer to page 155*
Pr. 178 to Pr. 189 (Input terminal function selection) ☞ *Refer to page 96*
Pr. 190 to Pr. 196 (Output terminal function selection) ☞ *Refer to page 102*

4.20.3 Advanced PID function (pump function) (Pr. 575 to Pr. 591)

PID control function can adjust the volume of water, etc. by controlling a pump. Multiple motors (4 motors maximum) can be controlled by switching between the inverter-driven operation and commercial power-driven operation. Use *Pr. 579 Motor connection function selection* to select switchover operation of the motor. Up to three auxiliary motors can be connected.

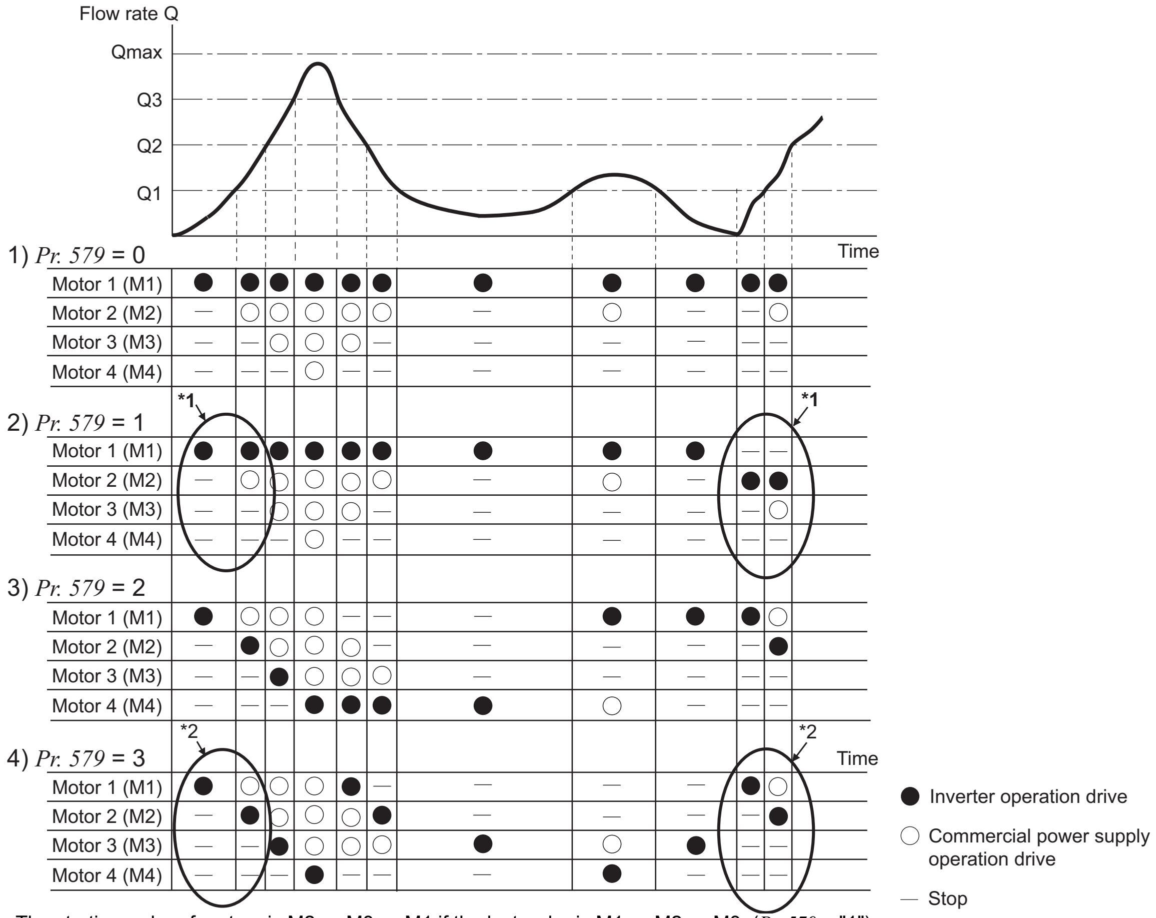
Parameter Number	Name	Initial Value	Setting Range	Description
575	**Output interruption detection time**	1s	0 to 3600s	If the output frequency after PID operation remains lower than the *Pr. 576* setting for longer than the time set in Pr. 575, the inverter stops operation.
			9999	Without output interruption function
576	**Output interruption detection level**	0Hz	0 to 400Hz	Set the frequency at which the output interruption processing is performed.
577	**Output interruption cancel level**	1000%	900 to 1100%	Level at PID output interruption function is canceled Set (*Pr. 577* – 1000%)
578	**Auxiliary motor operation selection**	0	0	No auxiliary motor operation
			1 to 3	Set the number of auxiliary motors to be run
579	**Motor connection function selection**	0	0	Basic system
			1	Alternative system
			2	Direct system
			3	Alternative-direct system
580	**MC switching interlock time**	1s	0 to 100s	You can set the time until MC switchover interlock time when *Pr. 579* = “2, 3” is set.
581	**Start waiting time**	1s	0 to 100s	You can set the time from when the MC is switched until it starts when *Pr. 579* = “2, 3”. Set this time a little longer than the MC switching time.
582	**Auxiliary motor connection-time deceleration time**	1s	0 to 3600s	You can set the deceleration time for decreasing the output frequency of the inverter if a motor connection occurs under advanced PID control.
			9999	The output frequency is not forcibly changed.
583	**Auxiliary motor disconnection-time acceleration time**	1s	0 to 3600s	You can set the acceleration time for increasing the output frequency of the inverter if a motor disconnection occurs under advanced PID control.
			9999	The output frequency is not forcibly changed.
584	**Auxiliary motor 1 starting frequency**	60Hz	0 to 400Hz	Set the frequency to connect an auxiliary motor.
585	**Auxiliary motor 2 starting frequency**	60Hz	0 to 400Hz	
586	**Auxiliary motor 3 starting frequency**	60Hz	0 to 400Hz	
587	**Auxiliary motor 1 stopping frequency**	0Hz	0 to 400Hz	Set the frequency to open an auxiliary motor.
588	**Auxiliary motor 2 stopping frequency**	0Hz	0 to 400Hz	
589	**Auxiliary motor 3 stopping frequency**	0Hz	0 to 400Hz	
590	**Auxiliary motor start detection time**	5s	0 to 3600s	You can set the delay time until the auxiliary motor is started.
591	**Auxiliary motor stop detection time**	5s	0 to 3600s	You can set the delay time until the auxiliary motor is stopped.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(1) Operation

· Set the number of commercial power supply operation motors in *Pr. 578 Auxiliary motor operation selection* and motor switching method in *Pr. 579 Motor connection function selection*.

Pr.579 Setting	Name	Description
0	Basic system	The motor to be inverter-driven is always fixed and you can increase/decrease the number of motors commercial power-driven by turning on and off the MC between the power supply and motor with the output frequency.
1	Alternative system	As same as basic system (*Pr. 579* = "0"), the motor to be driven by the inverter is fixed during operation and you can control the number of motors operated by the commercial power with the output frequency. When the inverter stops by the sleep function, the MC between the inverter and motor is switched to switch motors to be inverter-driven.
2	Direct system	When the start signal is entered, the motor is started by the inverter. When the conditions to start the next motor are established, switching MCs between the inverter and motor and the power supply and motor will change the inverter driven motor to commercial power-supply operation and start the next motor by the inverter. Adversely, when conditions to stop the motor is established while multiple motors are running, motors stop in order of first started motor (in the commercial power-supply operation).
3	Alternative-direct system	When the start signal is entered, the motor is started by the inverter. When the conditions to start the next motor are established, switching MCs between the inverter and motor and the power supply and motor will change the inverter driven motor to commercial power-supply operation and start the next motor by the inverter. Conversely, when the conditions for stopping the motors are enabled during running of several motors, the inverter-driven motor is decelerated to s stop and the motors under commercial power supply operation are switched over to inverter-driven operation after frequency search.Since frequency search is performed when the motor running with commercial power-supply is switched to the inverter-driven operation, set a value other than "9999" in *Pr. 57 Restart coasting time*. When *Pr. 57* is set, the CS signal need not be turned on.



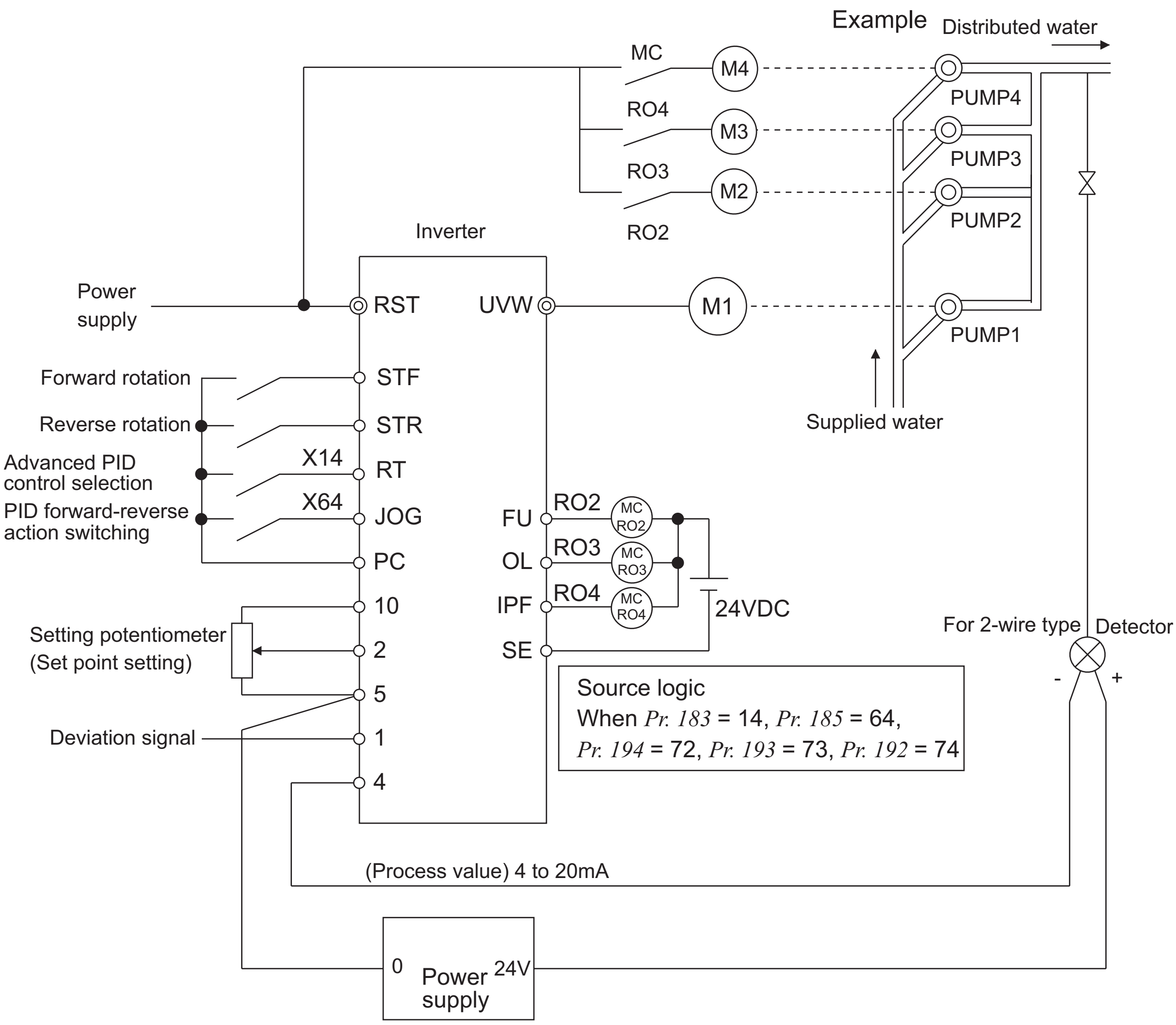
*1 The starting order of motors is M2 → M3 → M1 if the last order is M1 → M2 → M3. (*Pr. 579* = "1")
*2 The motor status in the order of elapsed time after the last inverter driving completion, from the longest (has not inverter-driven for the longest time) to the shortest. The motor 1 (M1) starts first when power is turned on for the first time or after reset. (*Pr. 579* = "3")

REMARKS

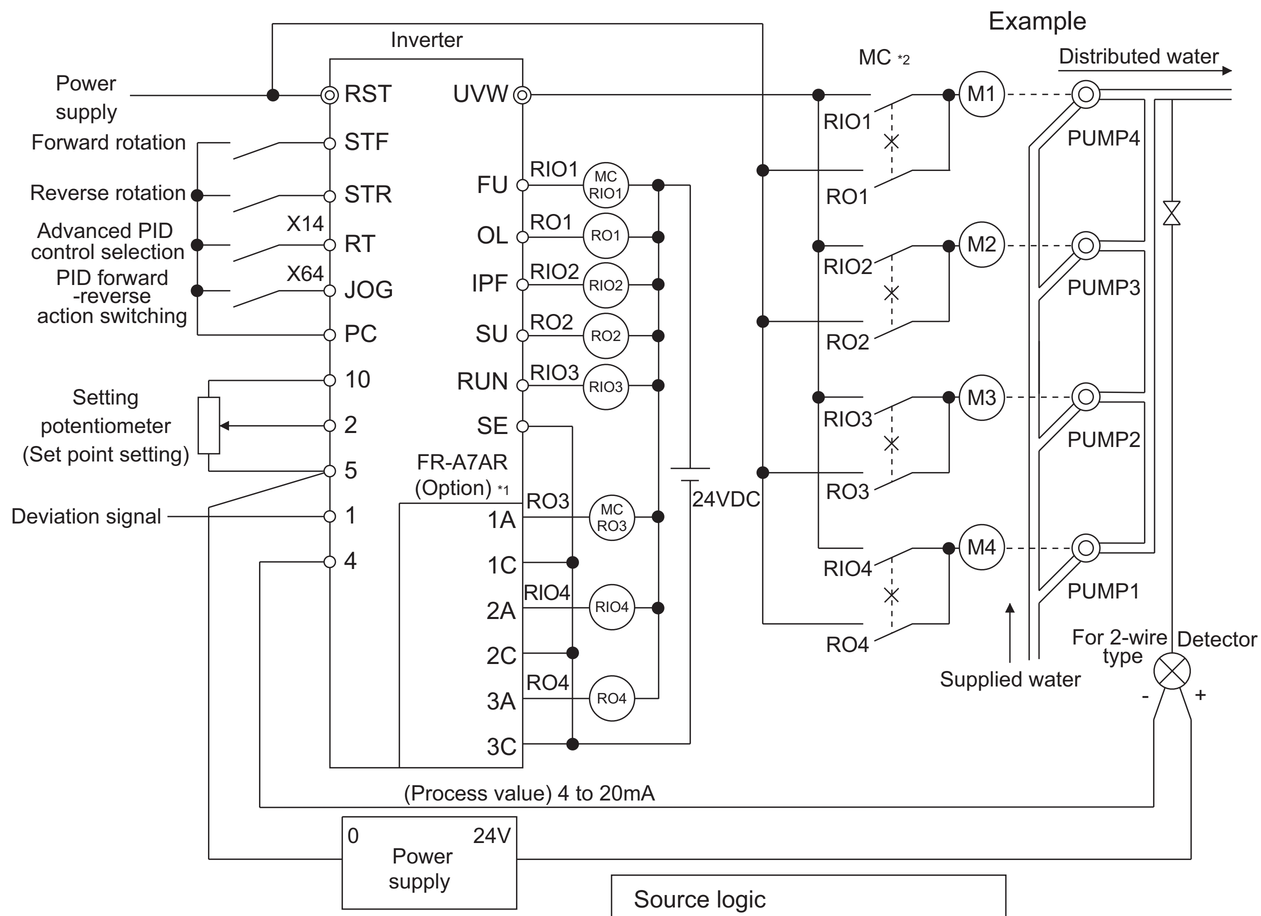
· The starting order of motors to be driven returns to the initial status at an inverter reset. (*Pr. 579* = "1, 2, 3")
· For *Pr. 578* and *Pr. 579*, parameter write is disabled during operation.In addition, when the *Pr. 578* or *Pr. 579* setting has been changed during stop, the starting order of motors also returns to the initial status.

(2) System configuration

· Basic system (*Pr. 579* = "0")



· Alternative system (*Pr. 579* = "1"), direct system (*Pr. 579* = "2"), alternative-direct system (*Pr. 579* = "3")



Source logic
When *Pr. 183* = 14, *Pr. 185* = 64
Pr. 194 = 75, *Pr. 193* = 71, *Pr. 192* = 76
Pr. 191 = 72, *Pr. 190* = 77, *Pr. 320* = 73
Pr. 321 = 78, *Pr. 322* = 74

*1 When driving three or more motors, use the plug-in option (FR-A7AR).
*2 Always provide mechanical interlocks for the MC.

(3) I/O signals

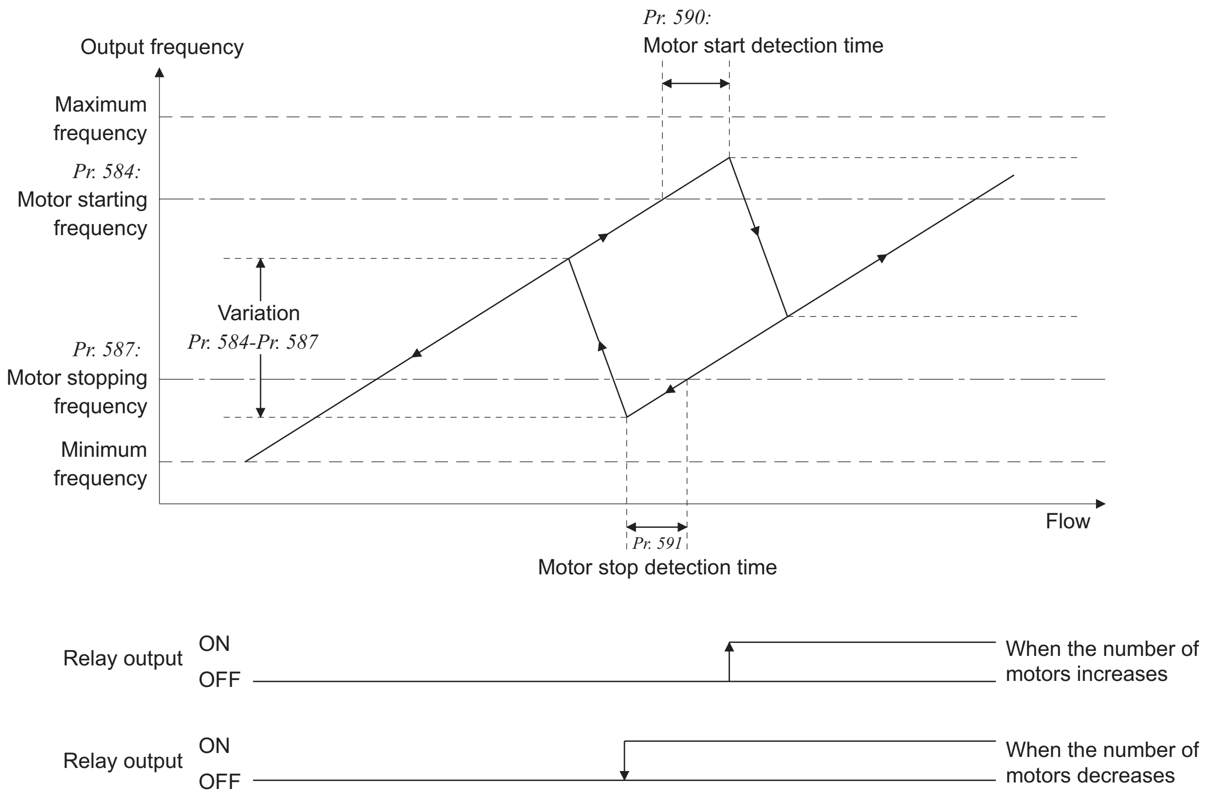
· Turn the X14 signal on when performing advanced PID control. Set "14" in *Pr. 186 to Pr. 189 (input terminal function selection)* to assign a function to the X14 signal.
· PID control depends on the *Pr. 127 to Pr. 134* settings. *(Refer to page 198)*
· Use *Pr.190 to Pr.196 (output terminal function selection)* or relay output option (FR-A7AR) to assign functions of motor control signal to *Pr.320 to Pr.322 (RA1, RA2, RA3 output selection)*. (Only positive logic is available for output terminals.

