MITSUBISHI ELECTRIC

FR-F700

Inverter

Instruction Manual

FR-F740 EC
FR-F746 EC

Art. No: 166461
11 10 2010
Version E

MITSUBISHI ELECTRIC INDUSTRIAL AUTOMATION

Instruction Manual
Inverter FR-F700 EC
Art. no.: 166461

Version			Changes / Additions / Corrections	
A	04/2005	pdp	First Edition	
B	07/2005	pdp	Section 3.8.1	Revision of the section "Note on selecting a suitable power supply ELCB"
C	03/2006	pdp	General Section 2.4.3	Extension of the capacity classes by the inverters FR-F740-02600 to 12120 Addition of the inverters FR-F746-00023 to 01160 with IP54 protection rating New parameter 299 Addition of a heatsink protrusion attachment
D	08/2010	akl	General	Adaption of document version numbers (english, german)
E	10/2010	akl	General Section 7.2 General Section 7.6	Additions: • Voltage/current input switch • Additional explanation to "Causes and corrective actions" • DC feeding operation permission signal (X70), DC feeding cancel signal (X71), PID integral value reset signal (X72) • PID deviation limit signal (Y48), Pulse output of output power signal (Y79), DC feeding signal (Y85) New setting values: • Pr. 29 Acceleration/deceleration pattern selection setting value "6" • Pr. 30 Regenerative function selection setting values "10", "11", "20", "21" • Pr. 59 Remote function selection setting values "11", "12", "13" • Pr. 128 PID action selection setting values "110", "111", "120", "121" • Pr. 167 Output current detection operation selection setting values "10", "11" • Pr. 261 Power failure stop selection setting values "21", "22" • Pr. 495 Remote output selection setting values "10", "11" New parameters: • Pr. 522 Output stop frequency • Pr. 539 Modbus-RTU communication check time interval • Pr. 653 Speed smoothing control • Pr. 654 Speed smoothing cutoff frequency • Pr. 553 PID deviation limit, Pr. 554 PID signal operation selection, C42 (Pr. 934) PID display bias coefficient, C43 (Pr. 934) PID display bias analog value, C44 (Pr. 935) PID display gain coefficient, C45 (Pr. 935) PID display gain analog value • Pr. 799 Pulse increment setting for output power Partial changes • Pr. 153 Zero current detection time setting range "0 to 10s" • Check first when you have a trouble

Thank you for choosing this Mitsubishi inverter.

This instruction manual 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 to use the equipment to its optimum.

Safety instructions

Do not attempt to install, operate, maintain or inspect the inverter until you have read through this instruction manual 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.

Electric Shock Prevention

WARNING:

- ***While power is on or when the inverter is running, do not open the front cover. Otherwise you may get an electric shock.***
- ***Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry and get an electric shock.***
- ***Even if power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.***
- ***Before starting wiring or inspection, check to make sure that the operation panel indicator is off, wait for at least 10 minutes after the power supply has been switched off, and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power off and it is dangerous.***
- ***This inverter must be earthed. Earthing must conform to the requirements of national and local safety regulations and electrical codes. (JIS, NEC section 250, IEC 536 class 1 and other applicable standards)***
- ***Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.***
- ***Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.***
- ***If your application requires by installation standards an RCD (residual current device) as up stream protection please select according to DIN VDE 0100-530 as following:***
  Single phase inverter type A or B
  Three phase inverter only type B.
- ***Perform setting dial and key operations with dry hands to prevent an electric shock. Otherwise you may get an electric shock. 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.***

Fire Prevention

CAUTION:

- ***Install the inverter on a nonflammable wall without holes (so that nobody can touch the inverter heatsink on the rear side, etc.). Mounting it to or near 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 and destroy the inverter. The surface temperature of braking resistors can far exceed 100°C for brief periods. Make sure that there is adequate protection against accidental contact and a safe distance is maintained to other units and system parts.***

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.***

Additional Instructions

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

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***

Operating Condition	FR-F740	FR-F746
Ambient temperature	–10°C to +40/+50°C (non-freezing)	–10°C to +30/+40°C (non-freezing)
	The maximum temperature depends on the setting of Pr. 570.	
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	Maximum 1000m above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (91%)	
Vibration	$5.9m^2$ ② or less at 10 to 55Hz (directions of X, Y, Z axes)	

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

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

Wiring

CAUTION:

- ***Do not install assemblies or components (e. g. power factor correction capacitors) on the inverter output side, which are not approved from Mitsubishi.***
- ***The direction of rotation of the motor corresponds to the direction of rotation commands (STF/STR) only if the phase sequence (U, V, W) is maintained.***

Operation

WARNING:

- ***When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.***
- ***Since pressing STOP/RESET key may not stop output depending on the function setting status, provide a circuit and switch separately to make an emergency stop (power off, mechanical brake operation for emergency stop, etc.).***
- ***Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.***
- ***The inverter can be started and stopped via the serial port communications link or the field bus. However, please note that depending on the settings of the communications parameters it may not be possible to stop the system via these connections if there is an error in the communications system or the data line. In configurations like this it is thus essential to install additional safety hardware that makes it possible to stop the system in an emergency (e.g. controller inhibit via control signal, external motor contactor etc). Clear and unambiguous warnings about this must be posted on site for the operating and service staff.***
- ***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 the equipment.***
- ***Do not modify the equipment.***
- ***Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the inverter.***

CAUTION:

- ***The electronic thermal relay function does not guarantee protection of the motor from overheating. It is recommended to install both an external thermal and PTC thermistor for overheat protection.***
- ***Do not use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter. Otherwise, the life of the inverter decreases.***
- ***Use a noise filter to reduce the effect of electromagnetic interference and follow the accepted EMC procedures for proper installation of frequency inverters. Otherwise nearby electronic equipment may be affected.***
- ***Take appropriate measures regarding harmonics. Otherwise this can endanger compensation systems or overload generators.***
- ***Use a motor designed for inverter operation. (The stress for motor windings is bigger than in line power supply).***
- ***When parameter clear or all clear is performed, set again 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.***
- ***The DC braking function of the frequency inverter is not designed to continuously hold a load. Use an electro-mechanical holding brake on the motor for this purpose.***
- ***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.***

Diagnosis and Settings

CAUTION:

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

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 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.***
- ***When the protective function is activated (i. e. the frequency inverter switches off with an error message), take the corresponding corrective action as described in the inverter manual, then reset the inverter, and resume operation.***

Maintenance, inspection and parts replacement

CAUTION:

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

Disposing the inverter

CAUTION:

- ***Treat as industrial waste.***

General instructions

Many of the diagrams and drawings in instruction manuals 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.

Symbols used in the manual

Use of instructions

Instructions concerning important information are marked separately and are displayed as follows:

NOTE Text of instruction

Use of examples

Examples are marked separately and are displayed as follows:

Example ▽ Example text △

Use of numbering in the figures

Numbering within the figures is displayed by white numbers within black circles and is explained in a table following it using the same number, e.g.:

❶ ❷ ❸ ❹

Use of handling instructions

Handling instructions are steps that must be carried out in their exact sequence during startup, operation, maintenance and similar operations.

They are numbered consecutively (black numbers in white circles):

① Text.

② Text.

③ Text.

Use of footnotes in tables

Instructions in tables are explained in footnotes underneath the tables (in superscript). There is a footnote character at the appropriate position in the table (in superscript).

If there are several footnotes for one table then these are numbered consecutively underneath the table (black numbers in white circle, in superscript):

① Text
② Text
③ Text

Contents

1 Product Checking and Part Identification

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

1.1 Inverter Type

FR - F740 - 00126 - EC

Symbol	Voltage Class
F740	Three-phase 400V class

Symbol	Type number
00023 to 12120	5-digit display

I001331E

Fig. 1-1: *Inverter Type FR-F740 EC*

FR - F746 - 00126 - EC

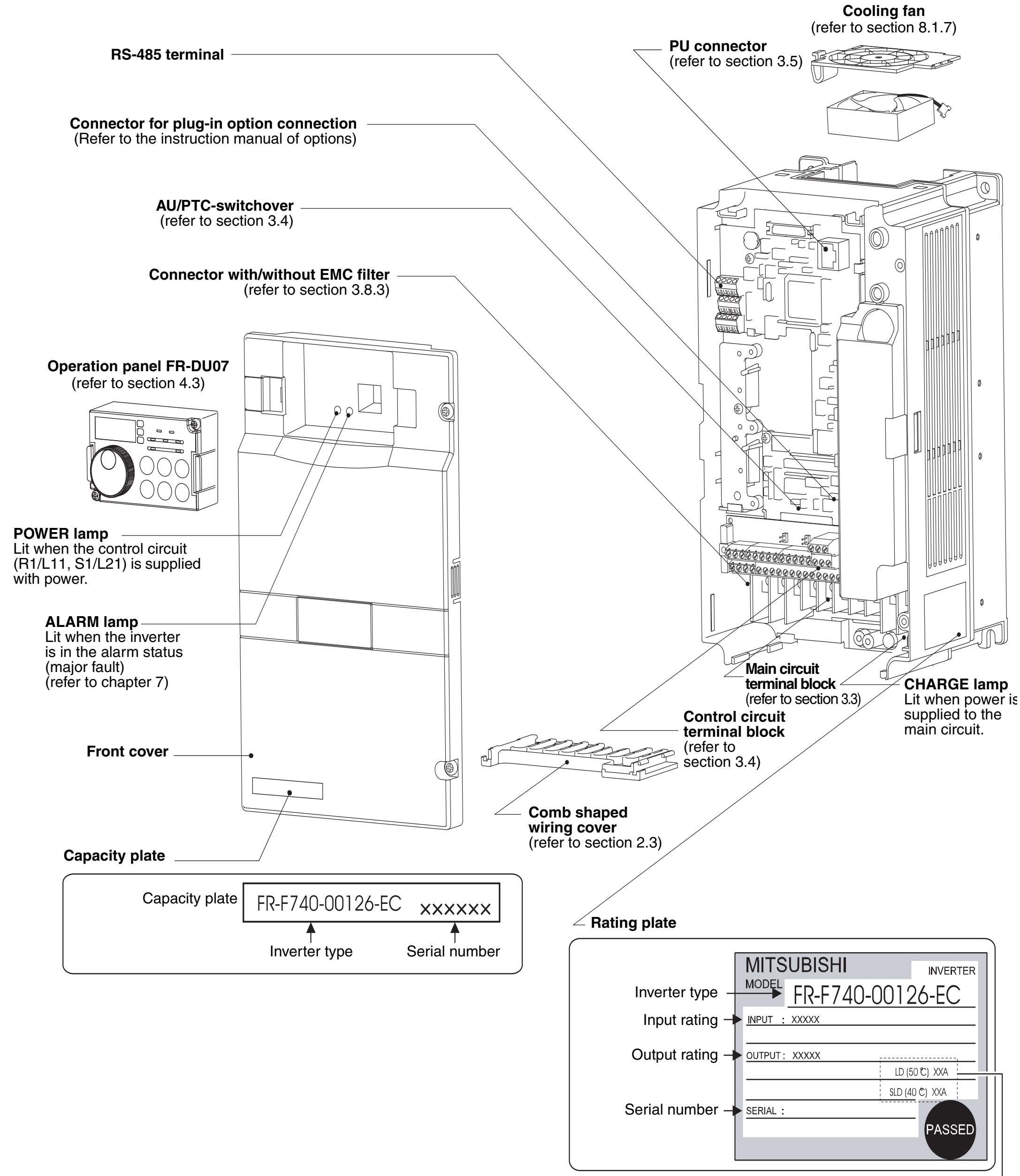
Symbol	Voltage Class
F746	Three-phase 400V class waterproof structure IP54 (standard IEC 60529: 2001) specification

Symbol	Type number
00023 to 01160	5-digit display

I001393E

Fig. 1-2: *Inverter type FR-F746 EC*

1.2 Description of the Case



	Overload current rating	Ambient temperature
LD	120% 60s, 150% 3s	50℃
SLD	110% 60s, 120% 3s	40℃

I000990E

Fig. 1-3: *Appearance and Structure*

NOTE For removal and reinstallation of covers, refer to section 2.2.

1.2.1 Accessory

Fan cover fixing screws

Capacity	Screw Size[mm]	Number
00083/00126	M3 × 35	1
00170 to 00380	M4 × 40	2
00470/00620	M4 × 50	1

Tab. 1-1: *Fan cover fixing screws*

NOTES

The fan cover fixing screws are not delivered with models 00620 or less.

For removal and reinstallation of the cooling fans, refer to section 8.1.7.

DC reactor

For models 01800 or more the supplied DC reactor has to be installed.

2 Installation

CAUTION:
Check that packing is not removed at removal or reinstallation of a cover. If packing is removed, contact the sales representative. If the inverter is used with packing removed, the inverter does not conform to IP54.

2.1 Removal and reinstallation of the operation panel

CAUTION:
- ***If the operation panel of the inverter FR-F746 is removed from the front cover, the inverter does not conform to IP54.***
- ***The operation panel (FR-DU07) is designed to IP54 specifications. Do not install the FR-DU07 mounted on the FR-F740 EC.***

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.

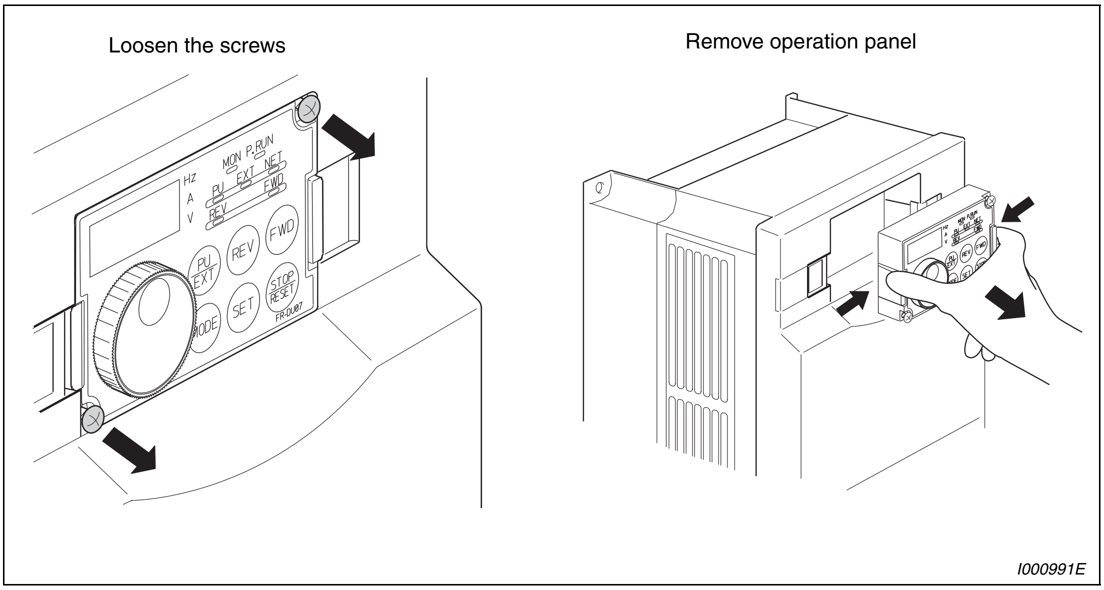


Fig. 2-1: *Removal and reinstallation of the operation panel*

③ When reinstalling the operation panel, insert it straight to reinstall securely and tighten the fixed screws of the operation panel.

2.2 Removal and reinstallation of the front cover

2.2.1 FR-F740-00023 to 00620-EC

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.

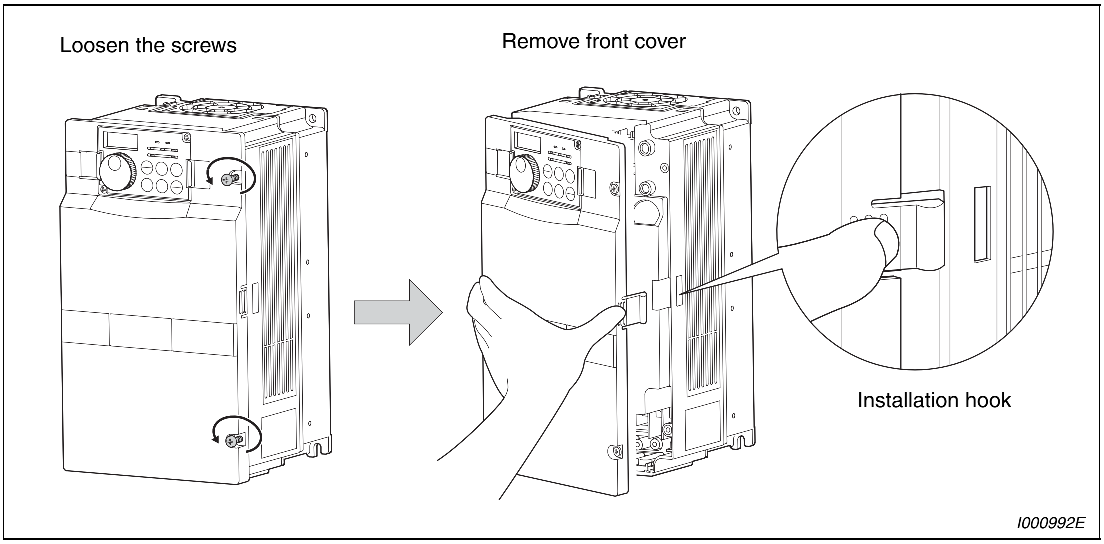


Fig. 2-2: *Removal of the front cover*

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.