Signal	Output Terminal Function Selection Setting		Function
	Positive logic	Negative logic	
SLEEP	70	170 *1	During PID output interruption
RO1	71	— *2	Commercial-power supply side motor 1 connection
RO2	72	— *2	Commercial-power supply side motor 2 connection
RO3	73	— *2	Commercial-power supply side motor 3 connection
RO4	74	— *2	Commercial-power supply side motor 4 connection
RIO1	75	— *2	Inverter side motor 1 connection
RIO2	76	— *2	Inverter side motor 2 connection
RIO3	77	— *2	Inverter side motor 3 connection
RIO4	78	— *2	Inverter side motor 4 connection
SE	—	— *2	Output terminal common

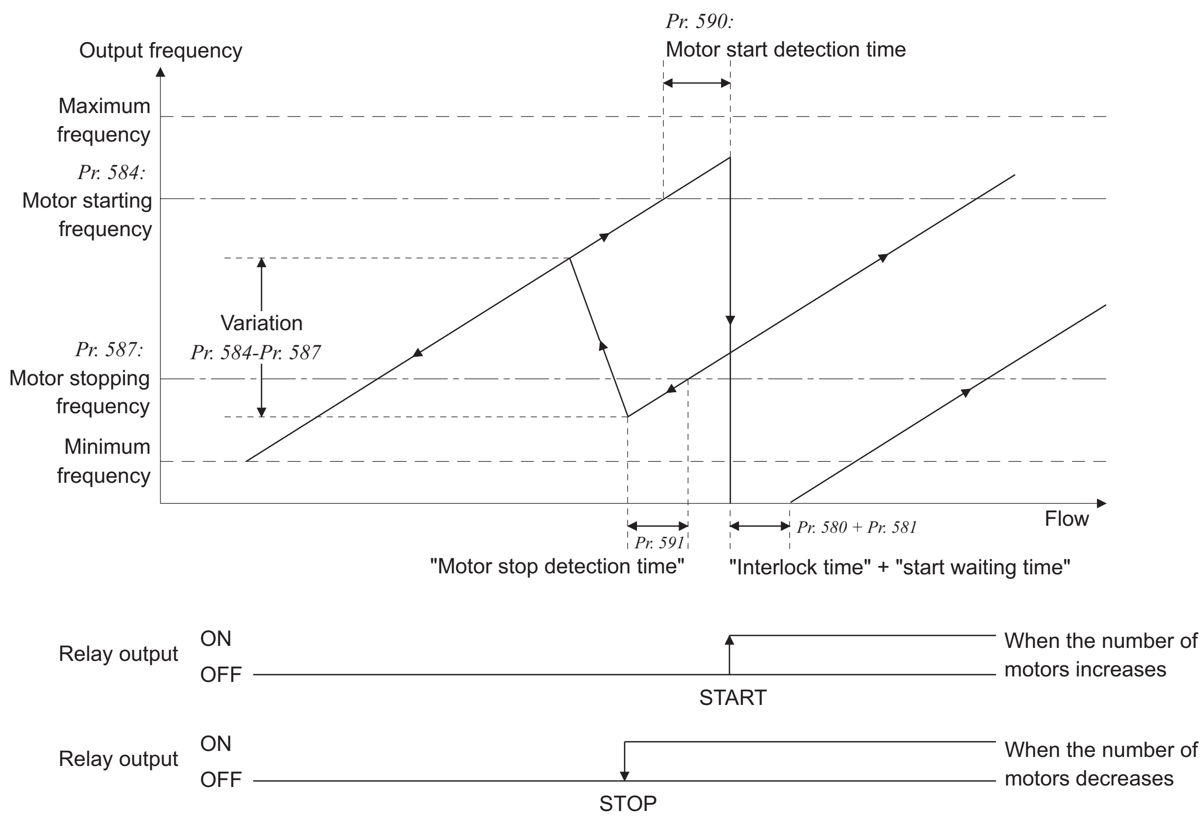
*1 This value can not be set in *Pr. 320 to Pr. 322 (RA1, RA2, RA3 output selection)*, parameters for relay output option (FR-A7AR).
*2 Negative logic can not be set.

(4) Motor switchover timing

· Switchover timing at a start (stop) of an auxiliary motor 1 in the basic system (*Pr. 579* = "0") and alternative system (*Pr. 579* = "1").



· Switchover timing at a start (stop) of an auxiliary motor 1 in the direct system (*Pr. 579* = "2") and alternative-direct system (*Pr. 579* = "3").

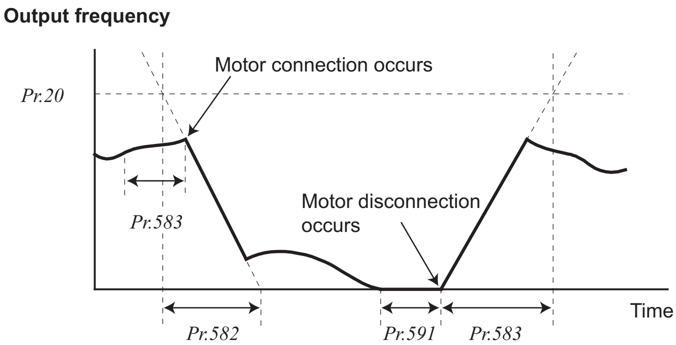


(5) Waiting time setting at MC switchover *(Pr. 580, Pr. 581)*

- Set a switching time of MC (e.g. time until RIO1 turns on after RO1 turns off) in *Pr. 580 MC switching interlock time* in the direct system (*Pr. 579* = "2").You can set the time from MC switch-over to a start (time from when RIO1 turns off and RIO2 turns on until inverter output starts). Set this time a little longer than the MC switching time.
- You can set the time from MC switch-over to a start (time from when RIO1 turns off and RIO2 turns on until inverter output starts) in *Pr. 581 Start waiting time* in the direct system (*Pr. 579* = "2"). Set this time a little longer than the MC switching time.

(6) Acceleration/deceleration time when an auxiliary motor is connected and disconnected *(Pr. 582, Pr.583)*

- You can set the deceleration time in *Pr. 582 Auxiliary motor connection-time deceleration time* for decreasing the output frequency of the inverter if an auxiliary motor connection occurs. Set the deceleration time in Pr. 582 from *Pr. 20 Acceleration/deceleration reference frequency* to stop.
  The output frequency is not forcibly changed when "9999" is set.
- You can set the acceleration time in *Pr. 583 Auxiliary motor disconnection-time acceleration time* for accelerating the output frequency of the inverter if an auxiliary motor disconnection occurs. Set the deceleration time in *Pr. 583* from *Pr. 20 Acceleration/deceleration reference frequency* to stop.
  The output frequency is not forcibly changed when "9999" is set.



REMARKS

Pr. 582 and *Pr. 583* are not affected by the *Pr. 21 Acceleration/deceleration time increments* setting. (Setting range and setting increments do not change.)

(7) Start of auxiliary motor *(Pr. 584 to Pr. 586, Pr. 590)*

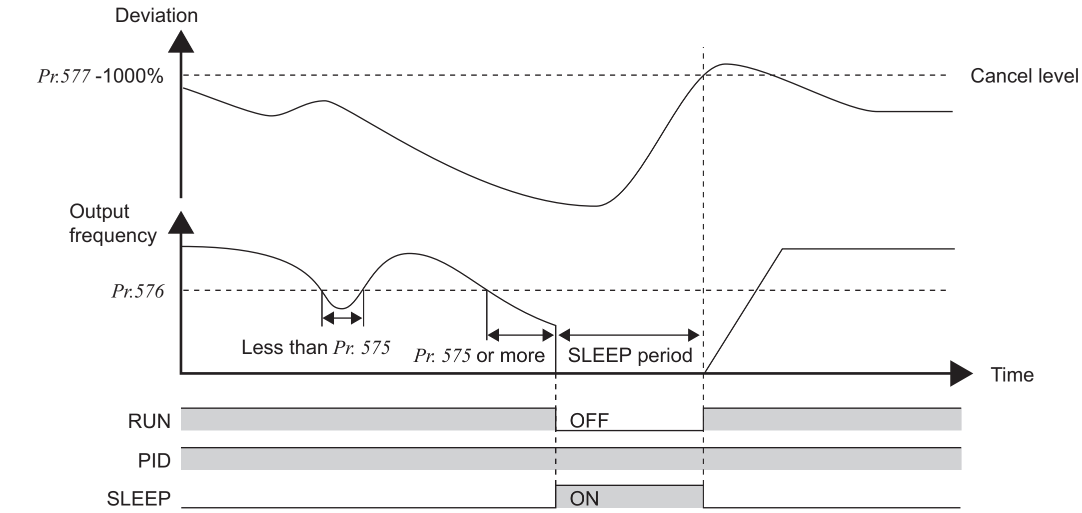
- You can set the output frequency of the inverter-operated motor in *Pr. 584 to Pr. 586* at which the commercial-power supply operation motors start. When the output frequency equal to or higher than the setting continues for longer than the time set in *Pr. 590 Auxiliary motor start detection time*, the commercial-power supply motors start. In this case, the starting sequence depends on the pattern in *Pr. 579 Motor connection function selection*.
- *Pr. 584 Auxiliary motor 1 starting frequency* value means the frequency at which the first commercial-power supply motor starts when the number of commercial-power supply motors.When starting the second commercial-power supply motor when one commercial-power supply motor is running, set *Pr. 585 Auxiliary motor 2 starting frequency*.

(8) Start of auxiliary motor *(Pr. 587 to Pr. 589, Pr. 591)*

- You can set the output frequency of the inverter-operated motor in *Pr. 587 to Pr. 589* at which the commercial-power supply operation motors stop. When the output frequency equal to or lower than the setting continues for longer than the time set in *Pr. 591 Auxiliary motor stop detection time*, the commercial-power supply motors stop.In this case, the stopping sequence depends on the pattern in *Pr. 579 Motor connection function selection*.
- Use *Pr. 587 Auxiliary motor 1 stopping frequency* to set the frequency at which one commercial-power supply motor running stops. When stopping one commercial-power supply motor when two commercial-power supply motors are running, set *Pr. 588 Auxiliary motor 2 stopping frequency*.

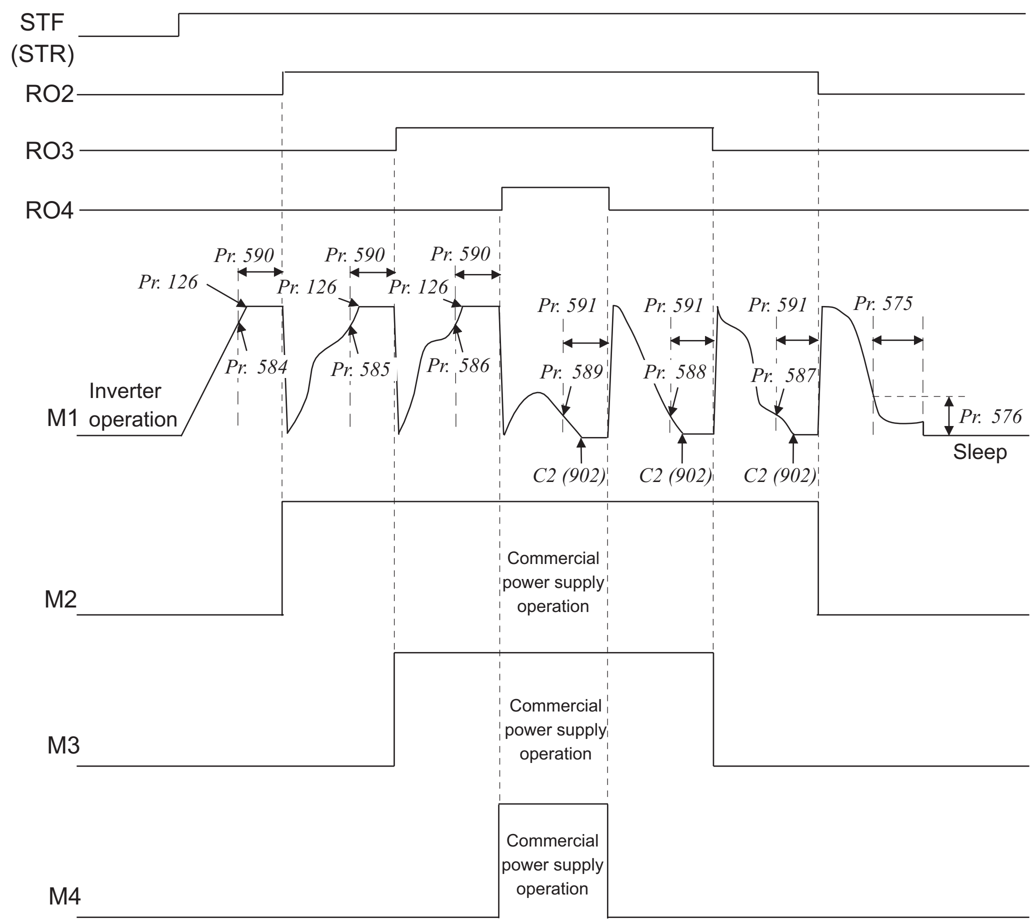
(9) PID output interruption function (SLEEP function) (SLEEP signal, *Pr. 575 to Pr. 577*)

- If the output frequency after PID operation remains lower than the *Pr. 576 Output interruption detection level* for longer than the time set in *Pr. 575 Output interruption detection time*, the inverter stops operation. The energy consumption in the inefficient low speed region can be reduced.
- When the deviation (= set point – measured value) reaches PID output interruption cancel level (*Pr. 577* setting – 1000%) when the PID output interruption function is activated, PID output interruption function is released and PID control operation is automatically resumed.
- PID output suspension signal (SLEEP) is output when the PID output interruption function is activated. At this time, the inverter running signal (RUN) turns off and the PID control activated signal (PID) turns on.

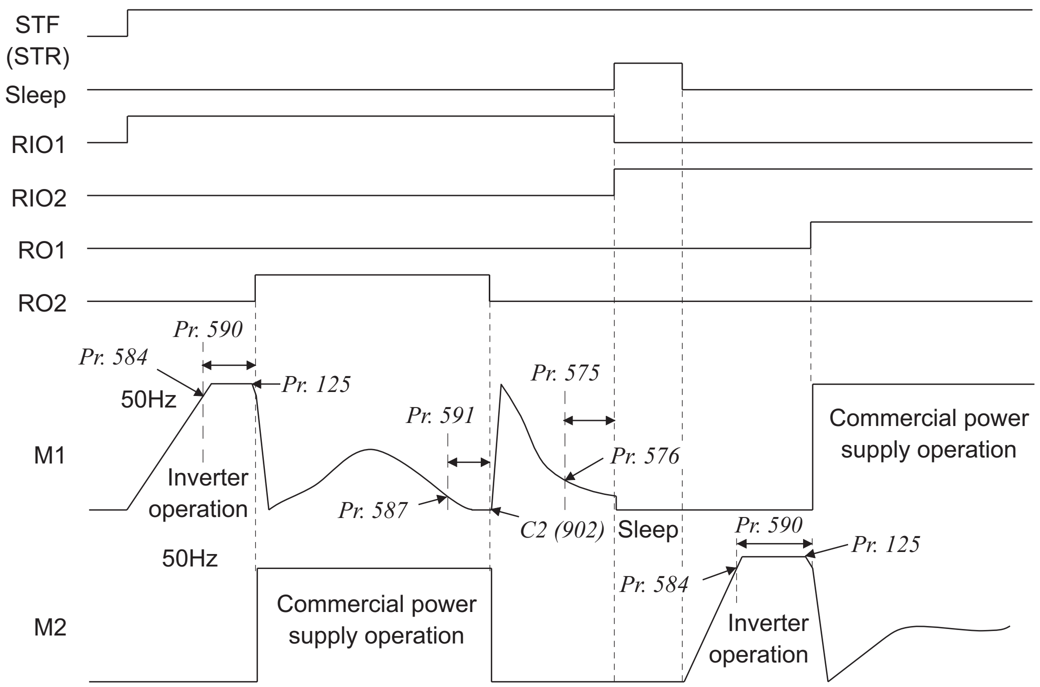


(10) Timing diagram

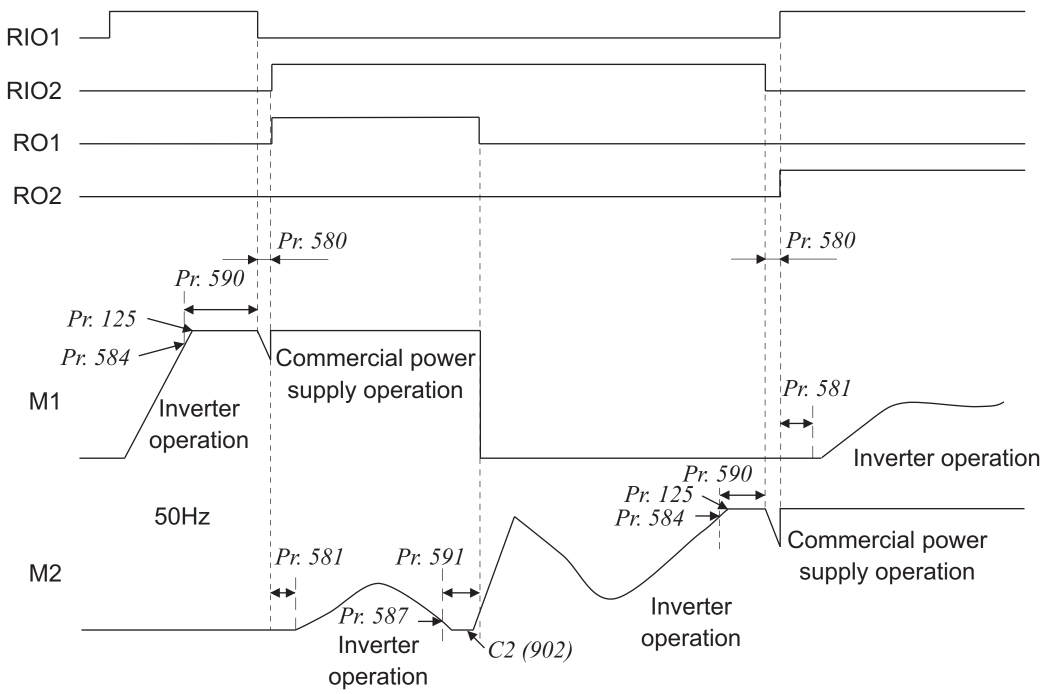
- When using four motors in the basic system (*Pr. 579* = "0")



· When using two motors in the alternative system (*Pr. 597* = "1")



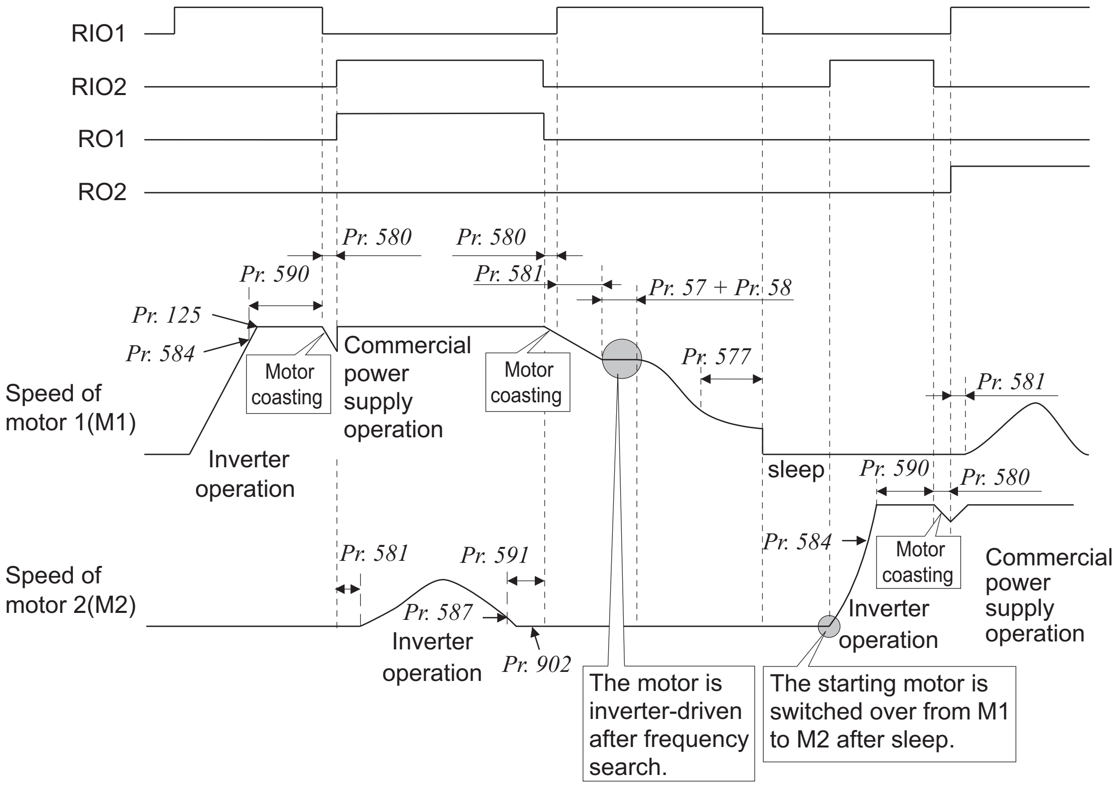
· When using two motors in the direct system (*Pr. 597* = "2")



CAUTION

· When a start signal is turned off while running, MC (RO1 to RO4) turns off and the inverter decelerates.
· When an error occurs while running, MC (RO1 to RO4) turns off and the inverter output is shut off.

· When using two motors in the alternative-direct system (*Pr. 579* = "3")



CAUTION

· If the start signal is turned off during operation, the inverter-driven motor is decelerated to stop, and the motors under commercial power supply operation are switched over to inverter-driven operation one at a time and decelerated to a stop after frequency search in order from the longest operation time.

· When an error occurs while running, MC (RO1 to RO4) turns off and the inverter output is shut off.

· If the MRS signal is turned on during operation, the inverter-driven motor is shut off. Although the motor with the longest operating time of the commercial power supply operation is switched to the inverter operation after elapse of time set in *Pr. 591 Auxiliary motor stop detection time* , the motor remains in the output shut off status. Frequency search is made after the MRS signal turns off and inverter operation is started.

· If the starting signal is turned on during deceleration to stop regardless of the *Pr. 579* setting, operation by the advanced PID control is performed again at the point when the signal is turned on.

♦ Parameters referred to ♦

Pr. 20 Acceleration/deceleration reference frequency, Pr. 21 Acceleration/deceleration time increments ☞ *Refer to page 85*
Pr. 127 to Pr. 134 (PID control) ☞ *Refer to page 198*
Pr.178 to Pr.189 (input terminal function selection) ☞ *Refer to page 96*
Pr. 190 to Pr. 196 (output terminal function selection) ☞ *Refer to page 102*

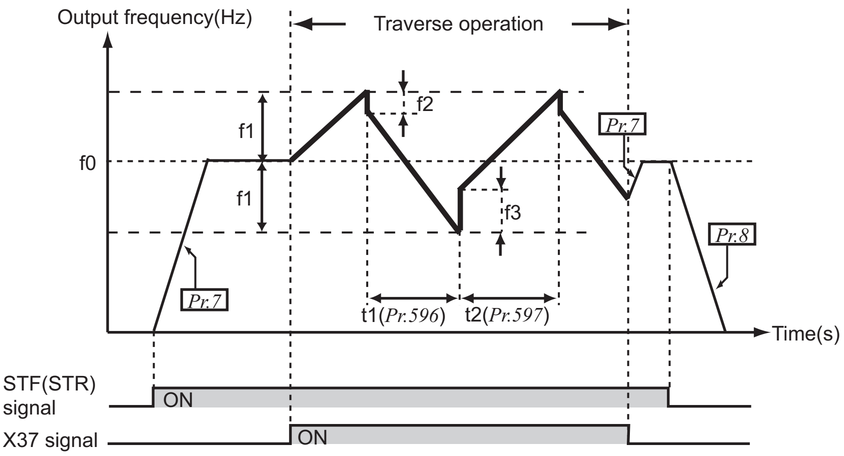
4.20.4 Traverse function (Pr. 592 to Pr. 597)

Traverse operation which varies the amplitude of the frequency in a constant cycle can be performed.

Parameter Number	Name	Initial Value	Setting Range	Description
592	**Traverse function selection**	0	0	Traverse function invalid
			1	Traverse function is valid only in the external operation mode
			2	Traverse function is valid independently of operation mode
593	**Maximum amplitude amount**	10%	0 to 25%	Amplitude amount during traverse operation
594	**Amplitude compensation amount during deceleration**	10%	0 to 50%	Compensation amount at the time of amplitude inversion (acceleration → deceleration)
595	**Amplitude compensation amount during acceleration**	10%	0 to 50%	Compensation amount during amplitude inversion operation (deceleration → acceleration)
596	**Amplitude acceleration time**	5s	0.1 to 3600s	Acceleration time during traverse operation
597	**Amplitude deceleration time**	5s	0.1 to 3600s	Deceleration time during traverse operation

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

- When "1" or "2" is set in *Pr. 592 Traverse function selection*, turning on the traverse operation signal (X37) makes the traverse function valid.
- Set "37" in any of *Pr. 178 to Pr. 189 Input terminal function selection* and assign the X37 signal to the external terminal.
  When the X37 signal is not assigned to the input terminal, the traverse function is always valid (X37-ON).

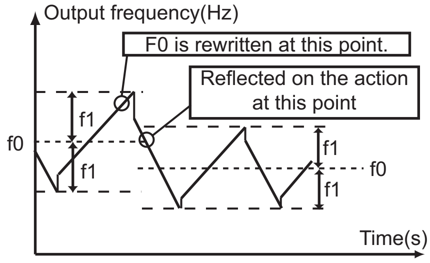


f0: set frequency
f1: amplitude amount from the set frequency (f0 × *Pr.593*/100)
f2: compensation amount at transition from acceleration to deceleration (f1 × *Pr.594*/100)
f3: compensation amount at transition from deceleration to acceleration (f1 × *Pr.595*/100)
t1: time from acceleration during traverse operation (Time from (f0 – f1) to (f0 + f1) *(Pr. 596)*
t2: time from deceleration during traverse operation (Time from (f0 + f1) to (f0 – f1) *(Pr. 597)*

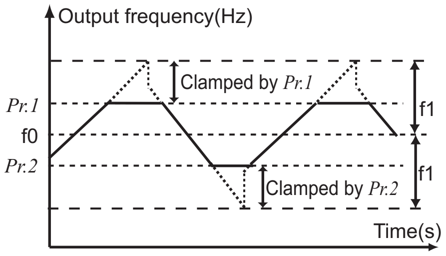
1) When the starting command (STF or STR) is switched on, the output frequency accelerates to the set frequency f0 according to the normal *Pr. 7 Acceleration time*.
2) When the output frequency reaches f0, traverse operation can be started by switching the X37 signal on, then the frequency accelerates to f0 + f1.(The acceleration time at this time depends on the *Pr. 596* setting.
3) After having accelerated to f0 + f1, compensation of f2 (f1 × Pr. 594) is made and the frequency decreases to f0-f1. (The deceleration time at this time depends on the *Pr. 597* setting.)
4) After having decelerated to f0 – f1, compensation of f3 (f1 × *Pr. 595*) is made and the frequency again accelerates to f0 + f1.
5) If the X37 signal is turned on during traverse operation, the frequency accelerates/decelerates to f0 according to the normal acceleration/deceleration time *(Pr. 7, Pr. 8)*.If the start command (STF or STR) is turned off during traverse operation, the frequency decelerates to a stop according to the normal deceleration time *(Pr. 8)*.

REMARKS

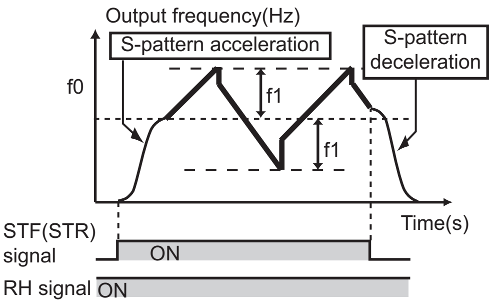
When the second function signal (RT) is on, normal acceleration/deceleration time *(Pr. 7, Pr. 8)* is the same as second acceleration/deceleration time *(Pr. 44, Pr. 45)*.



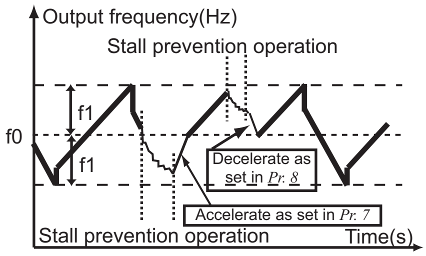
· If the set frequency (f0) and traverse operation parameters *(Pr. 598 to Pr. 597)* are changed, pattern operation is performed at changed f0 after the output frequency reached f0 before change.



· When the output frequency exceeds *Pr. 1 Maximum frequency* or *Pr.2 Minimum frequency*, the output frequency is clamped at maximum/ minimum frequency while the set pattern exceeds the maximum/ minimum frequency.



· When the traverse function and S-pattern acceleration/deceleration (*Pr. 29* ≠ 0) are selected, S-pattern acceleration/deceleration is performed only in the areas where operation is performed in normal Acceleration and deceleration time *(Pr. 7, Pr. 8)*. For acceleration/ deceleration during traverse operation, linear acceleration/ deceleration is made.



· When stall prevention is activated during traverse operation, traverse operation is stopped and normal operation is performed. When stall prevention operation ends, the motor accelerates/decelerates to f0 in normal acceleration/deceleration time *(Pr. 7, Pr. 8)*. After the output frequency reaches f0, traverse operation is again performed.

CAUTION

· When the value of amplitude inversion compensation amount *(Pr. 594, Pr. 595)* is too large, pattern operation as set is not performed due to overvoltage shut-off and stall prevention.
· 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. 1 Maximum frequency, Pr. 2 Minimum frequency ☞ *Refer to page 72*
Pr. 7 Acceleration time, Pr. 8 Deceleration time ☞ *Refer to page 85*
Pr. 29 Acceleration/deceleration pattern selection ☞ *Refer to page 88*
Pr.178 to Pr.189 (input terminal function selection) ☞ *Refer to page 96*

4.20.5 Regeneration avoidance function (Pr. 882 to Pr. 886)

This function detects a regeneration status and increases the frequency to avoid the regeneration status.

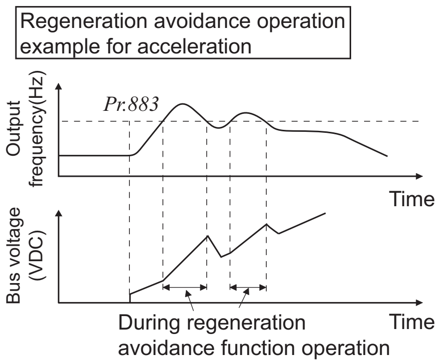
- Possible to avoid regeneration by automatically increasing the frequency and continue operation if the fan happens to rotate faster than the set speed due to the effect of another fan in the same duct.

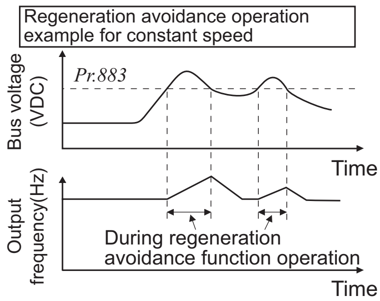
Parameter Number	Name	Initial Value	Setting Range	Description
882	**Regeneration avoidance operation selection**	0	0	Regeneration avoidance function invalid
			1	Regeneration avoidance function valid
			2	Regeneration avoidance function is valid only during a constant speed operation
883	**Regeneration avoidance operation level**	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 × $\sqrt{2}$.
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.

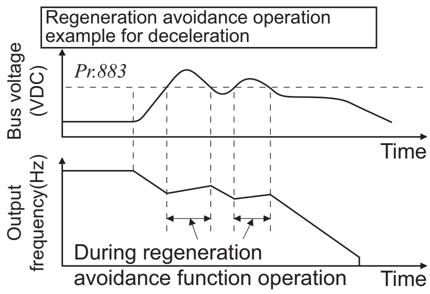
The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

(1) What is regeneration avoidance function? *(Pr. 882, Pr. 883)*

- When the regeneration 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 regeneration status.
- The regeneration avoidance operation, you can select whether it is always activated or activated only 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 regeneration status.
- The DC bus voltage of the inverter is normally about $\sqrt{2}$ times greater than the input voltage.

  When the input voltage is 440VAC, the bus voltage is about 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.
- Note that when coping parameters to the inverter without this function (inverter assembled in and before September 2005), copied Pr.882 ="2" is regarded as Pr.882 ="0"(regeneration avoidance function invalid).

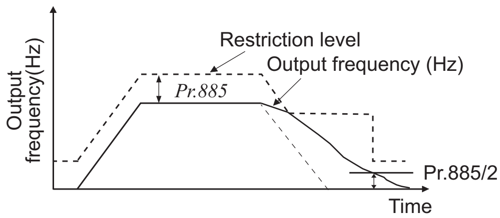
(2) To detect the regeneration status during deceleration faster *(Pr. 884)*

· 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. 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.

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 (BU, FR-BU, MT-BU5, FR-CV, FR-HC, MT-HC).
- When using the regeneration unit (BU, FR-BU, MT-BU5, FR-CV, FR-HC, MT-HC), set *Pr. 882* to "0 (initial value)" (regeneration avoidance function invalid).
- 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 72*
Pr. 8 Deceleration time ☞ *Refer to page 85*
Pr. 22 Stall prevention operation level ☞ *Refer to page 66*

4

PARAMETERS

4.21 Useful functions

Purpose	Parameter that must be Set		Refer to Page
Increase cooling fan life	**Cooling fan operation selection**	**Pr. 244**	224
To determine the maintenance time of parts.	**Inverter part life display**	**Pr. 255 to Pr. 259**	225
	Maintenance output function	**Pr. 503, Pr. 504**	227
	Current average value monitor signal	**Pr. 555 to Pr. 557**	228
Freely available parameter	**Free parameter**	**Pr. 888, Pr. 889**	230

4.21.1 Cooling fan operation selection (Pr. 244)

You can control the operation of the cooling fan (00083 or more) built in the inverter.

Parameter Number	Name	Initial Value	Setting Range	Description
244	**Cooling fan operation selection**	1	0	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.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*

· 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) to 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 102*

4.21.2 Display of the life of the inverter parts (Pr. 255 to Pr .259)

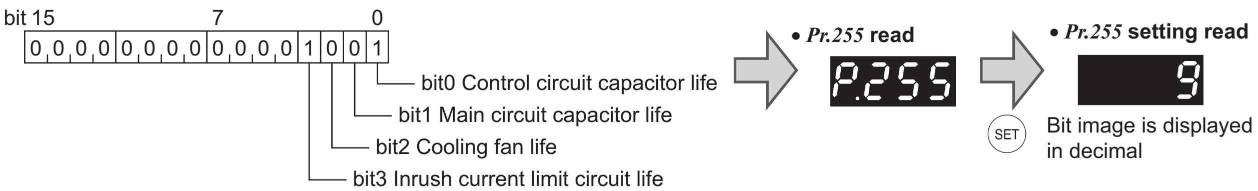
Degrees of deterioration of main circuit capacitor, control circuit capacitor, cooling fan and inrush current limit circuit can be diagnosed by monitor.
When any part has approached the end of its life, an alarm can be output by self diagnosis to prevent a fault.
(Use the life check of this function 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*.

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*

(1) Life alarm display and signal outuput (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

- 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) in any of *Pr. 190 to Pr. 196 (output terminal function selection)*.

REMARKS

- The digital output option (FR-A7AY, FR-A7AR, FR-A7NC) 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. 259*.
- 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 FR-HC, MT-HC, FR-CV, 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 motor capacity is two rank smaller as compared to the inverter capacity.
  (g) The inverter is at an alarm stop or an alarm occurred while power is off.
  (h) The inverter output is shut off with the MRS signal.
  (i) The start command is given while measuring.
- Operating environment: 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 standard 4P motor)

POINT

For the accurate life measuring of the main circuit capacitor, perform after more than 3 hrs passed since the turn off of the power as it is affected by the capacitor temperature.

(5) Cooling fan life display

- The cooling fan speed of 50% 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

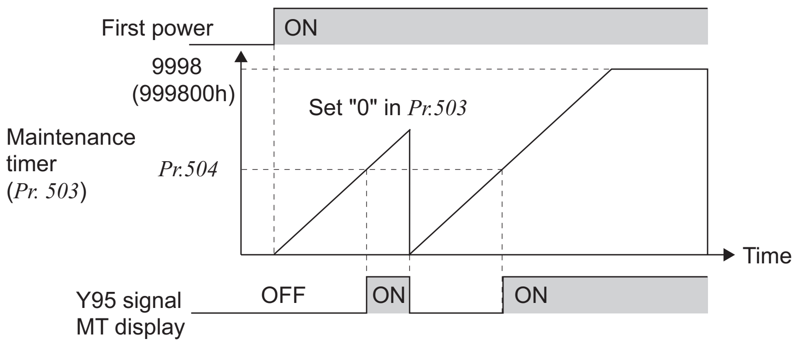
- For replacement of each part, contact the nearest Mitsubishi FA center.

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 above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*



- 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 to *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

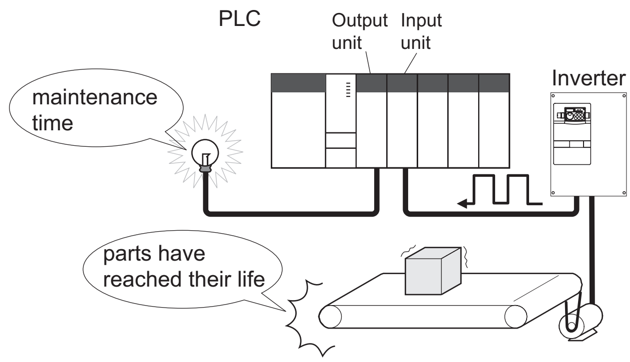
- The cumulative energization time is counted every hour. The energization time of less than 1h is not counted.
- When terminal assignment is changed using *Pr. 190 to Pr. 196 (output terminal function selection)*, the other functions may be affected. Please make setting after confirming the function of each terminal.

♦ Parameters referred to ♦

Pr. 190 to Pr. 196(output terminal function selection) ☞ *Refer to page 102*

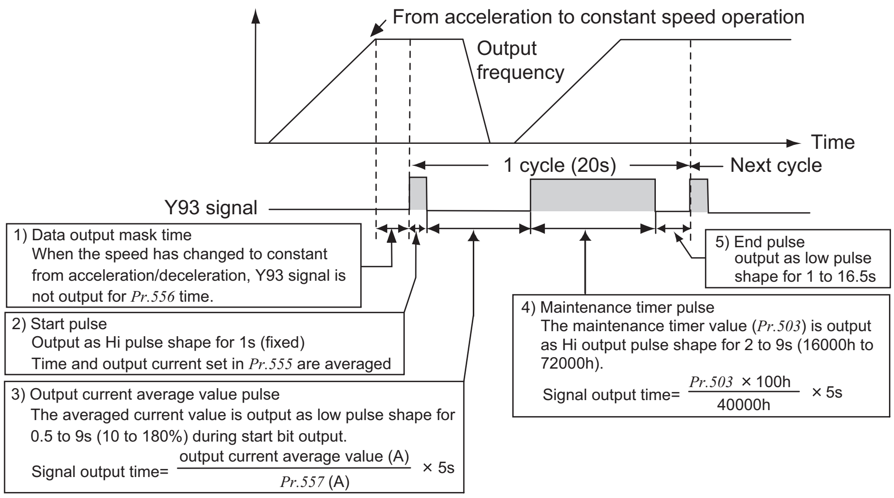
4.21.4 Current average value monitor signal (Pr. 555 to Pr. 557)

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 or the like 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 bit 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	01160 or less	0 to 500A	Set the reference (100%) for outputting the signal of the current average value.
			01800 or more	0 to 3600A	

The above parameters can be set when *Pr. 160 User group read selection*= "0". *(Refer to page 153)*
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*

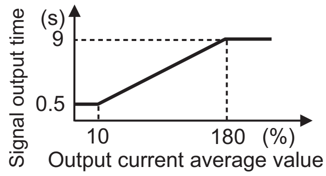
Set the reference (100%) for outputting the signal of the current average value. Obtain the time to output the signal from the following calculation.

$$\frac{\textbf{Output current average value}}{\textbf{\textit{Pr. 557} setting}} \times \textbf{5s} \quad \textbf{(output current average value 100\%/5s)}$$

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.

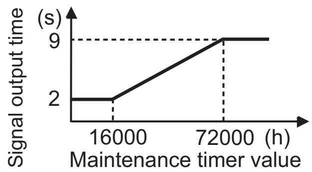


(4) Output of *Pr. 503 Maintenance timer*

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 calculation.

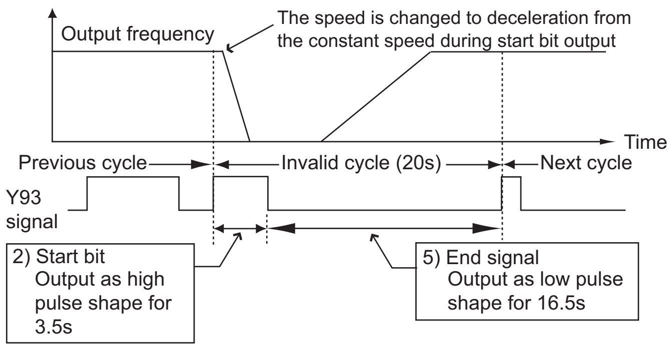
$$\frac{\textbf{\textit{Pr. 503}}}{\textbf{40000h}} \times \textbf{5s} \quad \textbf{(maintenance timer value 100\%/5s)}$$

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 bit output, the data is judged as invalid, the start bit 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 bit 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 102*
Pr. 503 Maintenance timer ☞ *Refer to page 227*
Pr. 57 Restart coasting time ☞ *Refer to page 120*

4.21.5 Free parameter (Pr. 888, Pr. 889)

Parameters you can use for your own purposes.
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	Desired values can be input. Data is held even if the inverter power is turned off.
889	**Free parameter 2**	9999	0 to 9999	

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153)*
The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in *Pr. 77 Parameter write selection*.

REMARKS

Pr. 888 and *Pr. 889* do not influence the inverter operation.

4.22 Setting from the parameter unit, 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**	231
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**	231
Control of the parameter unit, operation panel buzzer	**PU buzzer control**	**Pr. 990**	233
Adjust the LCD contrast of the parameter unit	**PU contrast adjustment**	**Pr. 991**	233

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	Definition
145	**PU display language selection**	1	0	Japanese
			1	English
			2	Germany
			3	French
			4	Spanish
			5	Italian
			6	Swedish
			7	Finnish

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*

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.

Parameter Number	Name	Initial Value	Setting Range	Description	
161	**Frequency setting/key lock operation selection**	0	0	Setting dial frequency setting mode	Key lock mode invalid
			1	Setting dial volume mode	
			10	Setting dial frequency setting mode	Key lock mode valid
			11	Setting dial volume mode	

The above parameters can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*

4

PARAMETERS

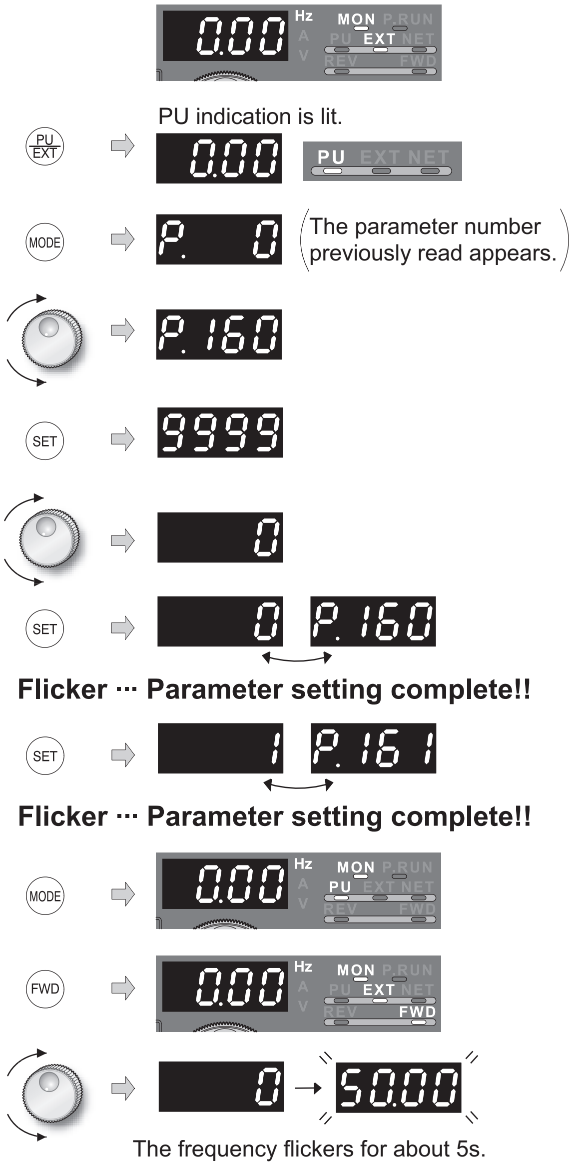
(1) Using the setting dial like a volume to set the frequency.

Operation example | Changing the frequency from 0Hz to 50Hz 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 the setting dial until P. 160 (*Pr. 160*) appears.
5. Press (SET) to read the currently set value.
   " 9999 " (initial value) appears.
6. Turn the setting dial to change it to the setting value " 0 ".
7. Press (SET) to set.
8. Change Pr. 161 to the setting value of " 1 " in the similar manner. (Refer to step 4 to 7.)
9. Mode/monitor check
   Press (MODE) twice to choose monitor/frequency monitor.
10. Press (FWD) (or (REV)) to start the inverter.
11. Turn the setting dial until " 50.00 " appears.
    The flickering frequency is the set frequency.
    You need not press (SET).

Display



REMARKS

- If the display changes from flickering "50.00" 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

- If the setting dial and key operation are disabled, the monitor display STOP RESET is valid.