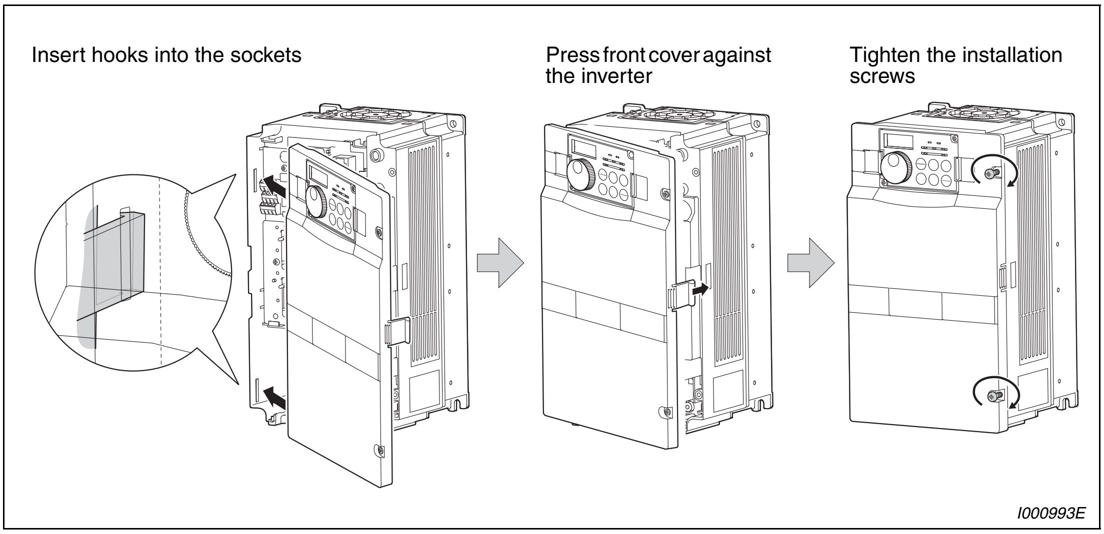


Fig. 2-3: *Reinstallation of the front cover*

2.2.2 FR-F740-00770 to 12120-EC

Removal

① Loosen the installation screws of 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.

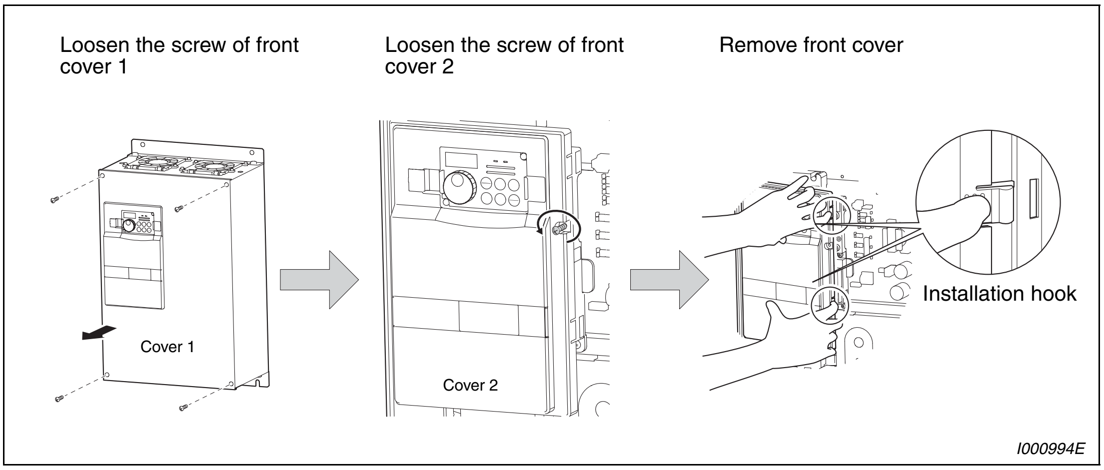


Fig. 2-4: *Removal of the front cover*

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.

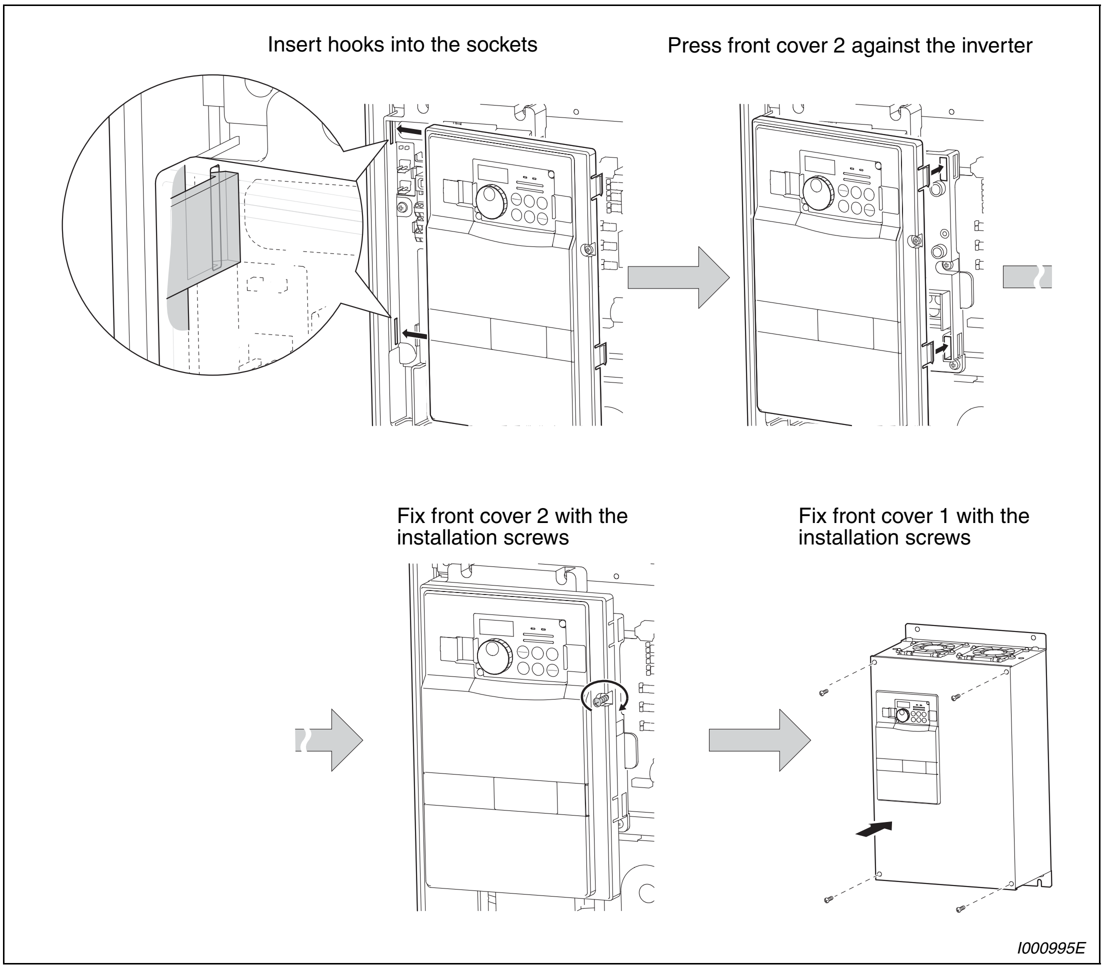


Fig. 2-5: *Reinstallation of the front cover*

NOTES

For the FR-F740-04320 or more, the front cover 1 is separated into two parts.

Fully make sure that the front cover has been reinstalled securely. Always tighten the installation screws of the front cover.

The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Before reinstalling the front cover, check the serial numbers to ensure that the cover removed is reinstalled to the inverter from where it was removed.

2.2.3 FR-F746-00023 to 01160-EC

Removal

① Loosen the installation screw of the front cover.

② Since the metal chain is mounted to the front cover, remove the front cover slowly.

③ Remove the connection cable from the PU connector.

④ Remove the hook of metal chain end from the inverter.

⑤ Remove the front cover.

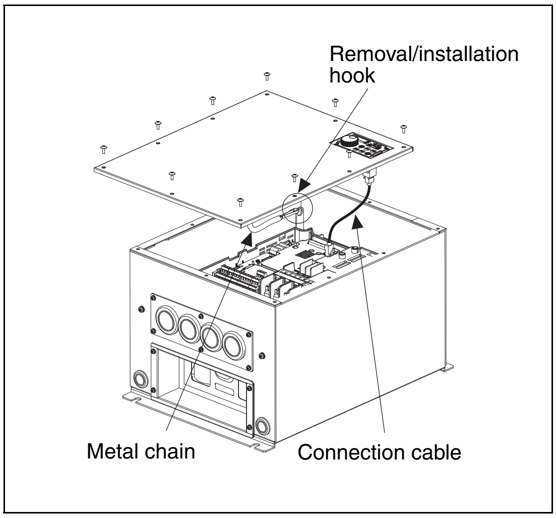


Fig. 2-6:
Removal of the front cover

I001394E

Reinstallation

① Install the hook of metal chain end to the inverter.