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 can be set when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*
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.
When the operation panel is connected, they can be set only when *Pr. 160 User group read selection* = "0". *(Refer to page 153.)*

4.23 Parameter clear

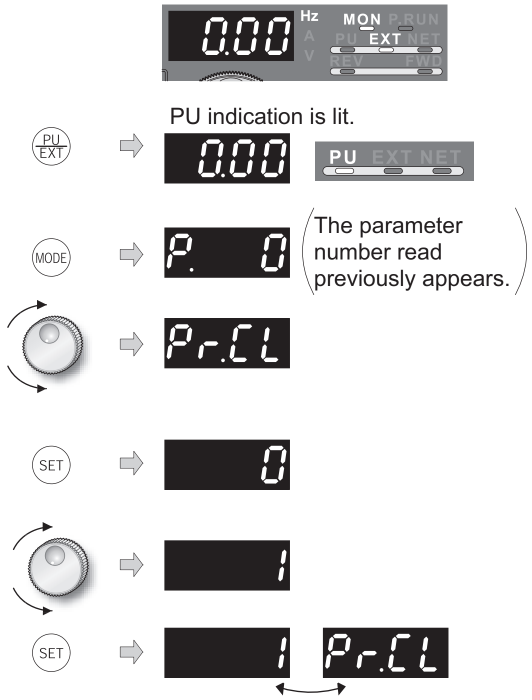
POINT

· Set "1" in *Pr. CL parameter clear* to initialize 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 "Pr.CL" (parameter clear) 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 292* 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

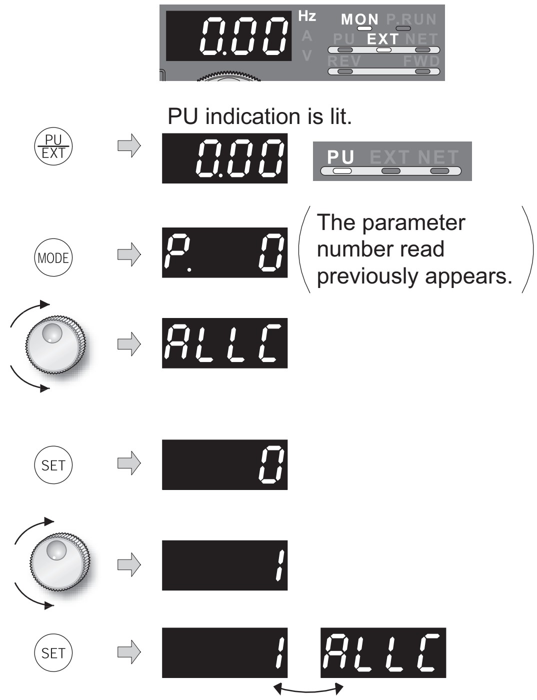
POINT

· Set "1" in *ALLC parameter clear* to initialize all parameters. (Parameters are not cleared when "1" is set in *Pr. 77Parameter 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 (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.

Display



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 292* 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.

4.25 Parameter copy and parameter verification

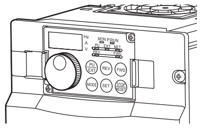
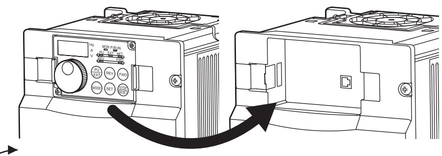
PCPY Setting	Description
0	Cancel
1	Copy the source parameters to the operation panel.
2	Write the parameters copied to the operation panel into the destination inverter.
3	Verify parameters in the inverter and operation panel. *(Refer to page 237.)*

REMARKS

· When the copy destination inverter is not the FR-F700 series or parameter copy write is performed after parameter read is stopped, "model error (rE4)" is displayed.
· Refer to the parameter list on the *Instruction Manual (basics)* 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 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 dial to change it to the setting value "1".	⇨ 1
6. Press SET to copy the source parameters to the operation panel.	SET ⇨ 1 The frequency 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 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 01160 or less and 01800 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*.

	01160 or less	01800 or more
Pr. 989 Setting	10	100

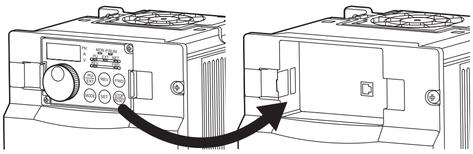
3. Reset *Pr. 9, Pr. 30, Pr. 51, Pr. 52, Pr. 54, Pr. 56, Pr. 57, Pr. 70, Pr. 72, Pr. 80, Pr. 90, Pr. 158, Pr. 190 to Pr. 196, Pr. 893*.

4.25.2 Parameter verification

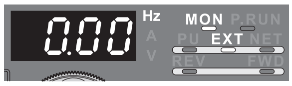
Whether same parameter values are set in other inverters or not can be checked.

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 — The frequency 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

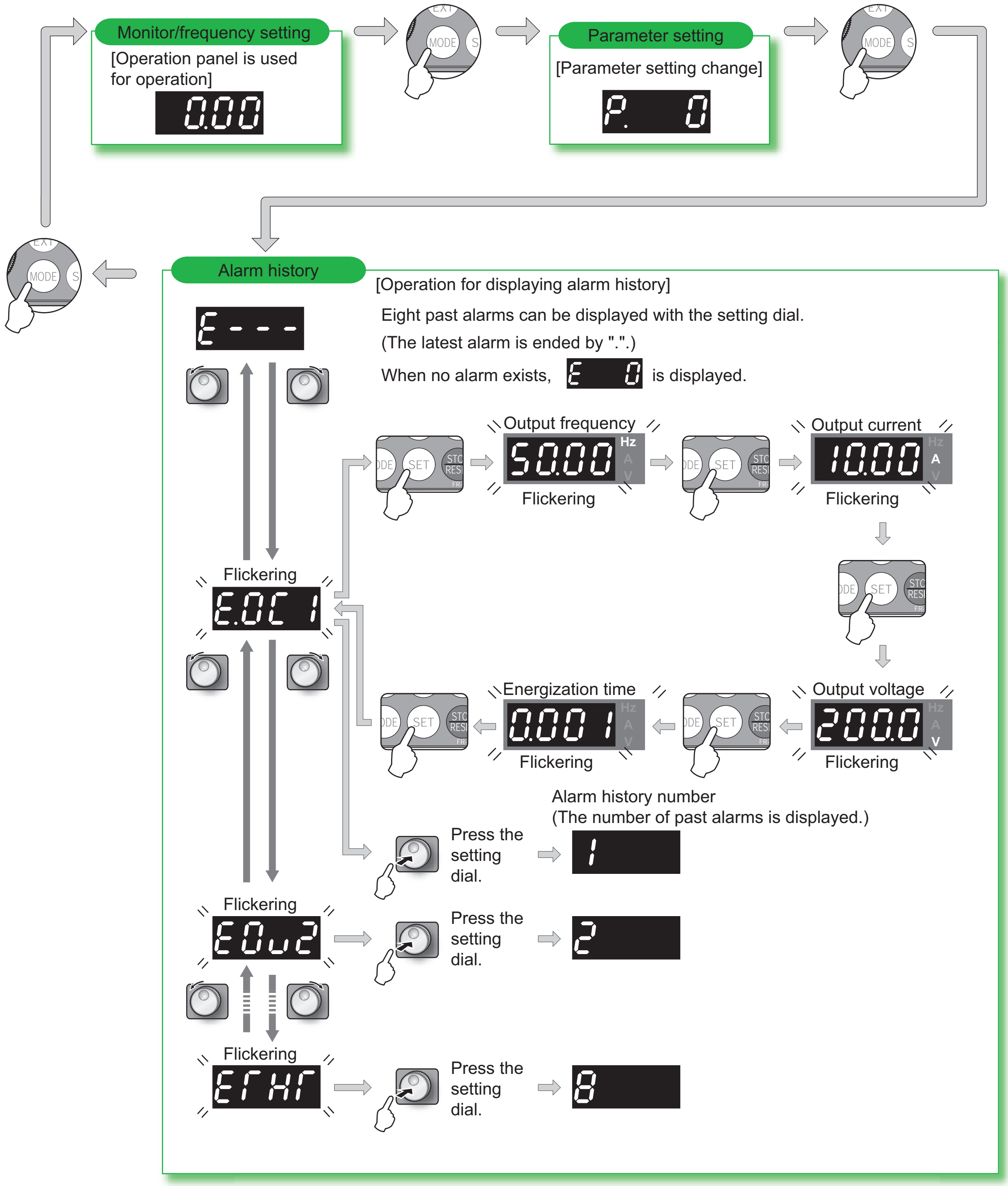
When the copy destination inverter is not the FR-F700 series, "model error (rE4)" is displayed.

? 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

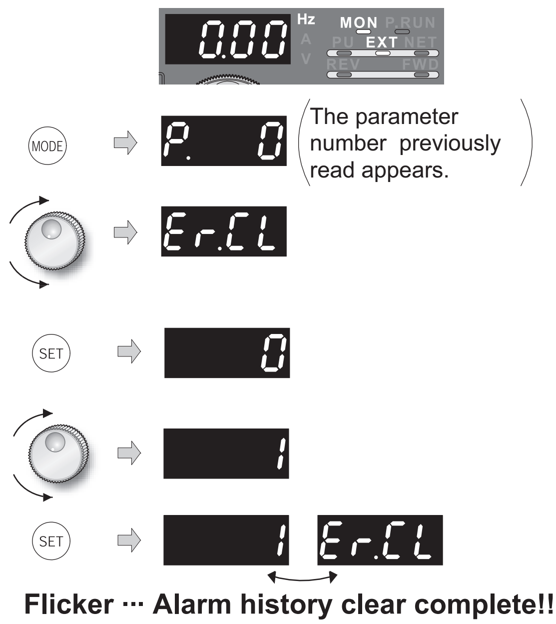
POINT

· 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

1. Screen at powering on
   The monitor display appears.
2. Press (MODE) to choose the parameter setting mode.
3. Turn the dial until Er.CL (alarm history clear) appears.
4. Press (SET) to read the currently set value.
   "0"(initial value) appears.
5. Turn the dial to change it to the setting value "1".
6. Press (SET) to set.

Display



· Press the dial to read another parameter.

· Press (SET) to show the setting again.

· Press (SET) twice to show the next parameter.

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 242.)*
- 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) or 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.

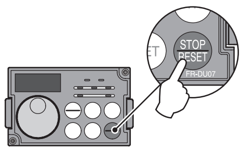
(3) Minor fault
The inverter output is not shut off. You can also output a minor fault signal by making parameter setting.

(4) Maijor fault
When the protective function is activated, the inverter output is shut off and an alarm is output.

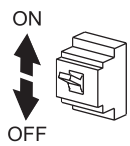
5.1 Reset method of protective function

(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.

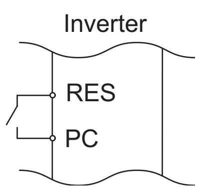
Operation 1: ..... Using the operation panel, press STOP RESET to reset the inverter.
(Enabled only when the inverter protective function is activated (major fault) (Refer to *page 248* for major fault.))



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	238
	HOLd	HOLD	Operation panel lock	244
	Er1 to Er4	Er1 to 4	Parameter write error	244
	rE1 to rE4	rE1 to 4	Copy operation error	245
	Err.	Err.	Error	245
Warnings	OL	OL	Stall prevention (overcurrent)	246
	oL	oL	Stall prevention (overvoltage)	246
	rb	RB	Regenerative brake prealarm	247
	TH	TH	Electronic thermal relay function prealarm	247
	PS	PS	PU stop	246
	MT	MT	Maintenance signal output	247
	CP	CP	Parameter copy	247
Minor fault	Fn	FN	Fan fault	248
Major fault	E.OC1	E.OC1	Overcurrent shut-off during acceleration	248
	E.OC2	E.OC2	Overcurrent shut-off during constant speed	248
	E.OC3	E.OC3	Overcurrent shut-off during deceleration or stop	248
	E.Ov1	E.OV1	Regenerative overvoltage shut-off during acceleration	249
	E.Ov2	E.OV2	Regenerative overvoltage shut-off during constant speed	249
	E.Ov3	E.OV3	Regenerative overvoltage shut-off during deceleration or stop	249
	E.THT	E.THT	Inverter overload shut-off (electronic thermal relay function)	249
	E.THM	E.THM	Motor overload shut-off (electronic thermal relay function)	249
	E.FIn	E.FIN	Fin overheat	250
	E.IPF	E.IPF	Instantaneous power failure	250
	E. bE	E.BE	Brake transistor alarm detection/internal circuit error	250
	E.UvT	E.UVT	Undervoltage	250
	E.ILF	E.ILF*	Input phase failure	250
	E.OLT	E.OLT	Stall prevention	251

	Operation Panel Indication		Name	Refer to
Major fault	E. GF	E.GF	Output side earth fault overcurrent	251
	E. LF	E.LF	Output phase failure	251
	E.OHT	E.OHT	External thermal relay operation *2	251
	E.PTC	E.PTC*	PTC thermistor operation	251
	E.OPT	E.OPT	Option alarm	251
	E.OP1	E.OP1	Communication option alarm	252
	E. 1	E. 1	Option alarm	252
	E. PE	E.PE	Parameter storage device alarm	252
	E.PUE	E.PUE	PU disconnection	252
	E.rET	E.RET	Retry count excess	252
	E.PE2	E.PE2*	Parameter storage device alarm	252
	E. 6/ E. 7/ E.CPU	E. 6 / E. 7 / E.CPU	CPU error	253
	E.CTE	E.CTE	Operation panel power supply short circuit, RS-485 terminal power supply short circuit	253
	E.P24	E.P24	24VDC power output short circuit	253
	E.CdO	E.CDO*	Output current detection value exceeded	253
	E.IOH	E.IOH*	Inrush current limit circuit alarm	253
	E.SEr	E.SER*	Communication error (inverter)	254
	E.AIE	E.AIE*	Analog input error	254
	E. 13	E.13	Internal circuit error	254

* If an error occurs when using the FR-PU04/FR-PU07, "Fault 14" is displayed on the FR-PU04/FR-PU07.

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 233.)*	
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 152.)* 2. Check the settings of *Pr. 31 to 36 (frequency jump). (Refer to page 73.)* 3. Check the settings of *Pr. 100 to Pr. 109 (Adjustable 5 points V/F). (Refer to page 77.)* 4. Check the connection of the PU and inverter.	

Operation Panel Indication	**Er2**	Er 2
Name	Write error during operation	
Description	When parameter write was performed during operation with a value other than "2" (writing is enabled independently of 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 152.)* 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**	Er 3
Name	Calibration error	
Description	Analog input bias and gain calibration values are too close.	
Check point	Check the settings of C3, C4, C6 and C7 (calibration functions). *(Refer to page 142.)*	

Operation Panel Indication	**Er4**	Er 4
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 152.)*	
Corrective action	1. After setting the operation mode to the "PU operation mode", make parameter setting. *(Refer to page 152.)* 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 236.)* · 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 236.)* 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 237.)* 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-F700 series) 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><th>Operation Panel Indication</th><th>OL</th><th>OL</th><th>FR-PU04
FR-PU07</th><th>OL</th></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 lowers the frequency until the overload current decreases to prevent 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. 0 Torque boost setting is not too large.
2. Check that the Pr. 7 Acceleration time and Pr. 8 Deceleration time settings are not too small.
3. Check that the load is not too heavy.
4. Are there any failure in peripheral devices?
5. 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. Increase or decrease the Pr. 0 Torque boost value 1% by 1% and check the motor status. (Refer to page 63.)
2. Set a larger value in Pr. 7 Acceleration time and Pr. 8 Deceleration time. (Refer to page 85.)
3. Reduce the load weight.
4. Try simple magnetic flux vector control (Pr. 80).
5. Change the Pr. 14 Load pattern selection setting.
6. Set stall prevention operation current in Pr. 22 Stall prevention operation level. (The initial value is 110% *1.) 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>

*1 120% when LD is selected

<table>
<tr><th>Operation Panel Indication</th><th>oL</th><th>oL</th><th>FR-PU04
FR-PU07</th><th>oL</th></tr>
<tr><td>Name</td><td colspan="4">Stall prevention (overcurrent)</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 152.)</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 222.)</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><th>Operation Panel Indication</th><th>PS</th><th>PS</th><th>FR-PU04
FR-PU07</th><th>PS</th></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 149.)</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 prealarm			
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 102)* Appears only for the 01800 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**	TH	**FR-PU04 FR-PU07**	**TH**
Name	Electronic thermal relay function prealarm			
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 102)*			
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 89.)*			
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 89.)*			

Operation Panel Indication	**MT**	MT	**FR-PU04**	———
			FR-PU07	**MT**
Name	Maintenance signal output			
Description	Indicates that the cumulative energization time of the inverter has reached a given time.			
Check point	The *Pr. 503 Maintenance timer* setting is larger than the *Pr. 504 Maintenance timer alarm output set time* setting. *(Refer to page 227.)*			
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 01160 or less and 01800 or more.			
Check point	Resetting of *Pr.9, Pr.30, Pr.51, Pr.52, Pr.54, Pr.56, Pr.57, Pr.70, Pr.72, Pr.80, Pr.90, Pr.158, Pr.190 to Pr.196,* 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 102.)*)

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 170% 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 66.)* 5. Set base voltage (rated voltage of the motor, etc.) in *Pr. 19 Base frequency voltage*. *(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 170% 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 66.)*			

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 170% 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 66.)*			

Operation Panel Indication	**E.OV1**		**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 222.)*			

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 222.)* · Use the brake unit or power regeneration common converter (FR-CV) as required.			

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 222.)* · Use the brake unit or power regeneration common converter (FR-CV) as required.			

Operation Panel Indication	**E.THT**		**FR-PU04 FR-PU07**	**Inv. Overload**
Name	Inverter overload shut-off (electronic thermal relay function) *3			
Description	If a current not less than 110%*2 of the rated output current flows and overcurrent shut-off does not occur (170% 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 110%*2 60s)			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			

*2 120% when LD is selected

Operation Panel Indication	**E.THM**		**FR-PU04 FR-PU07**	**Motor Overload**
Name	Motor overload shut-off (electronic thermal relay function) *3			
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 or multiple motors, provide a thermal relay on the inverter output side since such motor(s) cannot be protected by the electronic thermal relay function.			
Check point	1. Check the motor for use under overload. 2. Check that the setting of *Pr. 71 Applied motor* for motor selection is correct. *(Refer to page 91.)* 3. 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 66.)*			

*3 Resetting the inverter initializes the internal thermal integrated data of the electronic thermal relay function.

Operation Panel Indication	**E.FIN**	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 102)*			
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.			

Operation Panel Indication	**E.IPF**	E.IPF	**FR-PU04** **FR-PU07**	**Inst. Pwr. Loss**
Name	Instantaneous power failure			
Description	If a power failure occurs for longer than 15ms (this also applies to inverter input shut-off), the instantaneous power failure protective function is activated to 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 120)*			
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 120.)*			

Operation Panel Indication	**E.BE**	E. bE	**FR-PU04** **FR-PU07**	**Br. Cct. Fault**
Name	Brake transistor alarm detection/internal circuit error			
Description	This function stops the inverter output if an alarm occurs in the brake circuit, e.g. damaged brake transistors when using functions of the 01800 or more. In this case, the inverter must be powered off immediately. For the 01160 or less, it appears when an internal circuit error occurred.			
Check point	· Reduce the load inertia. · Check that the frequency of using the brake is proper. · Check that the brake resistor selected is correct.			
Corrective action	For the 01800 or more, when the protective function is activated even if the above measures are taken, replace the brake unit with a new one. For the 01160 or less, 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 reduces, 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 reduces below about 300VAC, 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 120)*			
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. 3. If the problem still persists after taking the above measure, please contact your sales representative.			

Operation Panel Indication	**E.ILF**	E.ILF	**FR-PU04**	**Fault 14**
			FR-PU07	**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 129.)*			
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		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 67.)*			
Corrective action	· Reduce the load weight.			

Operation Panel Indication	E.GF		FR-PU04 FR-PU07	Ground Fault
Name	Output side earth fault overcurrent			
Description	This function stops the inverter output if an earth fault overcurrent flows due to an earth fault that occurred on the inverter's output (load) side.			
Check point	Check for an earth fault in the motor and connection cable.			
Corrective action	Remedy the earth fault portion.			

Operation Panel Indication	E.LF		FR-PU04	——
			FR-PU07	E. LF
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	OH Fault
Name	External thermal relay operation *4			
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.			

*4 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 relay protector. · Check the motor for operation under overload. · Is valid setting (= 63) selected in *Pr. 184 AU terminal function selection* ? *(Refer to page 90, 96.)*			
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.			
Check point	· Check that the AC power supply is not connected to the terminal R/L1, S/L2, T/L3 when a high power factor converter (FR-HC, MT-HC) or power regeneration common converter (FR-CV) 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.			

Operation Panel Indication	**E.OP1**	E.OP 1	**FR-PU04** **FR-PU07**	**Option slot alarm 1**
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.			

Operation Panel Indication	**E. 1**	E. 1	**FR-PU04** **FR-PU07**	**Fault 1**
Name	Option alarm			
Description	Stops the inverter output if a contact fault or the like of the connector between the inverter and communication option occurs.			
Check point	1. Check that the plug-in option is plugged into the connector securely. 2. Check for excess electrical noises around the inverter.			
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.			

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** **FR-PU07**	**Fault 14** **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.P24**	E.P24	**FR-PU04 FR-PU07**	**E.P24**
Name	24VDC power output short circuit			
Description	When the 24VDC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch off. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel or switch power off, then on again.			
Check point	· Check for a short circuit in the PC terminal output.			
Corrective action	· Remedy the earth fault portion.			

Operation Panel Indication	**E.CDO**	E.CdO	**FR-PU04**	**Fault 14**
			FR-PU07	**OC detect level**
Name	Output current detection value exceeded			
Description	This function is activated when the output current exceeds the *Pr. 150 Output current detection level* setting.			
Check point	Check the settings of *Pr. 150 Output current detection level*, *Pr. 151 Output current detection signal delay time*, *Pr. 166 Output current detection signal retention time*, *Pr. 167 Output current detection operation selection*. *(Refer to page* 107.*)*			

Operation Panel Indication	**E.IOH**	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 ON/OFF is not repeated. · Check that no meltdown is found in the primary side fuse (5A) in the power supply circuit of the inrush current suppression circuit contactor (FR-F740-03250 or more) or no fault is found in the power supply circuit of the contactor.			
Corrective action	Configure a circuit where frequent 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.AIE	**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 137.)*			
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.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.

REMARKS

For the 01800 or more, you can set *Pr. 75* to disable reset operation until the thermal cumulative amount reaches 0 when a thermal trip (THM, THT) or an overcurrent trip (OC1 to OC3) occurs consecutively twice. *(Refer to Indtruction Manual (applied).)*

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	Digital	Actual	Digital	Actual	Digital
0		A		M	
1		B		N	
2		C		O	
3		D		o	
4		E		P	
5		F		S	
6		G		T	
7		H		U	
8		I		V	
9		J		r	
		L		-	

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 re-set the required parameter values and check again.

5.5.1 Motor does not start

1) Check the value of *Pr. 0 Torque boost* setting. *(Refer to page*

2) 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.

3) Check the input signals
- Check that the 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 24.)*
- Check that the voltage/current input switch is correctly set for analog input signal (0 to 5V/0 to 10V, 4 to 20mA).

4) 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.

5) 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

- No carrier frequency noises (metallic noises) are generated.
  - Soft-PWM control to change the motor tone into an unoffending complex tone is factory-set to valid by *Pr.72 PWM frequency selection*.
    Adjust *Pr.72 PWM frequency selection* to change the motor tone.
    (When operating the inverter with the carrier frequency of 3kHz or more set in *Pr. 72*, the carrier frequency will automatically decrease if the output current of the inverter exceeds the value in parenthesis of the rated output current on *page 274*. This may cause the motor noise to increase. But it is not a fault.)
- Check for any mechanical looseness.
- Contact 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.
- Check that the *Pr.0 Torque boost* setting is correct.
- Was the motor type set? Check the setting of *Pr. 71 Applied motor.*

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 100)*

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.
- Check that the torque boost (*Pr. 0, Pr. 46*) setting is not too large and the stall prevention function is not activate.

5.5.7 Motor current is large

- Check that the load is not too heavy.
- Check that the *Pr. 0 Torque boost* setting is correct.
- Check that the *Pr. 3 Base frequency* setting is correct.
- Check that the *Pr. 14 Load pattern selection* setting is appropriate.
- Check that the *Pr. 19 Base frequency voltage* setting is correct.

5.5.8 Speed does not increase

- Check that the *Pr. 1 Maximum frequency* setting is correct. (If you want to run the motor at 120Hz or more, set *Pr. 18 High speed maximum frequency*. *(Refer to page 72.)*)
- Check that the load is not too heavy. (In agitators, etc., load may become heavier in winter.)
- Check that the torque boost (*Pr. 0, Pr. 46*) setting is not too large and the stall prevention function is not activate.
- Check that the brake resistor is not connected to terminals P/+-P1 accidentally.

5.5.9 Speed varies during operation

- 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.
  - Check for a malfunction due to undesirable currents when the transistor output unit is connected. *(Refer to page 25)*
- 3) Others
  - Check that the wiring length is not too long for V/F control

5.5.10 Operation mode is not changed properly

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, pressing PU/EXT on the operation panel (press PU when the parameter unit (FR-PU04/FR-PU07) is used) switches the mode to the PU operation mode. For 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*.

6 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

This chapter describes 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 17.)*
3) Check the conductors and insulating materials for corrosion and damage.
4) Measure insulation resistance.
5) Check and change the cooling fan and relay.

6.1.3 Daily and periodic inspection

Area of Inspection	Inspection Item		Inspection Item	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 262)*		○		
	Relay/contactor		Check that the operation is normal and no chatter is heard.		○	Contact the manufacturer	
Control circuit protective circuit	Operation check		(1)Check that the output voltages across phases with the inverter operated alone is balanced		○	Contact the manufacturer	
			(2)Check that no fault is found in protective and display circuits in a sequence protective operation test.		○	Contact the manufacturer	
	Parts check	Overall	(1)Check for unusual odor and discoloration.		○	Stop the device and contact the manufacturer.	
			(2)Check for serious rust development		○	Contact the manufacturer	
		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 262.)*		○		
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 50% of the predetermined speed

Refer to page 225 to perform the life check of the inverter parts.

6.1.5 Checking the inverter and converter modules

<Preparation>

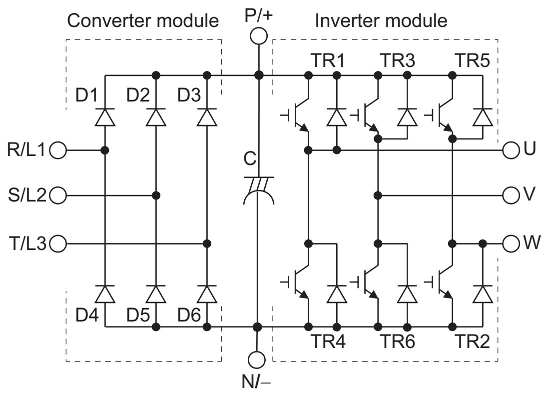
(1) Disconnect the external power supply cables (R/L1, S/L2, T/L3) and motor cables (U, V, W).
(2) Prepare a tester. (Use 100Ω range.)

<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.

<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.
Fuse (04320 or more)	10 years	Replace the fuse (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 standard 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

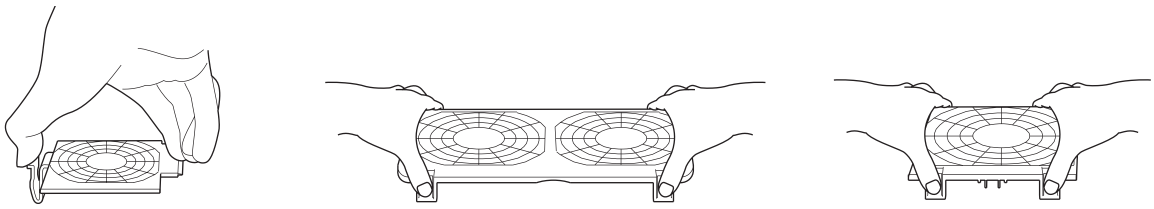
For parts replacement, consult the nearest Mitsubishi FA Center.

Inverter Type		Fan Type	Units
F740	00083, 00126	MMF-06F24ES-RP1 BKO-CA1638H01	1
	00170 to 00380	MMF-08D24ES-RP1 BKO-CA1639H01	2
	00470, 00620	MMF-12D24DS-RP1 BKO-CA1619H01	1
	00770	MMF-09D24TS-RP1 BKO-CA1640H01	2
	00930 to 01800	MMF-12D24DS-RP1 BKO-CA1619H01	2
	02160 to 03610		3
	04320, 04810	9LB1424H5H03	3
	05470 to 06830		4
	07700, 08660		5
	09620 to 12120	9LB1424S5H04	6

The FR-F740-00023 to 00052 are not provided with a cooling fan.

• Removal (00083 to 03610)

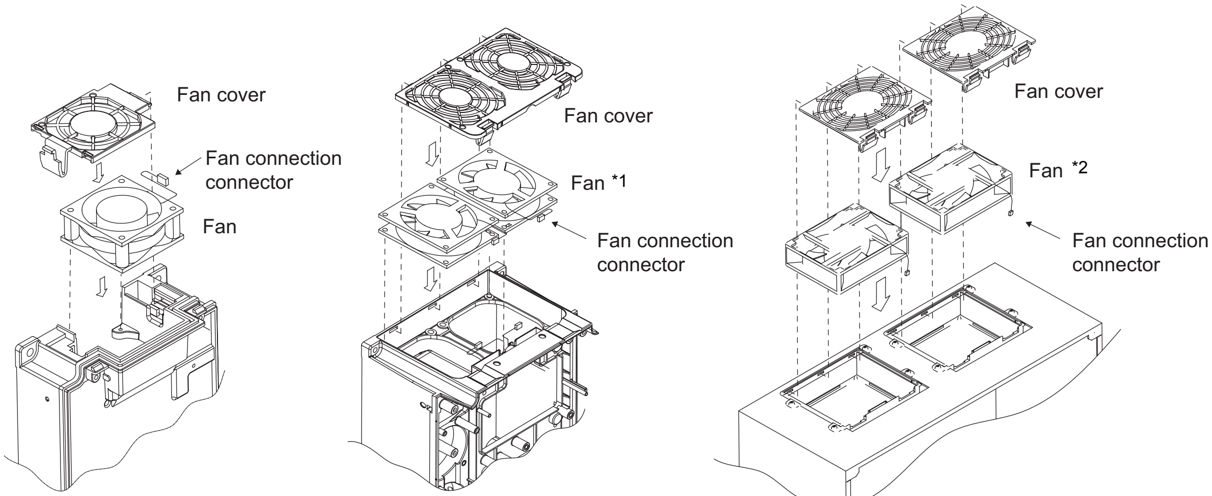
1) Push the hooks from above and remove the fan cover.



00083, 00126 **00170 to 00620** **00770 to 03610**

2) Disconnect the fan connectors.

3) Remove the fan.

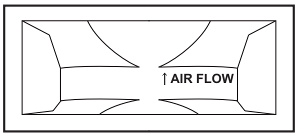


00083, 00126 **00170 to 00620** **00770 to 03610**

* The number of cooling fans differs according to the inverter capacity. (Refer to *page 264*)

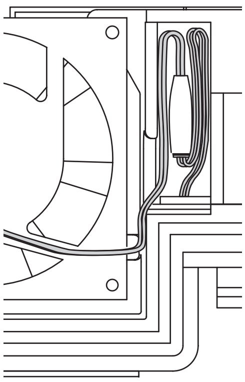
- Reinstallation (00083 to 03610)

1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.

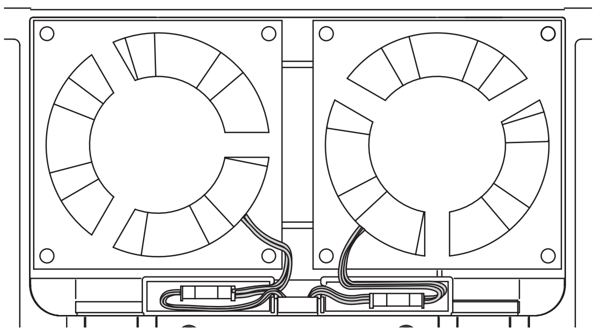


<Fan side face>

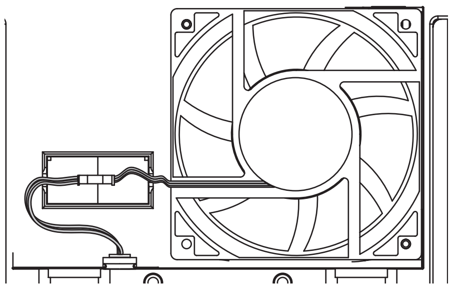
2) Reconnect the fan connectors.



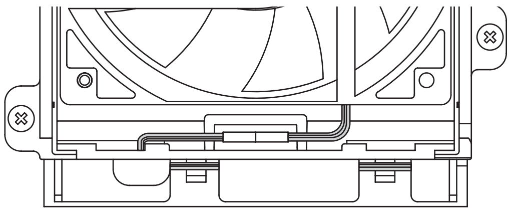
00083, 00126



00170 to 00380

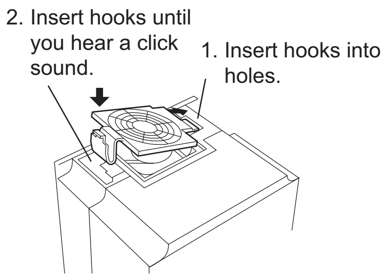


00470, 00620

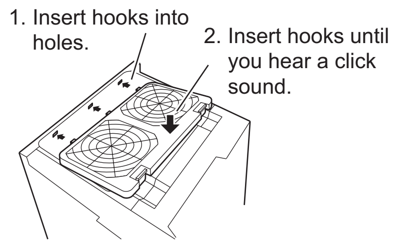


00770 to 03610

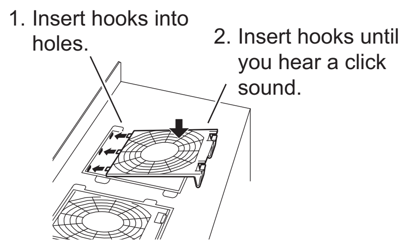
3) Reinstall the fan cover.



00083, 00126



00170 to 00620

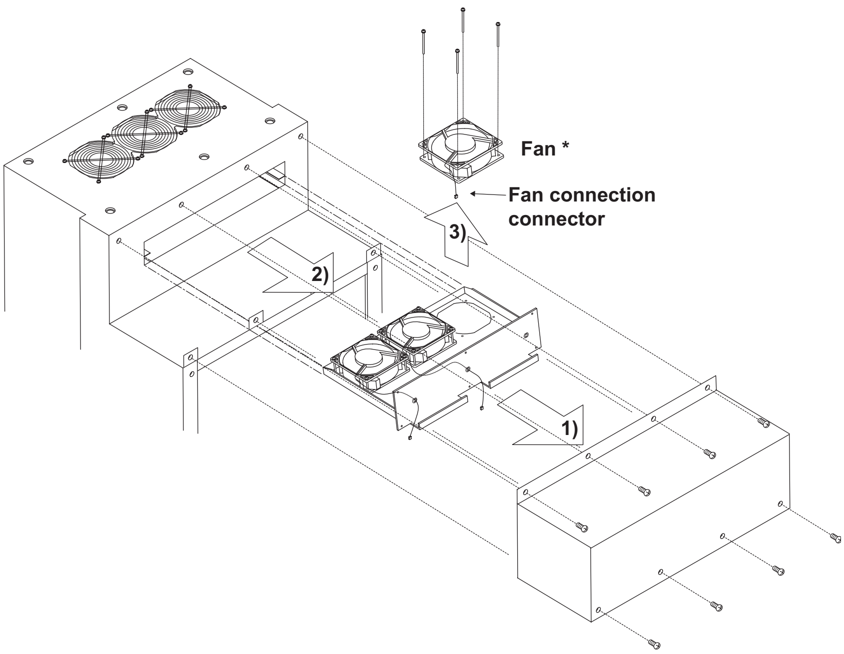


00770 to 03610

CAUTION

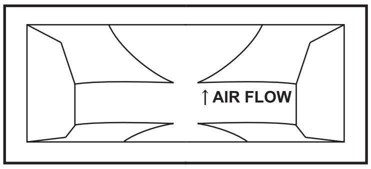
- Installing the fan in the opposite air flow direction can cause the inverter life to be shorter.
- When installing the fan, use care to prevent wires from being caught between the inverter and fan.
- Switch the power off before replacing fans. Since the inverter circuits are charged with voltage even after power off, replace fans only when the inverter cover is on the inverter to prevent an electric shock accident.

- Removal (04320 or more)
  1) Remove a fan cover.
  2) After removing a fan connector, remove a fan block.
  3) Remove a fan.



* The number of cooling fans differs according to the inverter capacity.

- Reinstallation (04320 or more)
  1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.



<Fan side face>

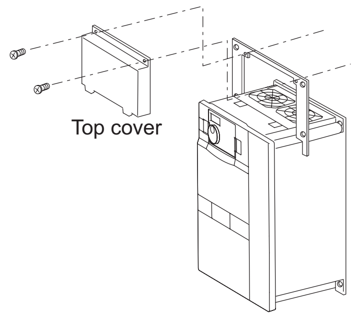
  2) Install fans referring to the above figure.

CAUTION

- Installing the fan in the opposite air flow direction can cause the inverter life to be shorter.
- When installing the fan, use care to prevent wires from being caught between the inverter and fan.
- Switch the power off before replacing fans. Since the inverter circuits are charged with voltage even after power off, replace fans only when the inverter cover is on the inverter to prevent an electric shock accident.

(2) Replacement procedure of the cooling fan when using a heatsink protrusion attachment (FR-A7CN)

When replacing a cooling fan, remove a top cover of the heatsink protrusion attachment and perform replacement. After replacing the cooling fan, replace the top cover in the original position.



(3) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the main circuit DC section, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Their characteristics are deteriorated by the adverse effects of ripple currents, etc.
The replacement intervals greatly vary with the 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.

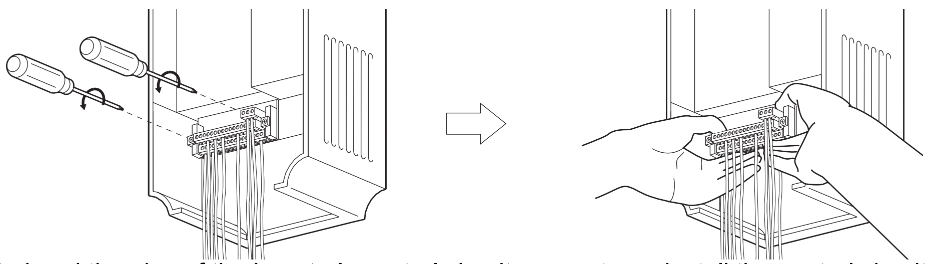
Refer to page 263 to perform the life check of the main circuit capacitor.

(4) Relays

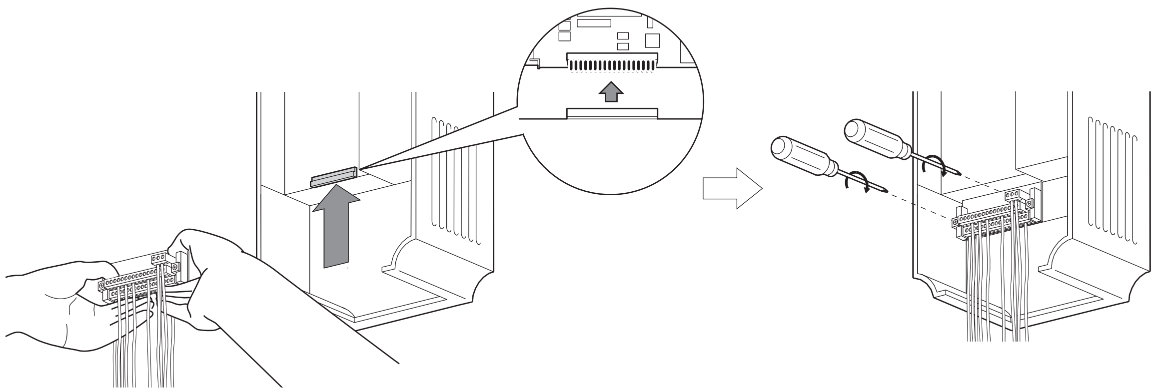
To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

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.

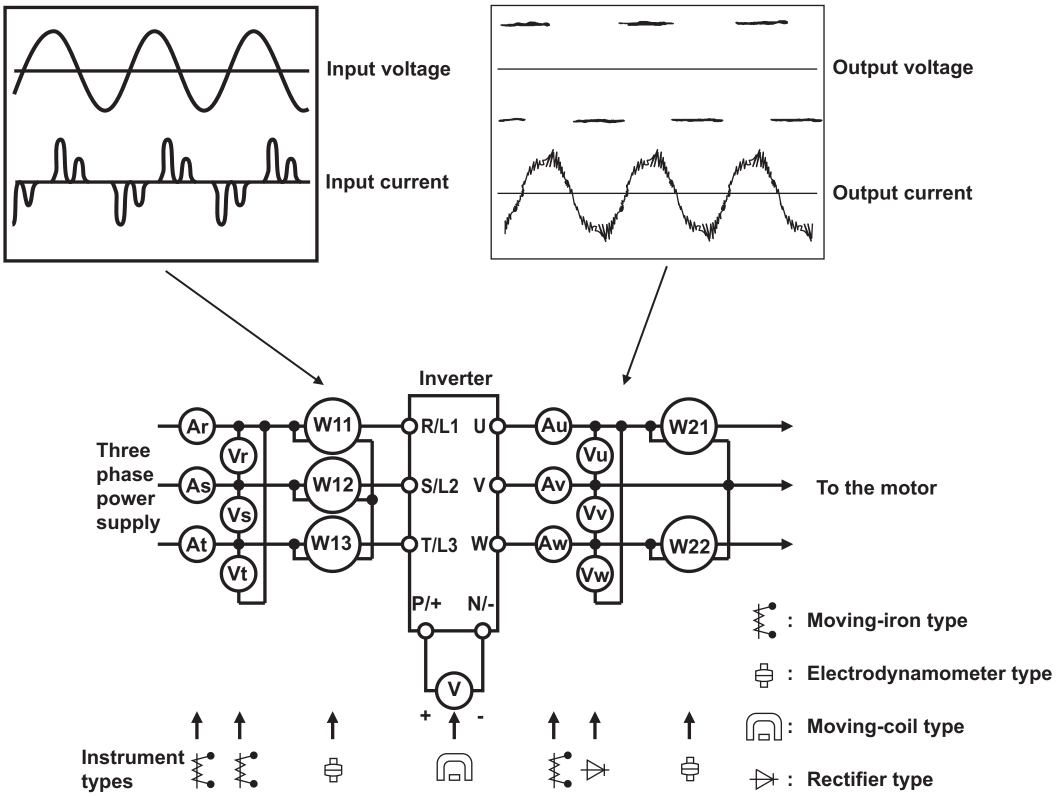
6.2 Measurement of main circuit voltages, currents and powers

6.2.1 Measurement of voltages and currents

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 CA-5 terminal output function of the inverter.