② Connect the connection cable to the PU connector.

③ Fix the front cover using the installation screws securely. When installing the front cover, be careful not to pinch the connection cable or the metal chain.

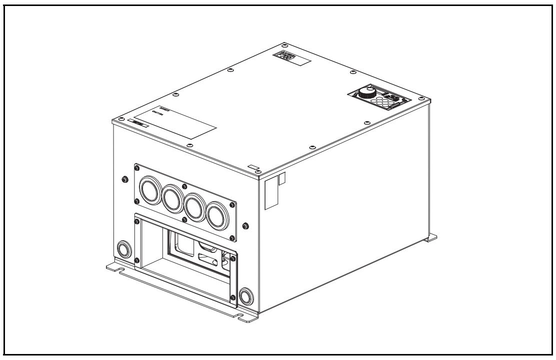


Fig. 2-7:
Reinstallation of the front cover

I001395E

2.3 Mounting

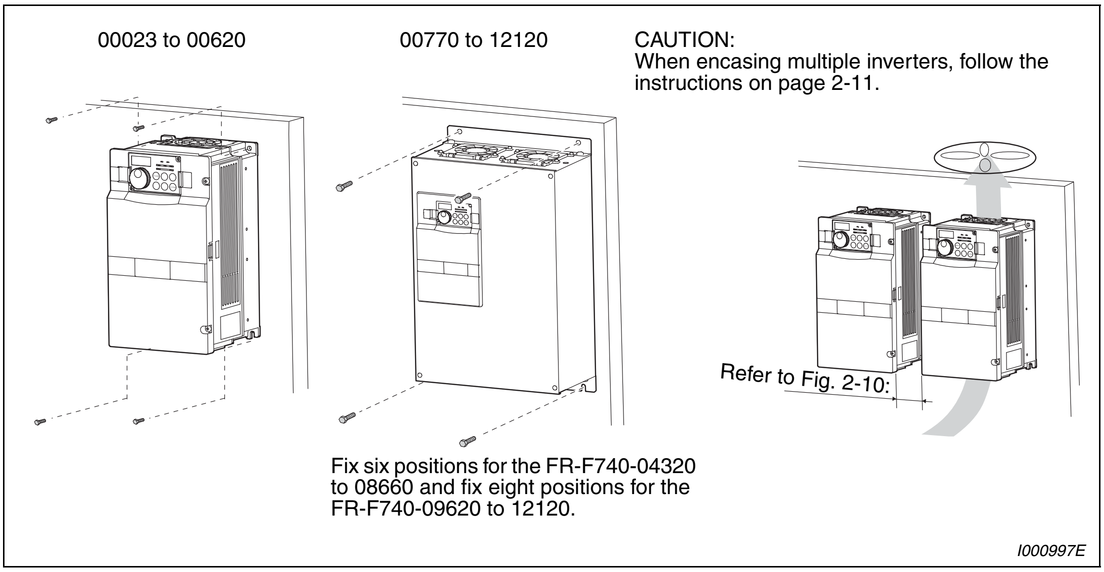


Fig. 2-8: *Installation on the panel*

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

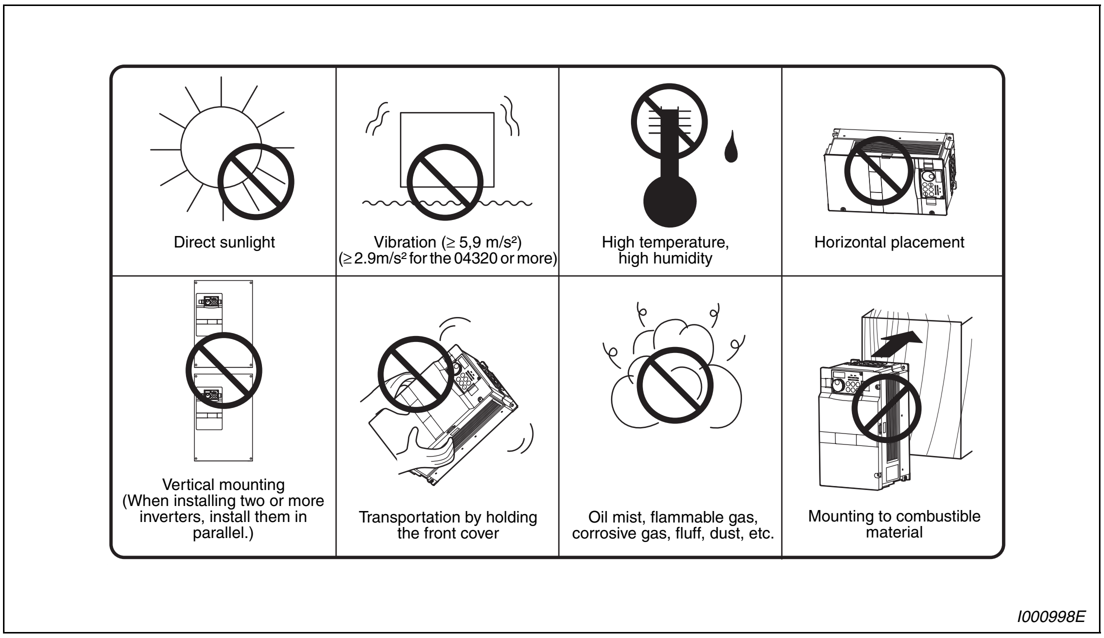


Fig. 2-9: *Conditions, that could cause an operation fault or failure*

2.4 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.

2.4.1 Inverter installation environment

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

Item		FR-F740	FR-F746
Ambient temperature	150 % overload capacity	–10 °C to +50°C (non-freezing)	–10°C to +40°C (non-freezing)
	120 % overload capacity (Initial setting)	–10 °C to +40°C (non-freezing)	–10°C to +30°C (non-freezing)
Ambient humidity		90% RH or less (non-condensing)	
Atmosphere		Free from corrosive and explosive gases, dust and dirt	
Maximum altitude		1000m or less	
Vibration		5.9m/s² or less (2.9m/s² or less for the 04320 or more) at 10 to 55Hz (directions of X, Y, Z axes)	

Tab. 2-1: *Environmental standard specifications of inverter*

Temperature

The permissible ambient temperature of the inverter FR-F740 is between –10 and +50°C (when LD is set) or –10 and +40°C (when SLD is set) and of the inverter FR-F746 is between –10 and +40°C (when LD is set) or –10 and +30°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.

- Measures against high temperature
  - Use a forced ventilation system or similar cooling system. (Refer to page 2-10.)
  - Install the enclosure in an air-conditioned electrical chamber.
  - Block direct sunlight.
  - Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
  - Ventilate the area around the enclosure well.
- 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.)
- 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.

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%.

- 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.
- 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.
- 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.
  - Do not power off the inverter. (Keep the start signal of the inverter off.)

Dust, dirt, oil mist

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

- Measures against dust, dirt, oil mist
  - Place in a totally enclosed enclosure.
    Take measures if the in-enclosure temperature rises. (Refer to page 2-10.)
  - Purge air.
    Pump clean air from outside to make the in-enclosure pressure higher than the outside-air pressure.

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 against dust, dirt, oil mist.

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.

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.

Vibration, impact

The vibration resistance of the inverter is up to 5.9m/s² (2.9m/s² for the 04320 or more) at 10 to 55Hz frequency and 1mm amplitude for the directions of X, Y, Z axes.

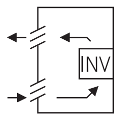
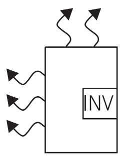
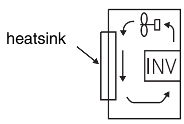
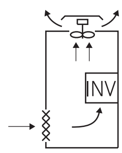
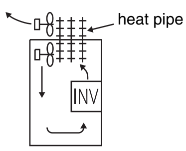
Vibration or impact, if less than the specified value, applied for a long time may make the mechanism loose or cause poor contact to the connectors.
Especially when impact is imposed repeatedly, caution must be taken as the part pins are likely to break.

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

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.

- Cooling by natural heat dissipation from the enclosure surface (Totally enclosed type)
- Cooling by heat sink (Aluminium fin, etc.)
- Cooling by ventilation (Forced ventilation type, pipe ventilation type)
- Cooling by heat exchanger or cooler (Heat pipe, cooler, etc.)

Cooling System		Enclosure Structure	Comment
Natural cooling	Natural ventilation (Enclosed, open type)	 I001000E	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)	 I001001E	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	 I001002E	Having restrictions on the heatsink mounting position and area, and designed for relative small capacities.
	Forced ventilation	 I001003E	For general indoor installation. Appropriate for enclosure downsizing and cost reduction, and often used.
	Heat pipe	 I001004E	Totally enclosed type for enclosure downsizing.