Examples of Measuring Points and Instruments

Measuring Points and Instruments

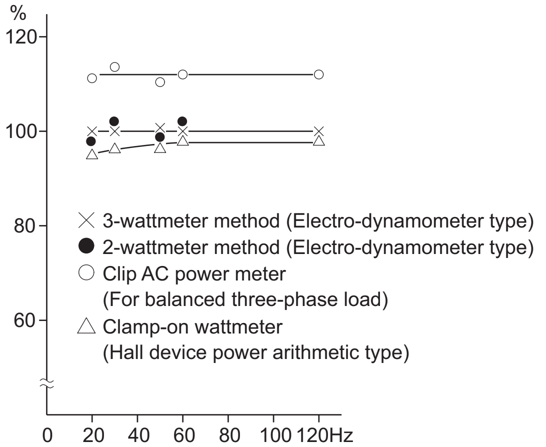
Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value)	
Power supply voltage V_1	Across R/L1-S/L2, S/L2-T/L3, T/L3-R/L1	Moving-iron type AC voltmeter	Commercial power supply Within permissible AC voltage fluctuation Refer to *page 274*.	
Power supply side current I_1	R/L1, S/L2, and T/L3 line currents	Moving-iron type AC ammeter		
Power supply side power P_1	R/L1, S/L2, T/L3 and R/L1-S/L2, S/L2-T/L3, T/L3-R/L1	Electrodynamic type single-phase wattmeter	P1=W11+W12+W13 (3-wattmeter method)	
Power supply side power factor Pf_1	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf_1 = \frac{P_1}{\sqrt{3} V_1 \times I_1} \times 100\%$			
Output side voltage V_2	Across U-V, V-W and W-U	Rectifier type AC voltage meter *1 (Moving-iron type cannot measure)	Difference between the phases is within ±1% of the maximum output voltage.	
Output side current I_2	U, V and W line currents	Moving-iron type AC ammeter *2	Difference between the phases is 10% or lower of the rated inverter current.	
Output side power P_2	U, V, W and U-V, V-W	Electrodynamic type single-phase wattmeter	$P_2 = W_{21} + W_{22}$ 2-wattmeter method (or 3-wattmeter method)	
Output side power factor Pf_2	Calculate in similar manner to power supply side power factor. $Pf_2 = \frac{P_2}{\sqrt{3} V_2 \times I_2} \times 100\%$			
Converter output	Across P/+-N/–	Moving-coil type (such as tester)	Inverter LED display is lit. 1.35 × V1	
Frequency setting signal	Across 2, 4 (positive)-5	Moving-coil type (Tester and such may be used) (Internal resistance: 50kΩ or larger)	0 to 10VDC, 4 to 20mA	"5" is common
	Across 1 (positive)-5		0 to ±5VDC, 0 to ±10VDC	
Frequency setting power supply	Across 10 (positive) -5		5.2VDC	
	Across 10E (positive)-5		10VDC	
Frequency meter signal	Across CA (positive)-5		About 20mA at maximum frequency	
	Across AM (positive)-5		Approximately 10DVC at maximum frequency (without frequency meter)	
Start signal Select signal	Across STF, STR, RH, RM, RL, JOG, RT, AU, STOP, CS - PC (positive)		When open 20 to 30VDC ON voltage: 1V or less	"PC" is common
Reset	Across RES-PC (positive)			
Output stop	Across MRS-PC (positive)			
Alarm signal	Across A1-C1 Across B1-C1	Moving-coil type (such as tester)	Continuity check*3 <Normal> <Abnormal> Across A1-C1 Discontinuity Continuity Across B1-C1 Continuity Discontinuity	

*1 Use an FFT to measure the output voltage accurately. A tester or general measuring instrument cannot measure accurately.
*2 When the carrier frequency exceeds 5kHz, do not use this instrument since using it may increase eddy-current losses produced in metal parts inside the instrument, leading to burnout. 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

6.2.2 Measurement of powers

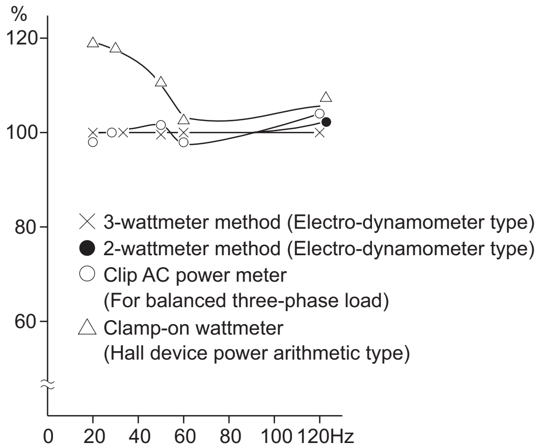
Using an electro-dynamometer type meter, measure the power in both the input and output sides of the inverter using the two- or three-wattmeter method. As the current is liable to be imbalanced especially in the input side, it is recommended to use the three-wattmeter method.
Examples of measured value 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

6.2.3 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.

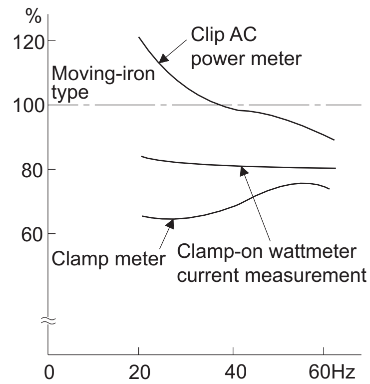
(3) PT

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.)

6.2.4 Measurement of currents

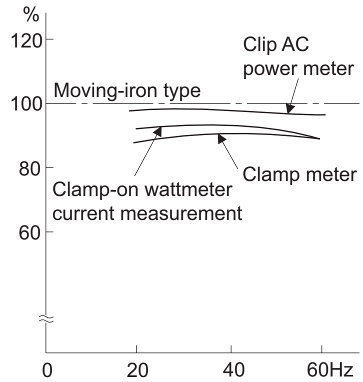
Use a moving-iron type meter on both the input and output sides of the inverter. However, if the carrier frequency exceeds 5kHz, do not use that meter since an overcurrent losses produced in the internal metal parts of the meter will increase and the meter may burn out. In this case, use an approximate-effective value type.
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 a clamp ammeter is used, always use an effective value detection type. A mean value detection type produces a large error and may indicate an extremely smaller value than the actual value. The value monitored on the operation panel is accurate if the output frequency varies, and it is recommended to monitor values (provide analog output) using the operation panel.
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

6.2.5 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.

6.2.6 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.

$$\text{Total power factor of the inverter} = \frac{\text{Effective power}}{\text{Apparent power}}$$

$$= \frac{\text{Three-phase input power found by 3-wattmeter method}}{\sqrt{3} \times \text{V (power supply voltage)} \times \text{I (input current effective value)}}$$

6.2.7 Measurement of converter output voltage (across terminals P/+ - N/-)

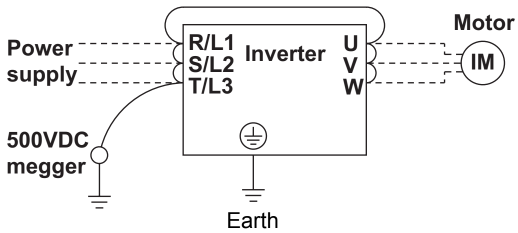
The output voltage of the converter is developed across terminals P/+ - N/- and can be measured with a moving-coil type meter (tester). Although the voltage varies according to the power supply voltage, approximately 540V to 600V is output when no load is connected and voltage decreases when a load is connected.
When regenerative energy is returned from the motor during deceleration, for example, the converter output voltage rises to nearly 800V to 900V maximum.

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.

7 SPECIFICATIONS

This chapter provides the "SPECIFICATIONS" of this product.
Always read the instructions before using the equipment

7.1 Rating

•400V class

SLD is initially set.

Type FR-F740-□□□□□-EC			00023	00038	00052	00083	00126	00170	00250	00310	00380	00470	00620	00770	00930	01160
Applied motor capacity (kW)*1		LD / SLD	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Output	Rated capacity (kVA)*2	LD / SLD	1.6	2.7	3.7	5.8	8.8	12.2	17.5	22.1	26.7	32.8	43.4	53.3	64.8	80.8
Output	Rated current (A)*3	LD	2.1 (1.8)	3.5 (3.0)	4.8 (4.1)	7.6 (6.5)	11.5 (9.8)	16 (13.6)	23 (20)	29 (25)	35 (30)	43 (37)	57 (48)	70 (60)	85 (72)	106 (90)
Output	Rated current (A)*3	SLD	2.3 (2.0)	3.8 (3.2)	5.2 (4.4)	8.3 (7.1)	12.6 (10.7)	17 (14.5)	25 (21)	31 (26)	38 (32)	47 (40)	62 (53)	77 (65)	93 (79)	116 (99)
Output	Overload current rating*4	LD	120% 60s, 150% 3s, 50°C (inverse time characteristics)													
Output	Overload current rating*4	SLD	110% 60s, 120% 3s, 40°C (inverse time characteristics)													
Output	Voltage*5		Three-phase 380 to 480V													
Power supply	Rated input AC voltage/frequency		Three-phase 380 to 480V 50Hz/60Hz													
Power supply	Permissible AC voltage fluctuation		323 to 528V 50Hz/60Hz													
Power supply	Permissible frequency fluctuation		±5%													
Power supply	Power supply system capacity (kVA)*6	Without DC reactor	2.1	4.0	4.8	8.0	11.5	16	20	27	32	41	52	65	79	99
Power supply	Power supply system capacity (kVA)*6	With DC reactor	1.2	2.6	3.3	5.0	8.1	10	16	19	24	31	41	50	61	74
Protective structure (JEM 1030)*8			Enclosed type (IP20)*7											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	13	23	35	35

Type FR-F740-□□□□□-EC			01800	02160	02600	03250	03610	04320	04810	05470	06100	06830	07700	08660	09620	10940	12120
Applied motor capacity (kW)*1		LD	75	90	110	132	160	185	220	250	280	315	355	400	450	500	560
Applied motor capacity (kW)*1		SLD	90	110	132	160	185	220	250	280	315	355	400	450	500	560	630
Output	Rated capacity (kVA)*2	LD	110	137	165	198	247	275	329	366	416	464	520	586	659	733	833
Output	Rated capacity (kVA)*2	SLD	137	165	198	247	275	329	366	416	464	520	586	659	733	833	923
Output	Rated current (A)*3	LD	144 (122)	180 (153)	216 (184)	260 (221)	325 (276)	361 (306)	432 (367)	481 (408)	547 (464)	610 (518)	683 (580)	770 (654)	866 (736)	962 (817)	1094 (929)
Output	Rated current (A)*3	SLD	180 (153)	216 (184)	260 (221)	325 (276)	361 (306)	432 (367)	481 (408)	547 (464)	610 (518)	683 (580)	770 (654)	866 (736)	962 (817)	1094 (929)	1212 (1030)
Output	Overload current rating*4	LD	120% 60s, 150% 3s, 50°C (inverse time characteristics)														
Output	Overload current rating*4	SLD	110% 60s, 120% 3s, 40°C (inverse time characteristics)														
Output	Voltage*5		Three-phase 380 to 500V														
Power supply	Rated input AC voltage/frequency		Three-phase 380 to 500V 50Hz/60Hz														
Power supply	Permissible AC voltage fluctuation		323 to 528V 50Hz/60Hz														
Power supply	Permissible frequency fluctuation		±5%														
Power supply	Power supply system capacity (kVA)*6	Without DC reactor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power supply	Power supply system capacity (kVA)*6	With DC reactor LD	110	137	165	198	247	275	329	366	416	464	520	586	659	733	833
Power supply	Power supply system capacity (kVA)*6	With DC reactor SLD	137	165	198	247	275	329	366	416	464	520	586	659	733	833	923
Protective structure (JEM 1030)*8			Open type (IP00)														
Cooling system			Forced air cooling														
Approx. mass (kg)			37	50	57	72	72	110	110	175	175	175	260	260	370	370	370

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.
*2 The rated output capacity indicated assumes that the output voltage is 440V.
*3 When operating the inverter with the carrier frequency set to 3kHz or more, the carrier frequency automatically decreases if the inverter output current exceeds the value in parenthesis of the rated current. This may cause the motor noise to increase.
*4 The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
*5 The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
*6 The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).
*7 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).
*8 FR-DU07: IP40 (except for the PU connector)

7.2 Common specifications

Control specifications	Control method		High carrier frequency PWM control (V/F control)/optimum excitation control/simple magnetic flux vector control
	Output frequency range		0.5 to 400Hz
	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/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		0 to 400Hz of the base frequency can be set from constant torque/adjustable 5 points V/F can be selected.
	Starting torque		120% (3Hz) when simple magnetic flux vector control and slip compensation are set
	Acceleration/deceleration time setting		0 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode 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 150% variable), whether to use the function or not can be set.
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	Four-digit BCD or16-bit binary using the setting dial of the operation panel or parameter unit (when used with the 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, second function selection, terminal 4 input selection, JOG operation selection, selection of automatic restart after instantaneous power failure, external thermal relay input, HC connection (inverter operation enable signal), HC connection (instantaneous power failure detection), PU operation/external interlock signal, External DC injection brake operation start, PID control enable terminal, PU operation, external operation switchover, output stop, start self-holding selection, traverse function selection, forward rotation command, reverse rotation command, inverter reset, PTC thermistor input, PID forward reverse operation switchover, PU-NET operation switchover, External-NET operation switchover, command source switchover.
	Operational functions		Maximum and minimum frequency settings, frequency jump operation, external thermal relay input selection, polarity reversible operation, automatic restart after instantaneous power failure operation, original operation continuation at an instantaneous power failure, commercial power supply-inverter switchover operation, forward/reverse rotation prevention, operation mode selection, external DC injection braking start, PID control, computer link operation (RS-485).
	Output signals — Operating status		You can select any seven signals using *Pr.190 to Pr.196 (output terminal function selection)* from among inverter running, up-to-speed, instantaneous power failure /undervoltage, overload warning, output frequency detection, second output frequency detection, regenerative brake prealarm*4, 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, bypass operation-inverter switchover MC1 to MC3, commercial power supply side motor 1 to 4 connection, inverter side motor 1 to 4 connection, fan fault output, heatsink overheat pre-alarm, inverter running start command on, deceleration at an instantaneous power failure, PID control activated, during retry, during PID output suspension, life alarm, alarm output 3 (power-off signal), power savings average value update timing, current average monitor, alarm output 2, maintenance timer alarm, remote output, minor failure output, alarm output, traverse function. 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)	You can select any seven 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)
	Output signals — Pulse/analog output		Selection can be made from output frequency, motor current (steady or peak value), output voltage, frequency setting value, running speed, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, reference voltage output, motor load factor, power saving effect, regenerative brake duty*4, PID set value, PID measured value using *Pr.54 CA terminal function selection (pulse train output)* and *Pr.158 AM terminal function selection (analog output)*.

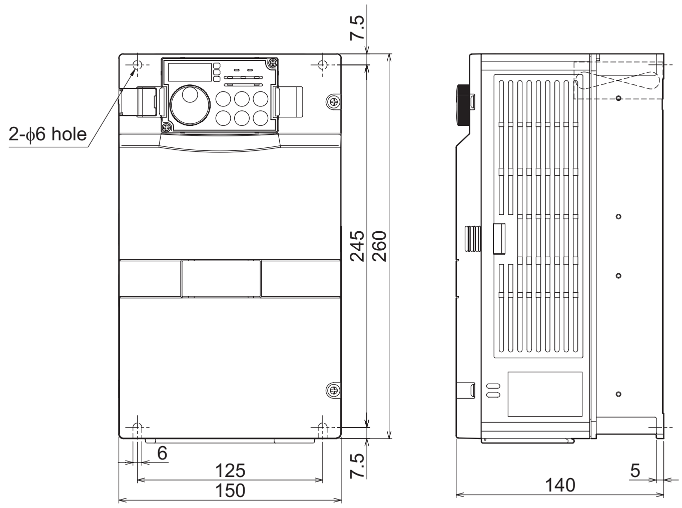
Display	PU (FR-DU07/ FR-PU04/ FR-PU07)	Operating status	Output frequency, motor current (steady or peak value), output voltage, alarm indication, frequency setting, running speed, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, cumulative energization time, actual operation time, motor load factor, cumulative power, power saving effect, cumulative saving power, regenerative brake duty*4,PID set point, PID measured value, PID deviation value, inverter I/O terminal monitor, input terminal option monitor*1, output terminal option monitor*1, option fitting status monitor*2, terminal assignment status*2
		Alarm definition	Alarm definition is displayed during the protective function is activated, output voltage/ current/frequency/cumulative energization time and eight past alarm definition is stored.
		Interactive guidance	Operation guide/trouble shooting with a help function *2
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 fault overcurrent, 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), analog input error, internal circuit error (15V power supply), fan fault, overcurrent stall prevention, overvoltage stall prevention, electronic thermal relay function prealarm, PU stop, maintenance timer alarm*1, brake transistor alarm detection *4, parameter write error, copy operation error, operation panel lock, parameter copy
Environment	Ambient temperature	LD	-10°C to +50°C (non-freezing)
		SLD (initial setting)	-10°C to +40°C (non-freezing)
	Ambient humidity		90%RH or less (non-condensing)
	Storage temperature*3		-20°C to +65°C
	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude, vibration		Maximum 1000m above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (92%) 5.9m/s^2 or less *5

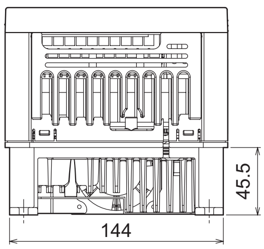
*1 Can be displayed only on the operation panel (FR-DU07).
*2 Can be displayed only on the parameter unit (FR-PU04/FR-PU07).
*3 Temperature applicable for a short period in transit, etc.
*4 Only the 01800 or more functions.
*5 2.9m/s^2 or less for the 04320 or more.

7.3 Outline dimension drawings

7.3.1 Inverter outline dimension drawings

• FR-F740-00023, 00038, 00052, 00083, 00126-EC

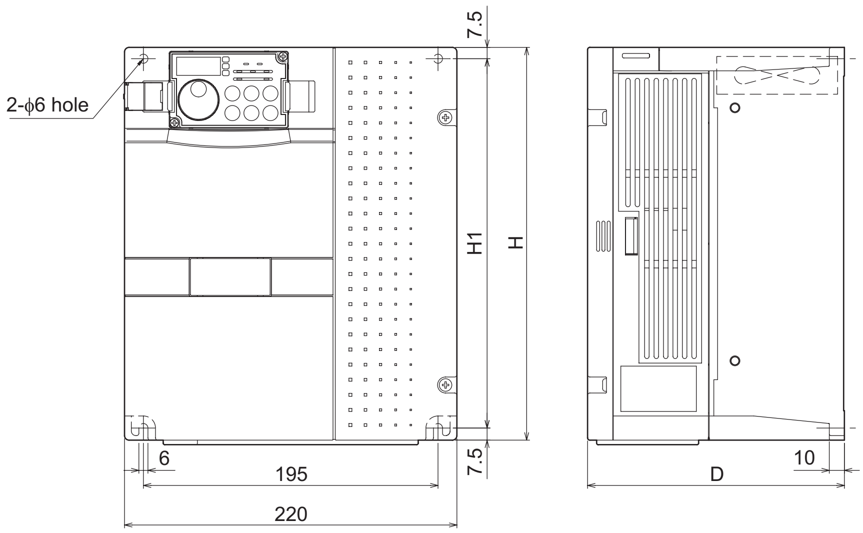


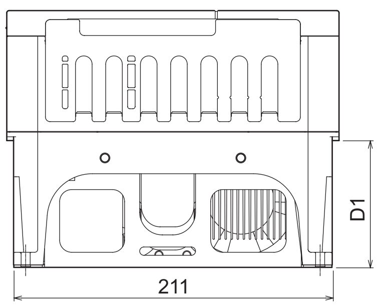


* The FR-F740-00023 to 00052-EC are not provided with a cooling fan.

(Unit: mm)

• FR-F740-00170, 00250, 00310, 00380-EC

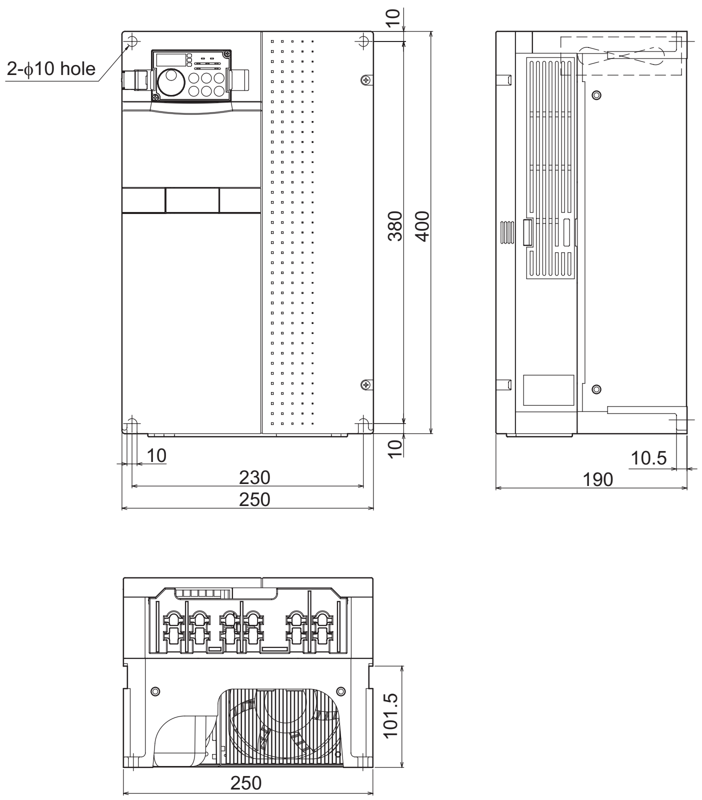




Inverter Type	H	H1	D	D1
FR-F740-00170, 00250-EC	260	245	170	84
FR-F740-00310, 00380-EC	300	285	190	101.5

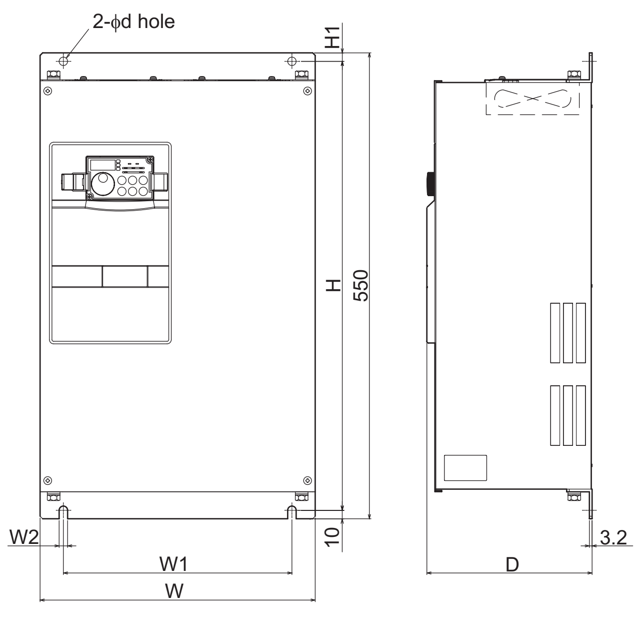
(Unit: mm)

• **FR-F740-00470, 00620-EC**



(Unit: mm)