Tab. 2-2: *Cooling system types for inverter enclosure*

2.4.2 Inverter placement

Clearances around the inverter

Always observe the specified minimum clearances to ensure good heat dissipation and adequate accessibility of the frequency inverter for servicing.

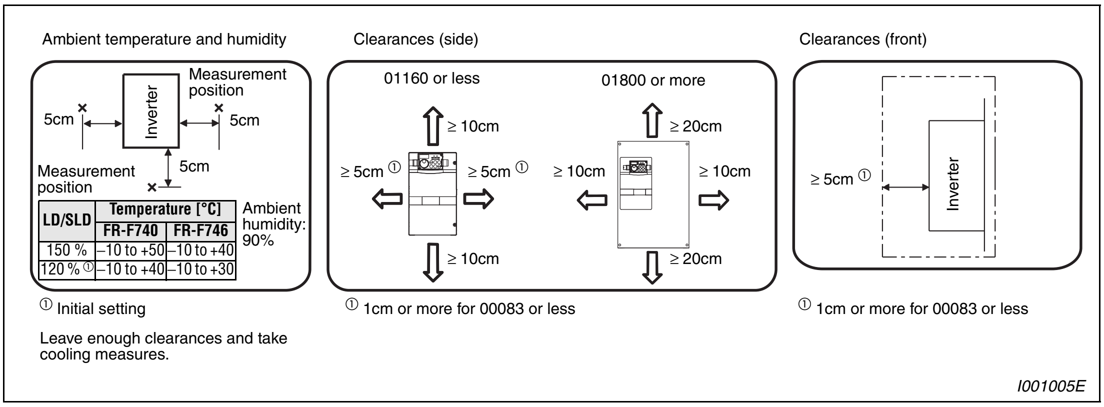


Fig. 2-10: *Clearances*

NOTES

For replacing the cooling fan of the 04320 or more, 30cm of space is necessary in front of the inverter. Refer to section 8.1.7 for fan replacement.

Since the fan cover of the inverter FR-F746 is fixed with screws, leave enough clearances so that the screws can be removed with a driver and such.

It is not necessary to leave spaces on both sides of the inverter FR-F746.

Inverter mounting orientation

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

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.

NOTE

The ambient temperature should be 50°C or less for the inverter FR-F740 and 40°C or less for the inverter FR-F746 at a distance of 5cm from the centre bottom of the inverter.

Arrangement of multiple inverters

When multiple inverters are placed in the same enclosure, generally arrange them horizontally as shown in the 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.

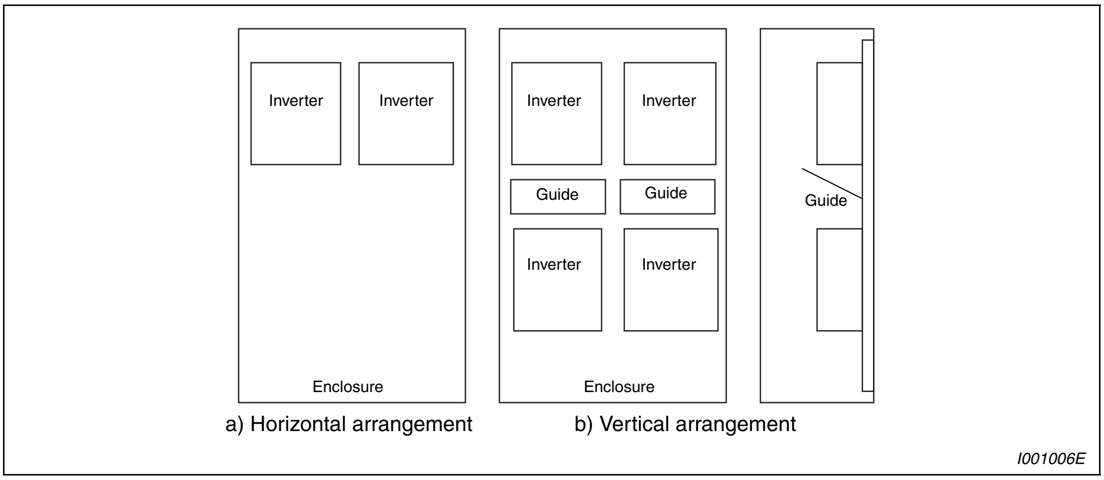


***Fig. 2-11:** Arrangement of multiple inverters*

NOTE 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.

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 installing a ventilation fan for that heat, determine the place of ventilation fan installation after fully considering an air flow. (Air passes through areas of low resistance. Make an airway and airflow plates to expose the inverter to cool air.)

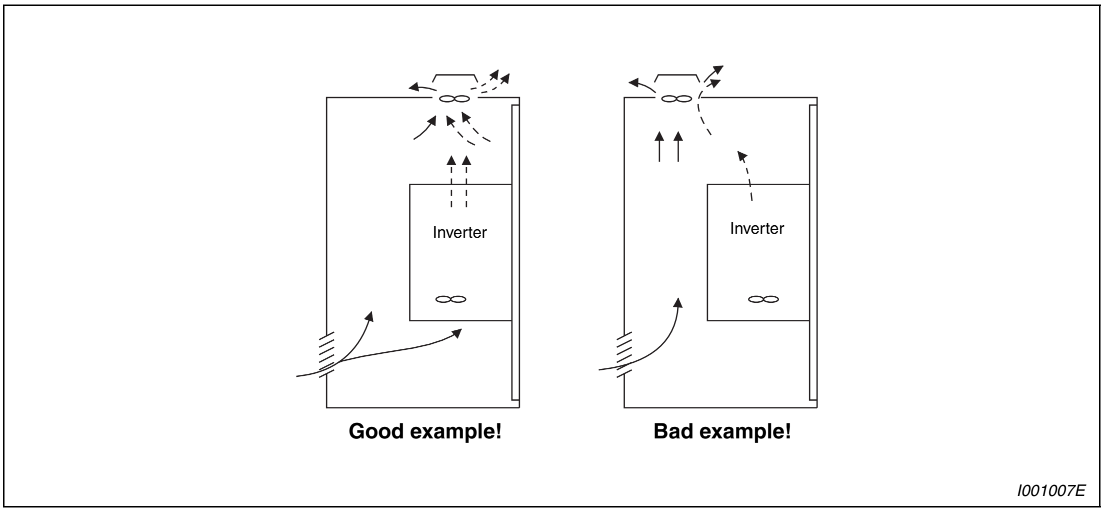


***Fig. 2-12:** Placement of ventilation fan and inverter*

2.4.3 Heatsink protrusion attachment (FR-A7CN)

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.

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".

For the panel cut dimensions of the inverters FR-F740-04320 to 03610 refer to Fig. A-21 in the appendix.

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 frontside as shown below. When changing the installation frames, make sure that the installation orientation is correct.

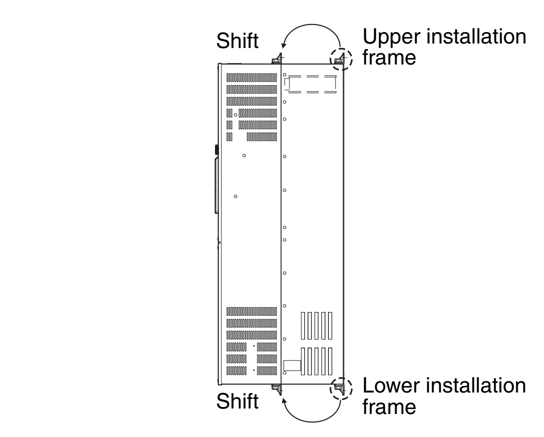


Fig. 2-13:
Shifting the rear side installation frame (05470 to 06830)

- FR-F740-04320, 04810, 07700 or more

  Two installation frames each are attached to the upper and lower part of the inverter. Remove the rear side installation frame on the upper and lower side of the inverter as shown below.

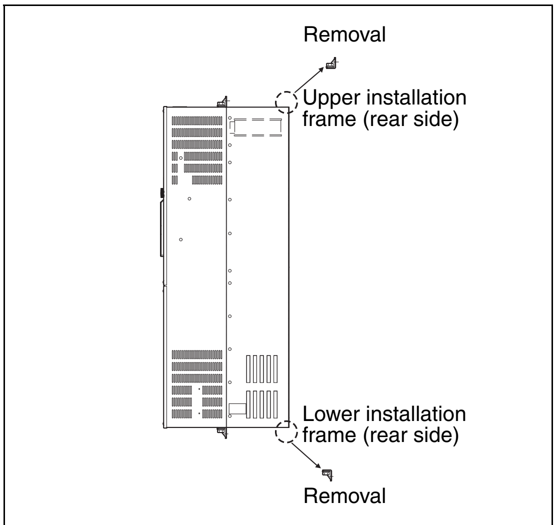
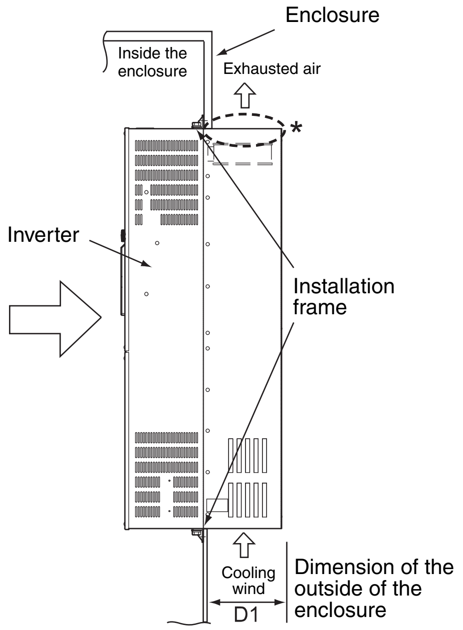


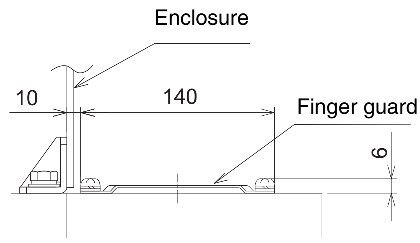
Fig. 2-14:
Removing the rear side installation frame (04320, 04810, 07700 or more)

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 and also do not place anything around finger guards to avoid contact with the finger guards.



Inverter Type	D1 [mm]
FR-F740-04320, 04810	185
FR-F740-05470 to 12120	184

I001383E

Fig. 2-15: *Installation of the inverter*

CAUTION:

- ***Having a cooling fan, the cooling section which comes out of the enclosure can not be used in the environment of waterdrops, oil, mist, dust, etc.***
- ***Be careful not to drop screws, dust etc. into the inverter and cooling fan section.***

3 Wiring

3.1 Inverter and peripheral devices

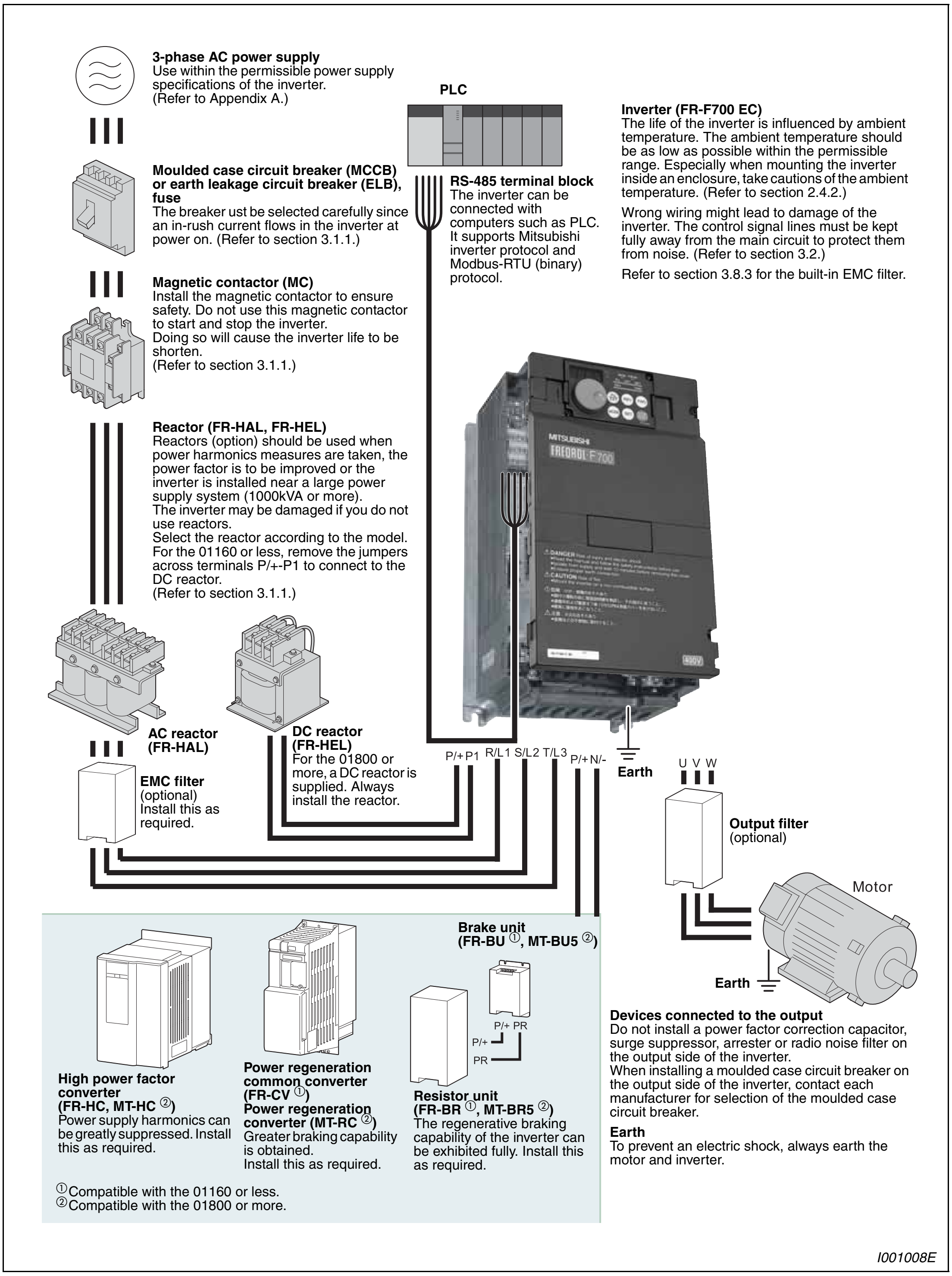


Fig. 3-1: *System configuration overview*

NOTES

Do not install a power factor correction capacitor or surge suppressor 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 Compatibility
Operation of the frequency inverter can cause electromagnetic interference in the input and output that can be propagated by cable (via the power input lines), by wireless radiation to nearby equipment (e.g. AM radios) or via data and signal lines.
Activate the integrated EMC filter (and an additional optional filter if present) to reduce air propagated interference on the input side of the inverter. Use AC or DC reactors to reduce line propagated noise (harmonics). Use shielded motor power lines to reduce output noise (refer also to section 3.8 Electromagnetic Compatibility).

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

3.1.1 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:

Motor Output [kW] ①	Applicable Inverter Type	Breaker Selection ②④			Input Side Magnetic Contactor ③	
		Reactor connection		With commercial power-supply operation	Reactor connection	
		Without	With		Without	With
0.75	FR-F740/746-00023-EC	NF32 xx 3P 6 A	NF32 xx 3P 4 A	NF32 xx 3P 6 A	S-N10	S-N10
1.5	FR-F740/746-00038-EC	NF32 xx 3P 10 A	NF32 xx 3P 6 A	NF32 xx 3P 10 A	S-N10	S-N10
2.2	FR-F740/746-00052-EC	NF32 xx 3P 10 A	NF32 xx 3P 10 A	NF32 xx 3P 10 A	S-N10	S-N10
3.7	FR-F740/746-00083-EC	NF32 xx 3P 16 A	NF32 xx 3P 10 A	NF32 xx 3P 16 A	S-N10	S-N10
5.5	FR-F740/746-00126-EC	NF32 xx 3P 20 A	NF32 xx 3P 16 A	NF32 xx 3P 20 A	S-N20	S-N11
7.5	FR-F740/746-00170-EC	NF32 xx 3P 32 A	NF32 xx 3P 25 A	NF32 xx 3P 32 A	S-N20	S-N20
11	FR-F740/746-00250-EC	NF63 xx 3P 40 A	NF32 xx 3P 32 A	NF63 xx 3P 40 A	S-N20	S-N20
15	FR-F740/746-00310-EC	NF63 xx 3P 50 A	NF63 xx 3P 40 A	NF63 xx 3P 50 A	S-N25	S-N21
18.5	FR-F740/746-00380-EC	NF63 xx 3P 63 A	NF63 xx 3P 50 A	NF63 xx 3P 63 A	S-N35	S-N25
22	FR-F740/746-00470-EC	NF125 xx 3P 100 A	NF63 xx 3P 63 A	NF125 xx 3P 100 A	S-N35	S-N25
30	FR-F740/746-00620-EC	NF125 xx 3P 100 A	NF125 xx 3P 100 A	NF125 xx 3P 100 A	S-N50	S-N35
37	FR-F740/746-00770-EC	NF125 xx 3P 125 A	NF125 xx 3P 100 A	NF125 xx 3P 125 A	S-N65	S-N50
45	FR-F740/746-00930-EC	NF160 xx 3P 163 A	NF125 xx 3P 125 A	NF160 xx 3P 163 A	S-N80	S-N65
55	FR-F740/746-01160-EC	NF250 xx 3P 250 A	NF160 xx 3P 163 A	NF250 xx 3P 250 A	S-N80	S-N80
75	FR-F740-01800-EC ⑤	—	NF250 xx 3P 250 A	NF250 xx 3P 400 A	—	S-N95
90	FR-F740-01800-EC ⑤	—	NF250 xx 3P 250 A	NF250 xx 3P 400 A	—	S-N150
110	FR-F740-02160-EC ⑤	—	NF250 xx 3P 250 A	NF400 xx 3P 400 A	—	S-N180
132	FR-F740-02600-EC ⑤	—	NF400 xx 3P 400 A	NF400 xx 3P 400 A	—	S-N220
160	FR-F740-03250-EC ⑤	—	NF400 xx 3P 400 A	NF630 xx 3P 500 A	—	S-N300
185	FR-F740-03610-EC ⑤	—	NF400 xx 3P 400 A	NF630 xx 3P 500 A	—	S-N300
220	FR-F740-04320-EC ⑤	—	NF630 xx 3P 500 A	NF630 xx 3P 600 A	—	S-N400
250	FR-F740-04810-EC ⑤	—	NF630 xx 3P 600 A	NF630 xx 3P 600 A	—	S-N600
280	FR-F740-05470-EC ⑤	—	NF630 xx 3P 600 A	NF800 xx 3P 800 A	—	S-N600
315	FR-F740-06100-EC ⑤	—	NF800 xx 3P 700 A	NF800 xx 3P 800 A	—	S-N600
355	FR-F740-6830-EC ⑤	—	NF800 xx 3P 800 A	NF800 xx 3P 800 A	—	S-N600
400	FR-F740-07700-EC ⑤	—	NF1000 xx 3P 900 A	NF1000 xx 3P 1000 A	—	S-N800
450	FR-F740-08660-EC ⑤	—	NF1000 xx 3P 1000 A	NF1000 xx 3P 1000 A	—	1000 A Rated current
500	FR-F740-09620-EC ⑤	—	NF1250 xx 3P 1200 A	NF1250 xx 3P 1200 A	—	1000 A Rated current
560	FR-F740-10940-EC ⑤	—	NF1600 xx 3P 1500 A	NF1600 xx 3P 1600 A	—	1200 A Rated current
630	FR-F740-12120-EC ⑤	—	AE2000-SS 3P 2000 A	AE2000-SS 3P 2000 A	—	1400 A Rated current