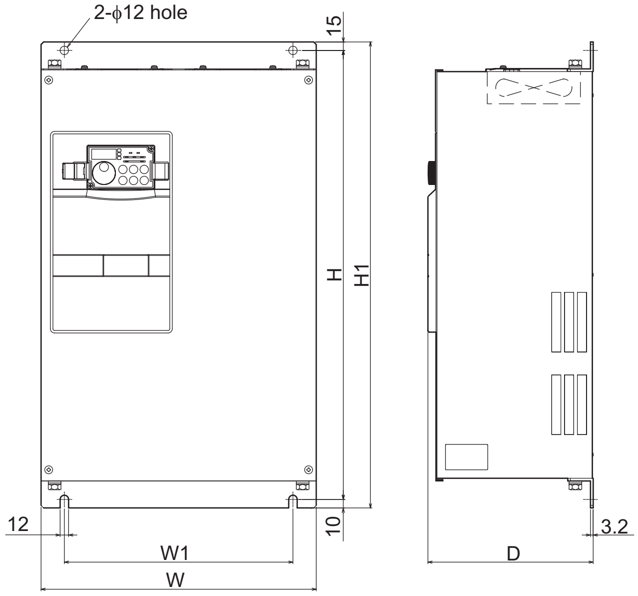
• **FR-F740-00770, 00930, 01160-EC**



Inverter Type	W	W1	W2	H	H1	d	D
FR-F740-00770-EC	325	270	10	530	10	10	195
FR-F740-00930, 01160-EC	435	380	12	525	15	12	250

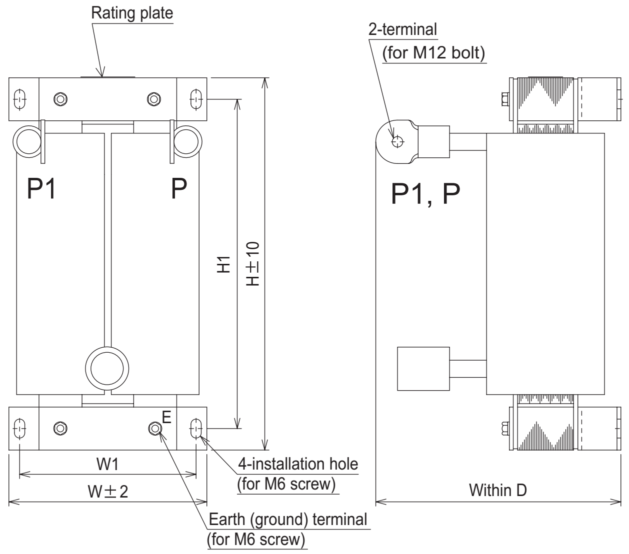
(Unit: mm)

- **FR-F740-01800-EC**



Inverter Type	W	W1	H	H1	D
FR-F740-01800-EC	435	380	525	550	250

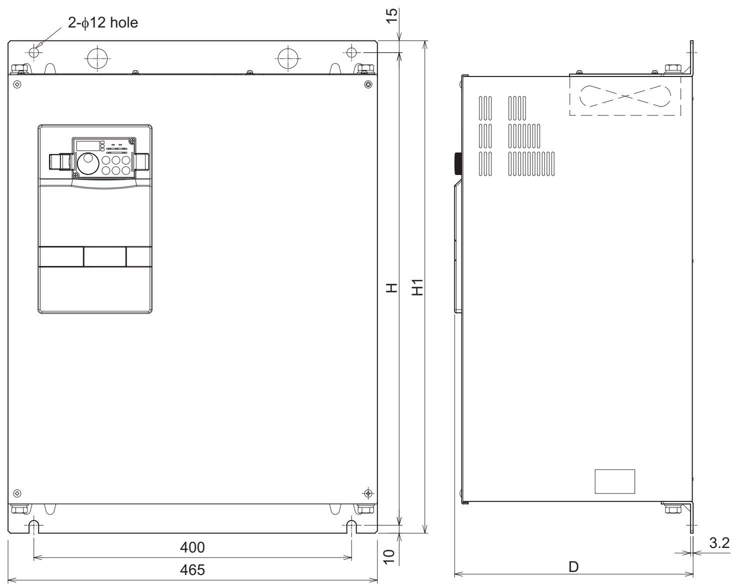
- **DC reactor supplied**



DC reactor Type	W	W1	H	H1	D	Mass (kg)
FR-HEL-H90K (FR-F740-01800-EC)	150	130	340	310	190	20

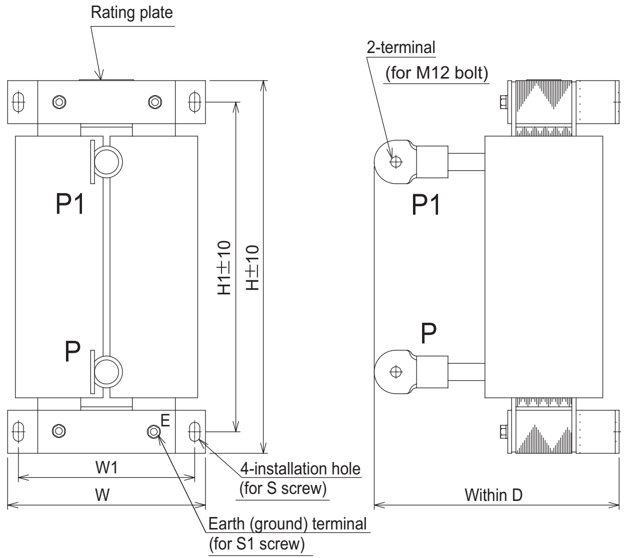
(Unit: mm)

• **FR-F740-02160, 02600, 03250, 03610-EC**



Inverter Type	H	H1	D
FR-F740-02160, 02600-EC	595	620	300
FR-F740-03250, 03610-EC	715	740	360

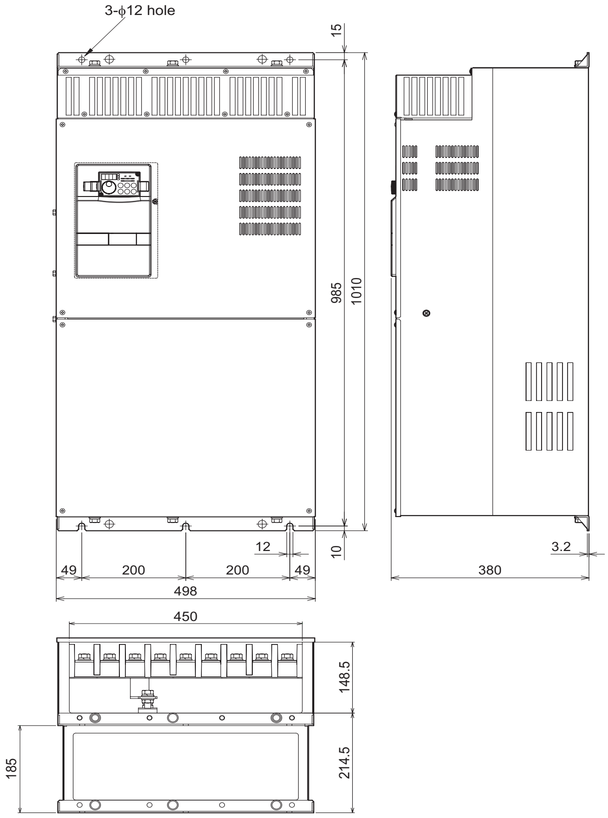
• **DC reactor supplied**



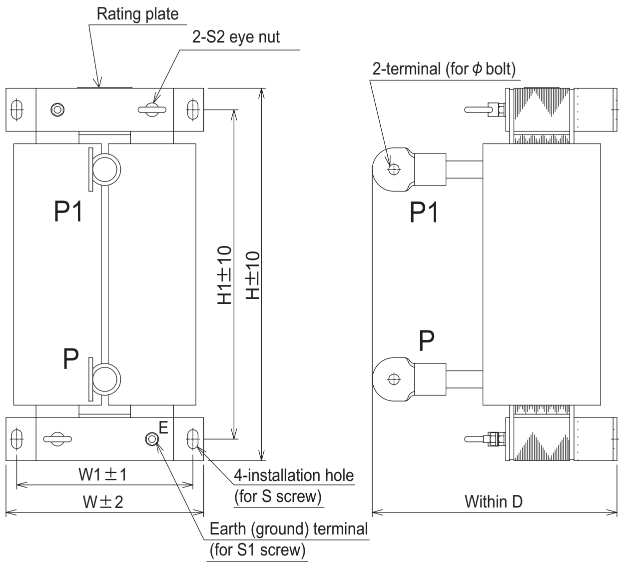
DC reactor Type	W	W1	H	H1	D	S	S1	Mass (kg)
FR-HEL-H110K(FR-F740-02160-EC)	150	130	340	310	195	M6	M6	22
FR-HEL-H132K(FR-F740-02600-EC)	175	150	405	370	200	M8	M6	26
FR-HEL-H160K(FR-F740-03250-EC)	175	150	405	370	205	M8	M6	28
FR-HEL-H185K(FR-F740-03610-EC)	175	150	405	370	240	M8	M6	29

(Unit: mm)

• FR-F740-04320, 04810-EC



• DC reactor supplied



* Remove the eye nut after installation of the product.

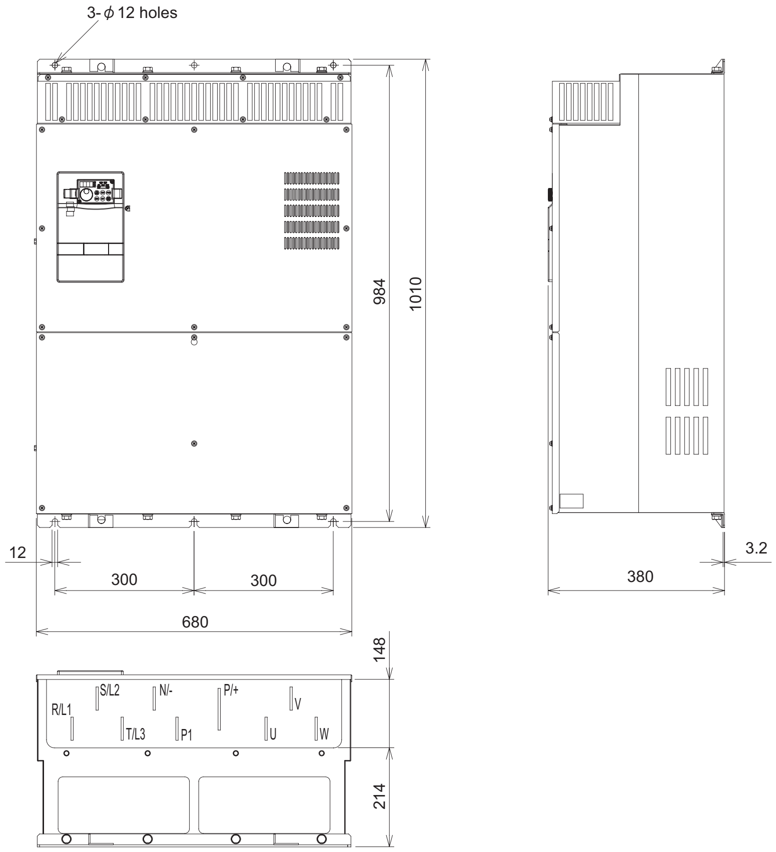
DC reactor Type	W	W1	H	H1	D	S	S1	S2	φ	Mass (kg)
FR-HEL-H220K (FR-F740-04320-EC)	175	150	405	370	240	M8	M6	M6	M12	30
FR-HEL-H250K (FR-F740-04810-EC)	190	165	440	400	250	M8	M8	M8	M12	35

(Unit: mm)

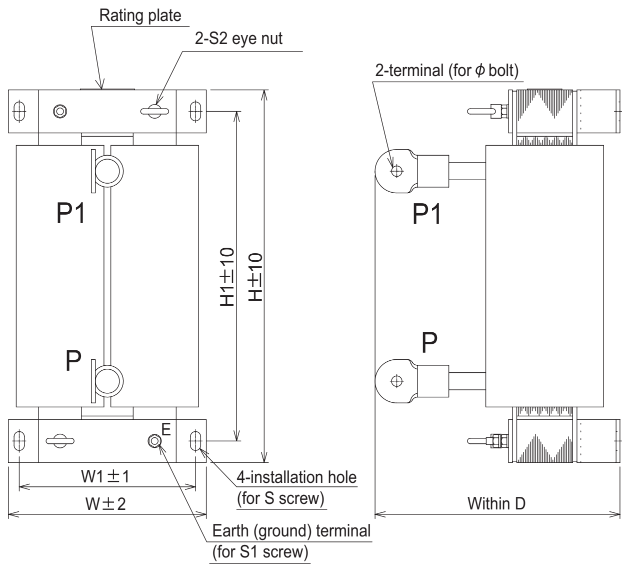
SPECIFICATIONS

7

- **FR-F740-05470, 06100, 06830-EC**



- **DC reactor supplied**

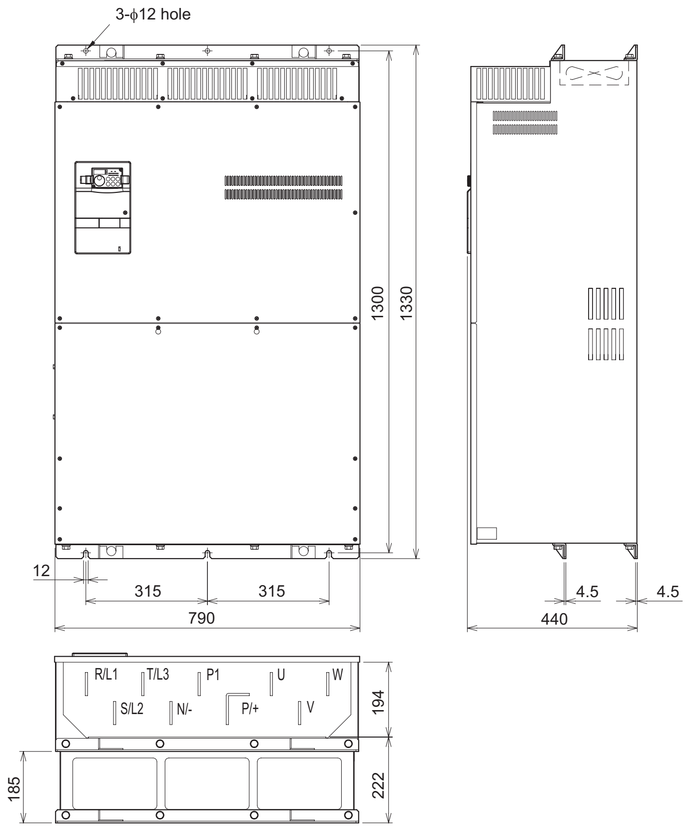


* Remove the eye nut after installation of the product.

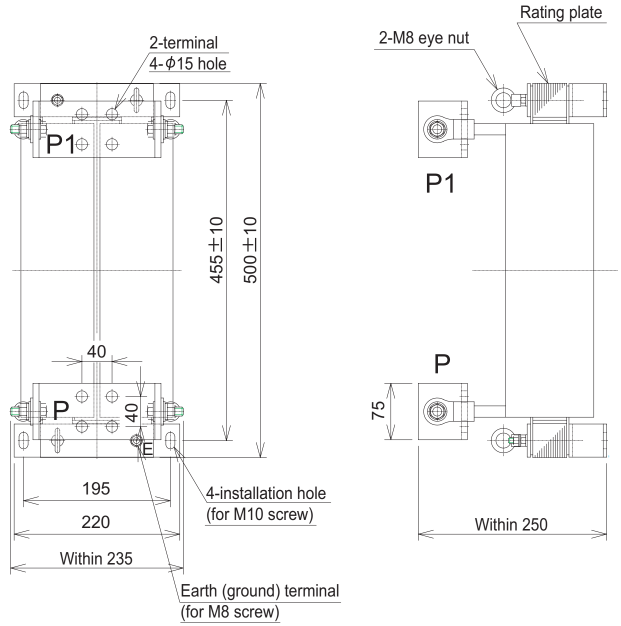
DC reactor Type	W	W1	H	H1	D	S	S1	S2	ϕ	Mass (kg)
FR-HEL-H280K (FR-F740-05470-EC)	190	165	440	400	255	M8	M8	M8	M16	38
FR-HEL-H315K (FR-F740-06100-EC)	210	185	495	450	250	M10	M8	M8	M16	42
FR-HEL-H355K (FR-F740-06830-EC)	210	185	495	450	250	M10	M8	M8	M16	46

(Unit: mm)

- **FR-F740-07700, 08660-EC**



- **DC reactor supplied**

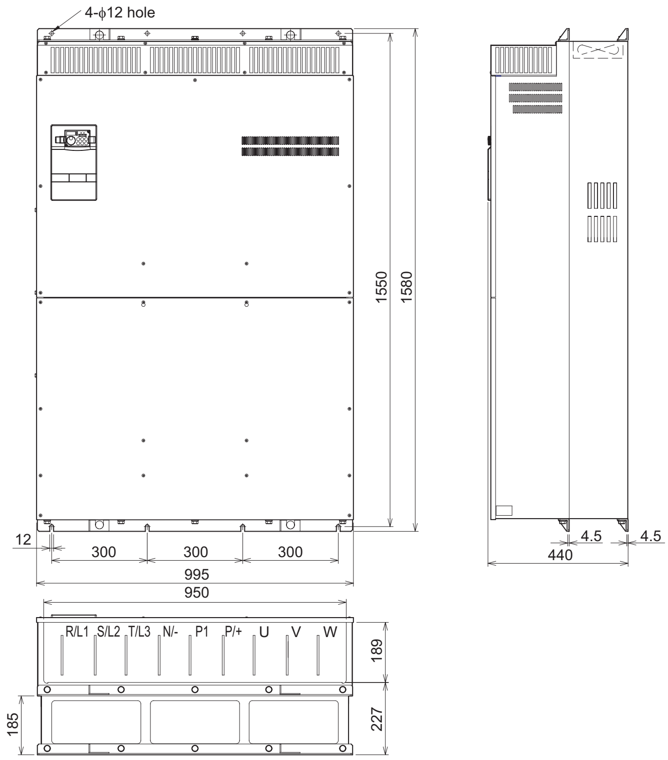


* Remove the eye nut after installation of the product.

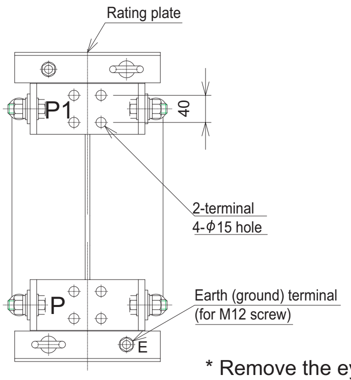
DC reactor Type	Mass (kg)
FR-HEL-H400K (FR-F740-07700-EC)	50
FR-HEL-H450K (FR-F740-08660-EC)	57

(Unit: mm)

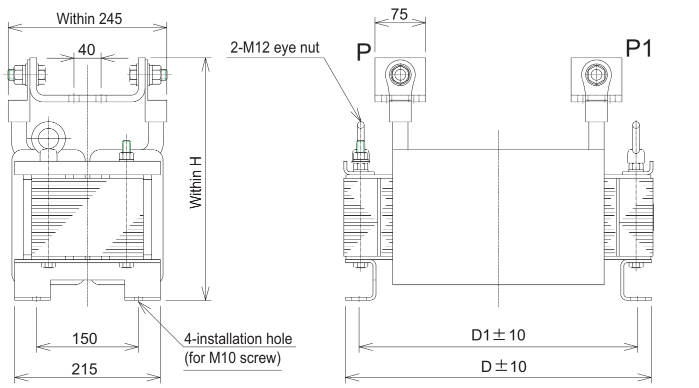
- **FR-F740-09620, 10940, 12120-EC**



- **DC reactor supplied**



* Remove the eye nut after installation of the product.

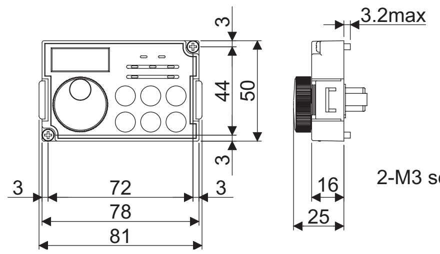


DC reactor Type	H	D	D1	Mass (kg)
FR-HEL-H500K (FR-F740-09620-EC)	345	455	405	67
FR-HEL-H560K (FR-F740-10940-EC)	360	460	410	85
FR-HEL-H630K (FR-F740-12120-EC)	360	460	410	95

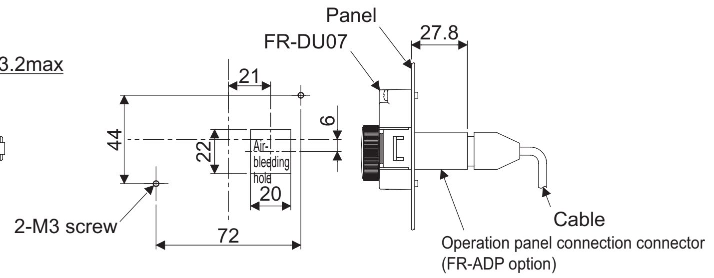
(Unit: mm)

• Operation panel (FR-DU07)

<Outline drawing>

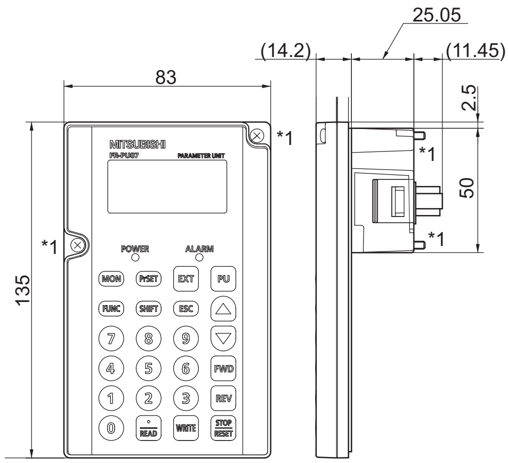


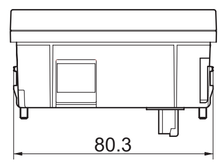
<Panel cutting dimension drawing>



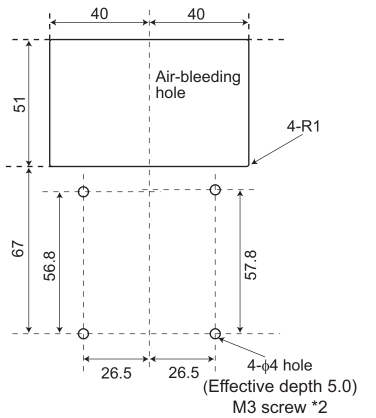
• Parameter unit (option) (FR-PU07)

<Outline drawing>





<Panel cutting dimension drawing>

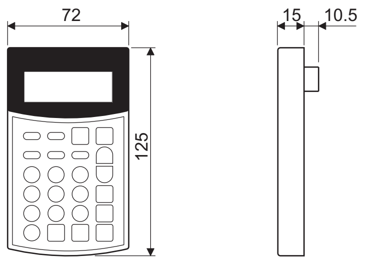


*1 When installing the FR-PU07 on the enclosure, etc., remove screws for fixing the FR-PU07 to the inverter or fix the screws to the FR-PU07 with M3 nuts.
*2 Select the installation screws whose length will not exceed the effective depth of the installation screws threads.