Tab. 3-1: *Breakers and contactors*

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

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

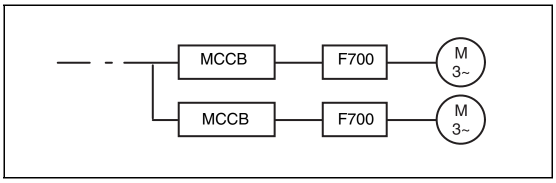


Fig. 3-2:
Installation of the breakers

I001332E

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 emergancy 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.

⑤ The supplied DC reactor has to be installed.

3.2 Terminal connection diagram

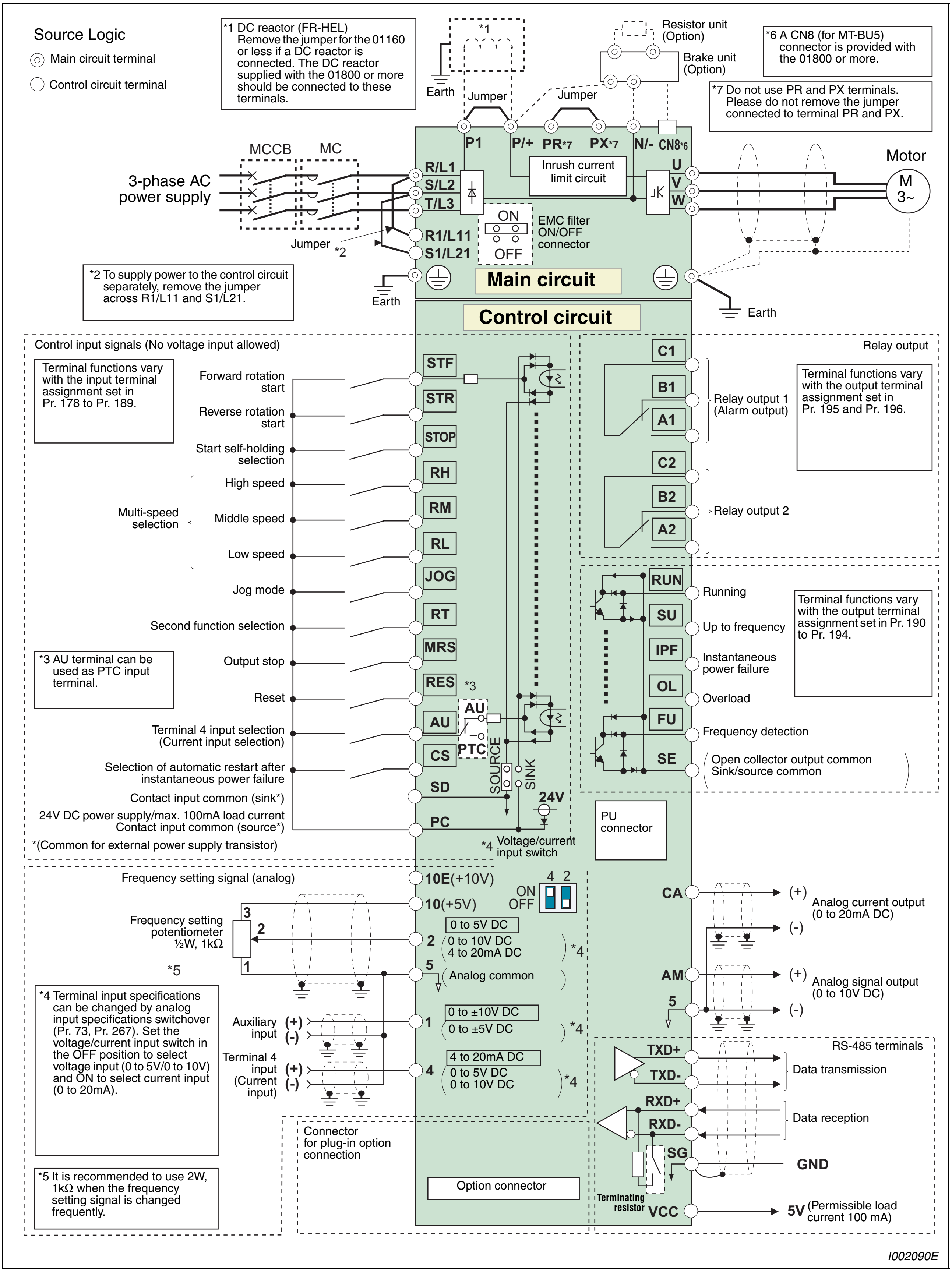


Fig. 3-3: Terminal connection diagram of the inverter

NOTES

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 correctly. Operation with a wrong setting may cause a fault, failure or malfunction.

3.3 Main circuit connection

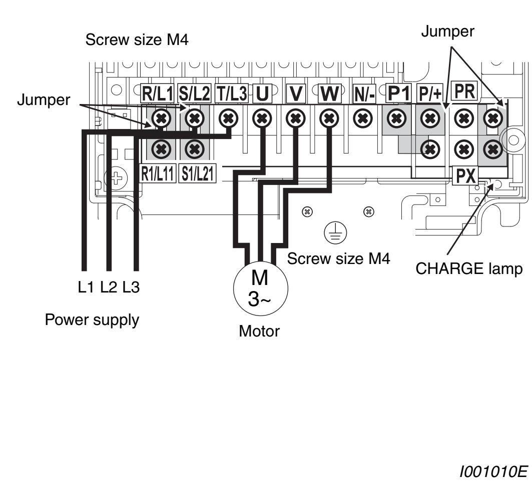
3.3.1 Specification of main circuit terminal

Terminal	Name	Description
L1, L2, L3	AC power input	Connect to the commercial power supply (380–500V AC, 50/60Hz) 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	Voltage ouput of the inverter (3 ~, 0V–power supply voltage, 0,5–400 Hz)
L11, L21	Power supply for control circuit	Connected to the AC power supply terminals L1 and L2. To retain the alarm display and alarm output or when using the high power factor converter (FR-C, MT-HC) or power regeneration common converter (FR-CV), remove the jumpers from terminals L1-L11 and L2-L21 and apply external power to these terminals. Do not turn off the power supply for control circuit (L11, L21) with the main circuit power (L1, L2, L3) on. Doing so may damage the inverter. The circuit should be configured so that the main circuit power (L1, L2, L3) is also turned off when the power supply for control circuit (L11, 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 optional DC reactor. (For the 01800 or more, a DC reactor is supplied as standard.)
PR, PX	Please do not remove or use terminals PR and PX or the jumper connected.	
⏚	PE	For earthing the inverter chassis. Must be earthed.