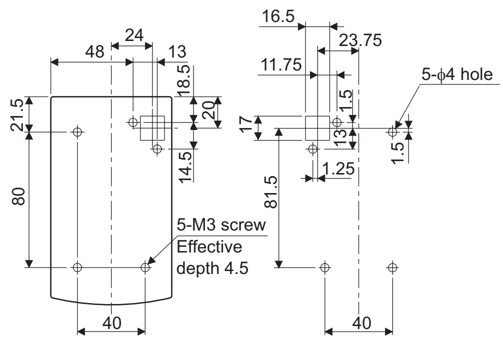
(Unit: mm)

• 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.

SPECIFICATIONS

7

7.4 Heatsink protrusion attachment procedure

When encasing the inverter in an enclosure, the generated heat amount in an enclosure can be greatly reduced by installing the heatsink portion of the inverter outside the enclosure. When installing the inverter in a compact enclosure, etc., this installation method is recommended.

7.4.1 When using a heatsink protrusion attachment (FR-A7CN)

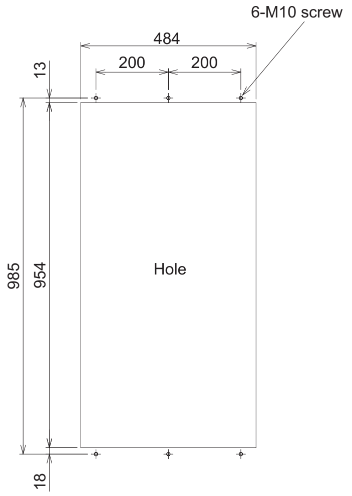
For the FR-F740-00023 to 03610, a heatsink can be protruded outside the enclosure using a heatsink protrusion attachment (FR-A7CN). For a panel cut dimension drawing and an installation procedure of the heatsink protrusion attachment (FR-A7CN) to the inverter, refer to a manual of "heatsink protrusion attachment (FR-A7CN01 to 11)".

7.4.2 Protrusion of heatsink of the FR-F740-04320 or more

(1) Panel cutting

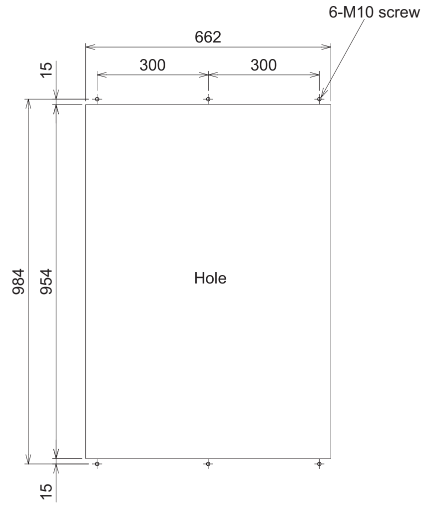
Cut the panel of the enclosure according to the inverter capacity.

• FR-F740-04320, 04810



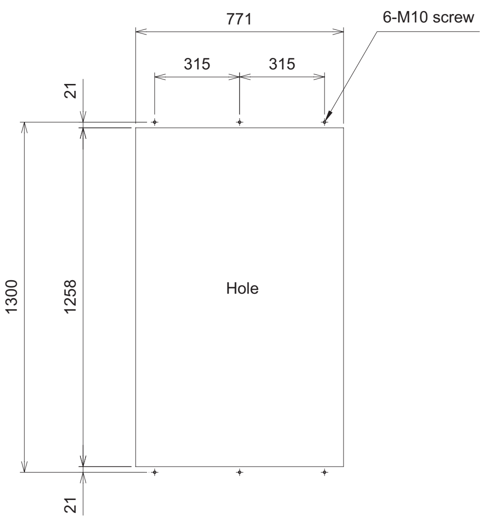
(Unit: mm)

• FR-F740-05470, 06100, 06830



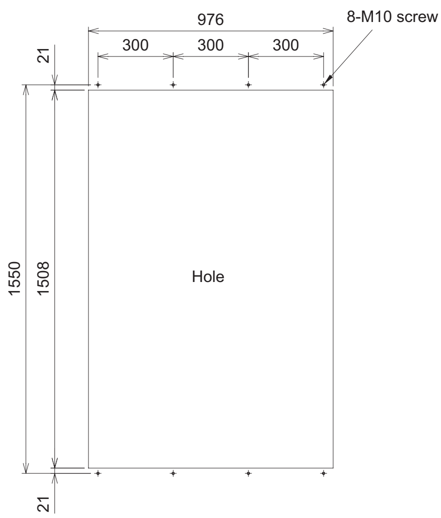
(Unit: mm)

• FR-F740-07700, 08660



(Unit: mm)

• FR-F740-09620, 10940, 12120

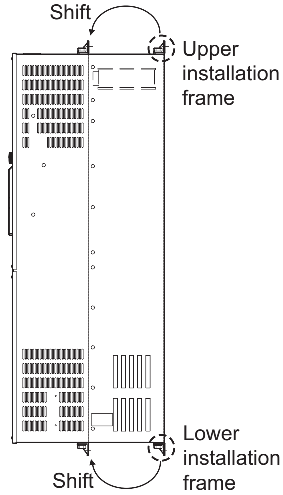


(Unit: mm)

(2) Shift and removal of a rear side installation frame

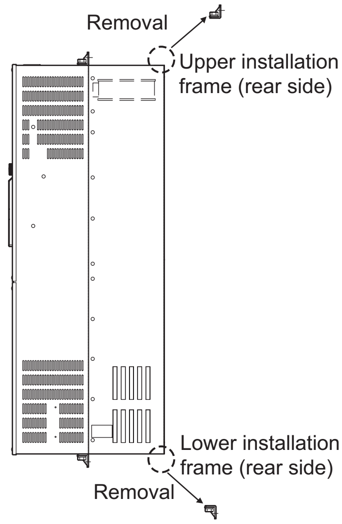
- **FR-F740-05470 to 06830**

One installation frame is attached to each of the upper and lower part of the inverter. Change the position of the rear side installation frame on the upper and lower side of the inverter to the front side as shown on the right. When changing the installation frames, make sure that the installation orientation is correct.



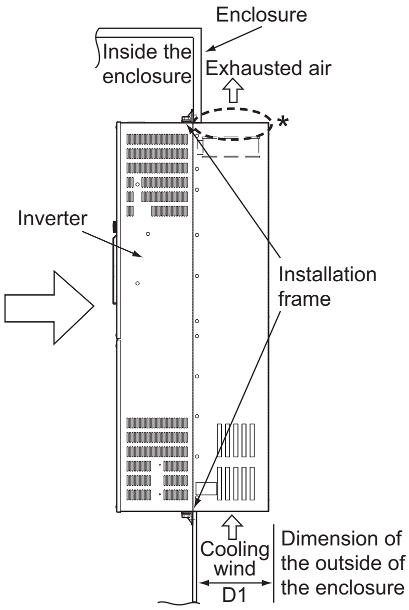
- **FR-F740-04320/04810, 07700 or more**

Two installation frames each are attached to the upper and lower parts of the inverter. Remove the rear side installation frame on the upper and lower side of the inverter as shown on the right.

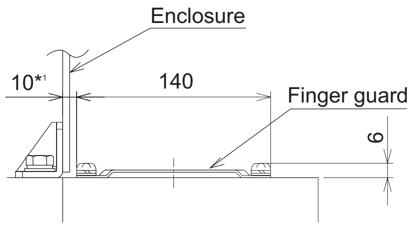


(3) Installation of the inverter

Push the inverter heatsink portion outside the enclosure and fix the enclosure and inverter with upper and lower installation frame.



* For the FR-F740-05470 or more, there are finger guards behind the enclosure. Therefore, the thickness of the panel should be less than 10mm(*1) and also do not place anything around finger guards to avoid contact with the finger guards.



(Unit: mm)

Inverter Type	D1(mm)
FR-F740-04320, 04810	185
FR-F740-05470 to 12120	184

CAUTION

· Having a cooling fan, the cooling section which comes out of the enclosure can not be used in the environment of water drops, oil, mist, dust, etc.
· Be careful not to drop screws, dust etc. into the inverter and cooling fan section.

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

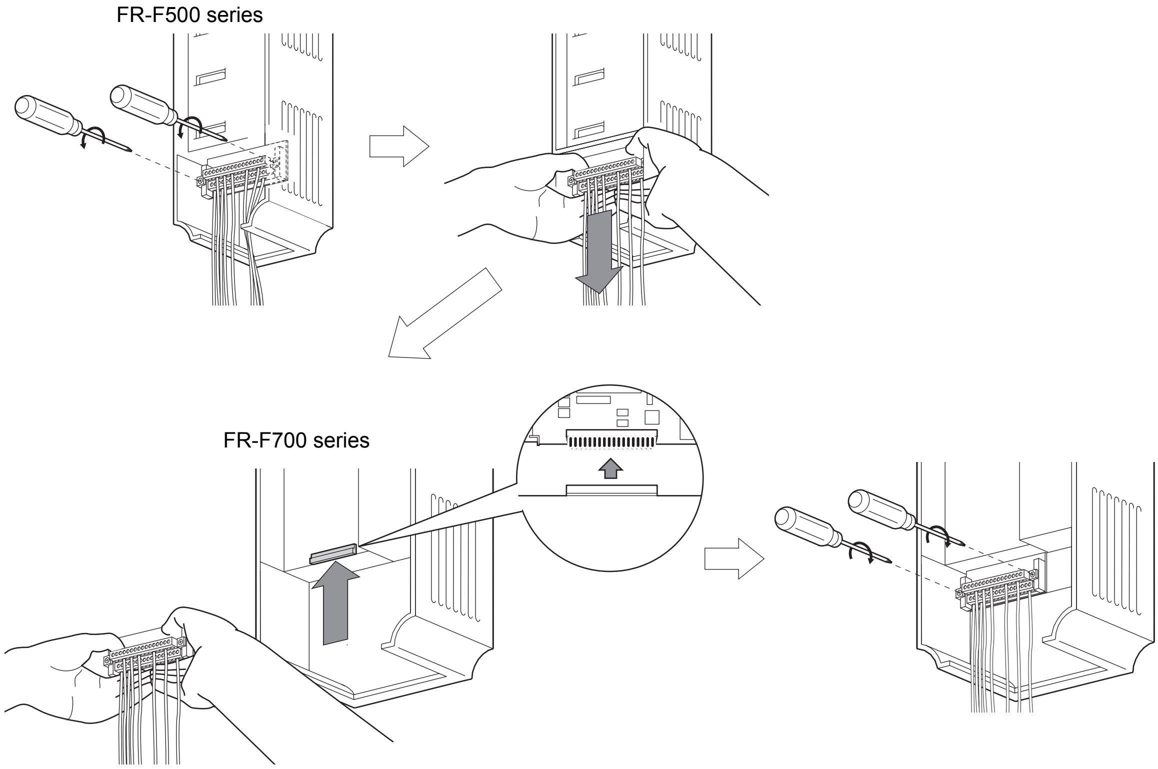
Appendix 1-1 Replacement of the FR-F500 series

(1) Instructions for installation

1)Removal procedure of the front cover was changed. (with screws) Please note. *(Refer to page 5.)*
2)Removal procedure of the operation panel was changed. (with screws) Please note. *(Refer to page 5.)*
3)Plug-in options of the F500 series are not compatible
4)Operation panel (FR-DU04) can not be used.
5)Setup software (FR-SW0-SETUP) can not be used.

(2) Wiring instructions

1)The control circuit terminal block can be used for the FR-F700 series without removing wiring.
Note that the wiring cover (00023 to 00470) is not compatible.



(Note that the relay output 2 (A2, B2, C2) specific for the FR-F700 series can not be used with the FR-F500 series terminals.)

(3) Instructions for continuous use of the FR-PU04 (parameter unit)

1) For the FR-F700 series, many functions (parameters) have been added. When setting these parameters, the parameter name and setting range are not displayed. Parameter list, change list, initial value list, initial value list 2 and parameter clear of the HELP function can not be used.
2) For the FR-F700 series, 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 and compatibilities with the FR-F500(L) series

Item	FR-F500(L)	FR-F700
Changed/cleared functions	Simple mode parameters 61	Simple mode parameters 15
	Pr. 0 Torque boost initial value 00250 to 01160:2%	*Pr. 0 Torque boost* initial value initial value 00250 to 00770: 2%, 00930, 01160: 1.5% (When the torque boost value of the FR-F500 series used was the initial value, it is not necessary to change the torque boost value from the initial value when replacing with the FR-F700 series.)
	User group 1 (16), user group 2 (16) (Pr. 160, Pr. 173 to Pr. 175)	User group (16) only Setting methods were partially changed (Pr. 160, Pr. 172 to Pr. 173)
	User initial value setting (Pr. 199)	"User initial value setting" (Pr. 199) was cleared Substitutable with the copy function of the operation panel (FR-DU07)
	Intelligent optimum acceleration/deceleration (Pr. 60 setting "3" and Pr. 61 to Pr. 63)	Function was cleared For deceleration time, overvoltage alarm can be avoided with regeneration avoidance function (Pr. 882 to Pr. 885).
	Automatic torque boost (Pr. 38, Pr. 39)	Automatic torque boost was cleared because of addition of "Simple magnetic flux vector" (Pr. 80)
	Advanced PID (pump function) Pr. 500 to Pr. 516	Parameter number change Pr. 575 to Pr. 591
Terminal block	Removable terminal block	Removable terminal block Upward compatibility (Terminal block of the F500 can be mounted)
PU	FR-PU04, DU04	FR-PU07 FR-DU07 FR-DU04 unavailable (Partly restricted when the FR-PU04 is used. *Refer to page 290.*)
Plug-in option	Dedicated plug-in option (not compatible)	
	Computer link, relay output option FR-A5NR	Built into the inverter (RS-485 terminal, relay output 2 points)
	Three boards can be mounted	One board can be mounted
Installation size	FR-F740-00023 to 00083, 00170, 00470, 00770 to 01160 are compatible in mounting dimensions For other capacities, an optional intercompatibility attachment (FR-AAT) is necessary.	

Appendix 1-2 Replacement of the FR-A100 <EXCELENT> series

Instructions for installation

• When using the installation holes of the FR-A100(E) series, FR-A5AT (intercompatibility attachment) is necessary.

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 174* for RS-485 communication)
*2 "○" 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, NCA FR-A7NCA

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
0	Torque boost	00	80	0	○	○	○
1	Maximum frequency	01	81	0	○	○	○
2	Minimum frequency	02	82	0	○	○	○
3	Base frequency	03	83	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	○	○	○
14	Load pattern selection	0E	8E	0	○	○	○
15	Jog frequency	0F	8F	0	○	○	○
16	Jog acceleration/deceleration time	10	90	0	○	○	○
17	MRS input selection	11	91	0	○	○	○
18	High speed maximum frequency	12	92	0	○	○	○
19	Base frequency voltage	13	93	0	○	○	○
20	Acceleration/deceleration reference frequency	14	94	0	○	○	○
21	Acceleration/deceleration time increments	15	95	0	○	○	○
22	Stall prevention operation level (Torque limit 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	○	○	○
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	○	○	○

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
44	Second acceleration/deceleration time	2C	AC	0	○	○	○
45	Second deceleration time	2D	AD	0	○	○	○
46	Second torque boost	2E	AE	0	○	○	○
47	Second V/F (base frequency)	2F	AF	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	○	○	○
51	Second electronic thermal O/L relay	33	B3	0	○	○	○
52	DU/PU main display data selection	34	B4	0	○	○	○
54	CA 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	○	○	○
60	Energy saving control selection	3C	BC	0	○	○	○
61	Reference current	3D	BD	0	○	○	○
62	Reference value at acceleration	3E	BE	0	○	○	○
63	Reference value at dcceleration	3F	BF	0	○	○	○
64	Starting frequency for elevator mode	40	C0	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	○	○	○
72	PWM frequency selection	48	C8	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	○	○	○
90	Motor constant (R1)	5A	DA	0	○	×	○
100	V/F1(first frequency)	00	80	1	○	○	○
101	V/F1(first frequency voltage)	01	81	1	○	○	○
102	V/F2(second frequency)	02	82	1	○	○	○
103	V/F2(second frequency voltage)	03	83	1	○	○	○
104	V/F3(third frequency)	04	84	1	○	○	○
105	V/F3(third frequency voltage)	05	85	1	○	○	○
106	V/F4(fourth frequency)	06	86	1	○	○	○
107	V/F4(fourth frequency voltage)	07	87	1	○	○	○
108	V/F5(fifth frequency)	08	88	1	○	○	○
109	V/F5(fifth frequency voltage)	09	89	1	○	○	○

* Read and write from communication with PU connector only is enabled.

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
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 presence/absence 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	○	○	○
135	Electronic bypass sequence selection	23	A3	1	○	○	○
136	MC switchover interlock time	24	A4	1	○	○	○
137	Start waiting time	25	A5	1	○	○	○
138	Bypass selection at an alarm	26	A6	1	○	○	○
139	Automatic switchover frequency from inverter to bypass operation	27	A7	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	○	○	○
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	○	○	○
159	Automatic switchover frequency range from bypass to inverter operation	3B	BB	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	○	○	○

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
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	○	×	○
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	○	○	○
240	Soft-PWM operation selection	30	B0	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	○	○	○
245	Rated slip	35	B5	2	○	○	○
246	Slip compensation time constant	36	B6	2	○	○	○
247	Constant-power region slip compensation selection	37	B7	2	○	○	○
250	Stop selection	3A	BA	2	○	○	○
251	Output phase failure protection selection	3B	BB	2	○	○	○
252	Override bias	3C	BC	2	○	○	○

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
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	○	○	○
260	PWM frequency automatic switchover	44	C4	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.						
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	○	○	○
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	○	○	○

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
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	○	○	○
347	CANopen address NCA	2F	AF	3	○	○	○
348	CANopen baud rate NCA	30	B0	3	○	○	○
349	Communication reset selection NC ND NL NP NCA	31	B1	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 NCA	00	80	5	○	○	○
501	Communication error occurrence count display NC ND NL NP NCA	01	81	5	×	○	○
502	Stop mode selection at communication error NC ND NL NP NCA	02	82	5	○	○	○
503	Maintenance timer	03	83	5	×	×	×
504	Maintenance timer alarm output set time	04	84	5	○	×	○
539	Modbus-RTU communication check time interval	27	A7	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	○	○	○

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
563	Energization time carrying-over times	3F	BF	5	×	×	×
564	Operating time carrying-over times	40	C0	5	×	×	×
570	Multiple rating setting	46	C6	5	○	×	×
571	Holding time at a start	47	C7	5	○	○	○
573	4mA input check selection	49	C9	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	○	○	○
578	Auxiliary motor operation selection	4E	CE	5	○	○	○
579	Motor connection function selection	4F	CF	5	○	○	○
580	MC switching interlock time	50	D0	5	○	○	○
581	Start waiting time	51	D1	5	○	○	○
582	Auxiliary motor connection-time deceleration time	52	D2	5	○	○	○
583	Auxiliary motor disconnection-time acceleration time	53	D3	5	○	○	○
584	Auxiliary motor 1 starting frequency	54	D4	5	○	○	○
585	Auxiliary motor 2 starting frequency	55	D5	5	○	○	○
586	Auxiliary motor 3 starting frequency	56	D6	5	○	○	○
587	Auxiliary motor 1 stopping frequency	57	D7	5	○	○	○
588	Auxiliary motor 2 stopping frequency	58	D8	5	○	○	○
589	Auxiliary motor 3 stopping frequency	59	D9	5	○	○	○
590	Auxiliary motor start detection time	5A	DA	5	○	○	○
591	Auxiliary motor stop detection time	5B	DB	5	○	○	○
592	Traverse function selection	5C	DC	5	○	○	○
593	Maximum amplitude amount	5D	DD	5	○	○	○
594	Amplitude compensation amount during deceleration	5E	DE	5	○	○	○
595	Amplitude compensation amount during acceleration	5F	DF	5	○	○	○
596	Amplitude acceleration time	60	E0	5	○	○	○
597	Amplitude deceleration time	61	E1	5	○	○	○
611	Acceleration time at a restart	0B	8B	6	○	○	○
867	AM output filter	43	C3	8	○	○	○
869	Current output filter	45	C5	8	○	○	○
872	Input phase failure protection selection	48	C8	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	○	○	○
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	○	×	○

Parameter	Name	Instruction Code *1			Parameter Copy *3	Parameter Clear *3	All Parameter Clear *3
		Read	Write	Extended			
899	Operation time rate (estimated value)	63	E3	8	○	○	○
C0 (900)	CA 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	○	×	○
C8 (930)	Current output bias signal	1E	9E	9	○	○	○
C9 (930)	Current output bias current	1E	9E	9	○	○	○
C10 (931)	Current output gain signal	1F	9F	9	○	○	○
C11 (931)	Current output gain current	1F	9F	9	○	○	○
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.

Print Date	*Manual Number	Revision
May, 2004	IB(NA)-0600193ENG-A	First edition
Aug., 2004	IB(NA)-0600193ENG-B	Additions · FR-F740 - 02600 to 03610 - EC · Pr.299 Rotation direction detection selection at restarting
Oct., 2004	IB(NA)-0600193ENG-C	Additions · FR-F740 - 04320 to 12120 - EC
Jun., 2005	IB(NA)-0600193ENG-D	Partial modification Additions · Panel cut dimension of heatsink protrusion
Jun., 2005	IB(NA)-0600193ENG-D	Partial modification Additions · Panel cut dimension of heatsink protrusion
Sep, 2006	IB(NA)-0600193ENG-E	·Partial modification Additions · Panel cut dimension of heatsink protrusion · *Pr. 539 Modbus-RTU communication check time interval* · Voltage/current input switch