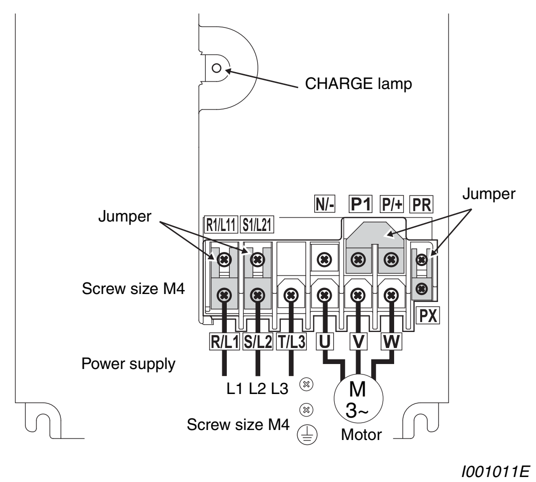
Tab. 3-2: *Specification of main circuit terminal*

3.3.2 Terminal layout and wiring

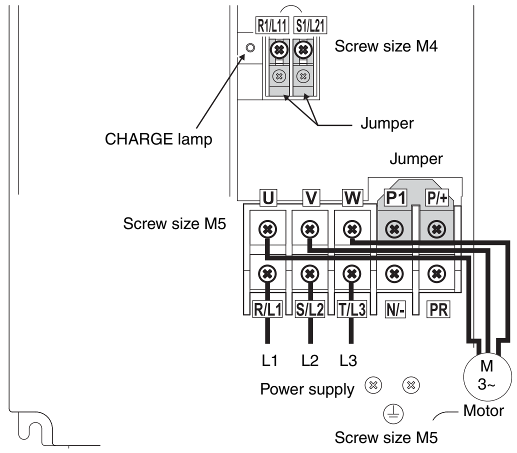
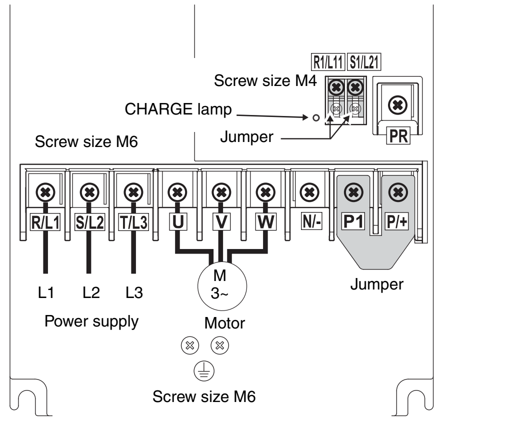
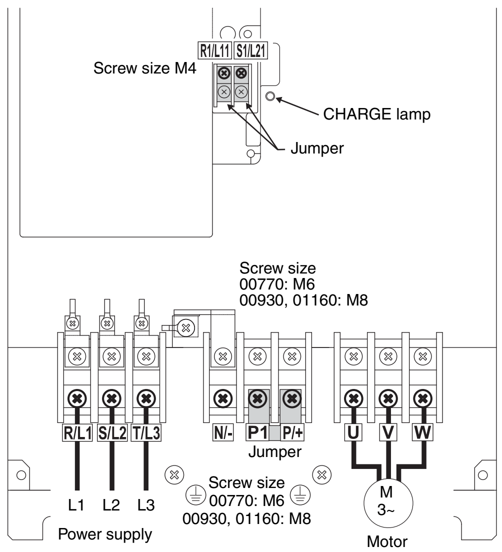
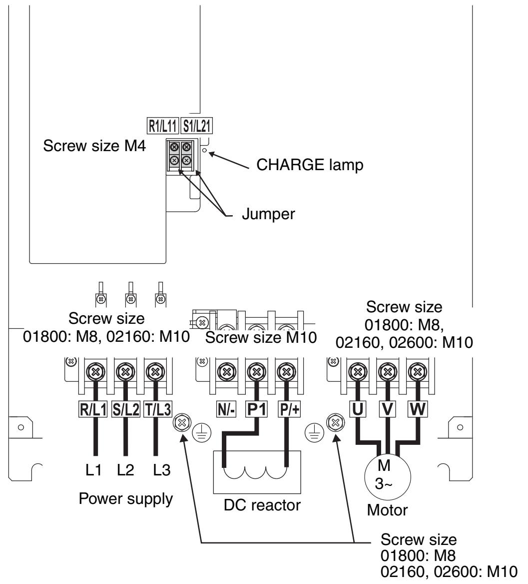
FR-F740/746-00023 to 00126-EC



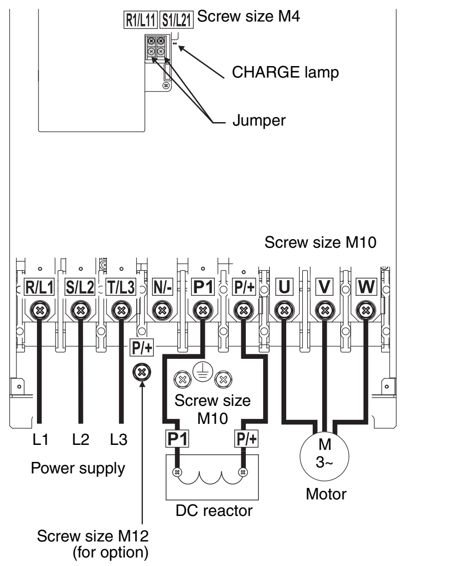
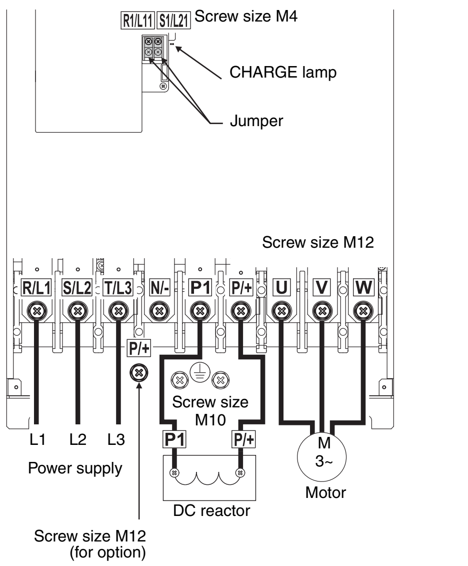
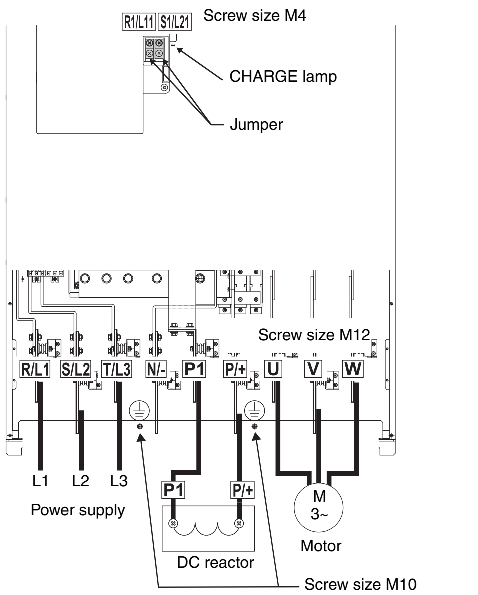
FR-F740/746-00170 and 00250-EC



Tab. 3-3: *Terminal layout and wiring (1)*

<table>
<tr><th>FR-F740/746-00310 and 00380-EC</th><th>FR-F740/746-00470 and 00620-EC</th></tr>
<tr><td>
I001012E</td>
<td>
I001013E</td></tr>
<tr><th>FR-F740/746-00770 to 01160-EC</th><th>FR-F740-01800 and 02600-EC</th></tr>
<tr><td>
I001014E</td>
<td>
I001015E</td></tr>
</table>

Tab. 3-3: *Terminal layout and wiring (2)*

FR-F740-03250 and 03610-EC	FR-F740-04320 and 04810-EC
 I001343E	 I001344E
FR-F740-05470 to 12120-EC	
 I001345E	—

Tab. 3-3: *Terminal layout and wiring (3)*

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 counter clockwise direction when viewed from the motor shaft.***

Connection to the conductors

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.

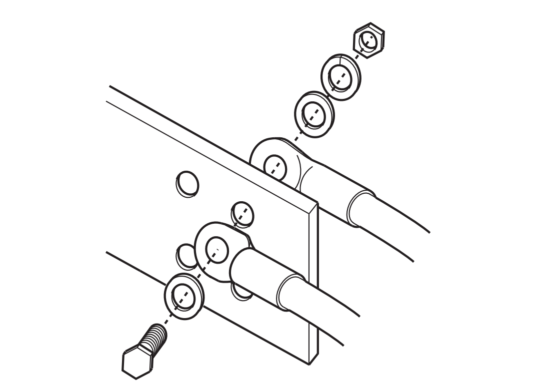
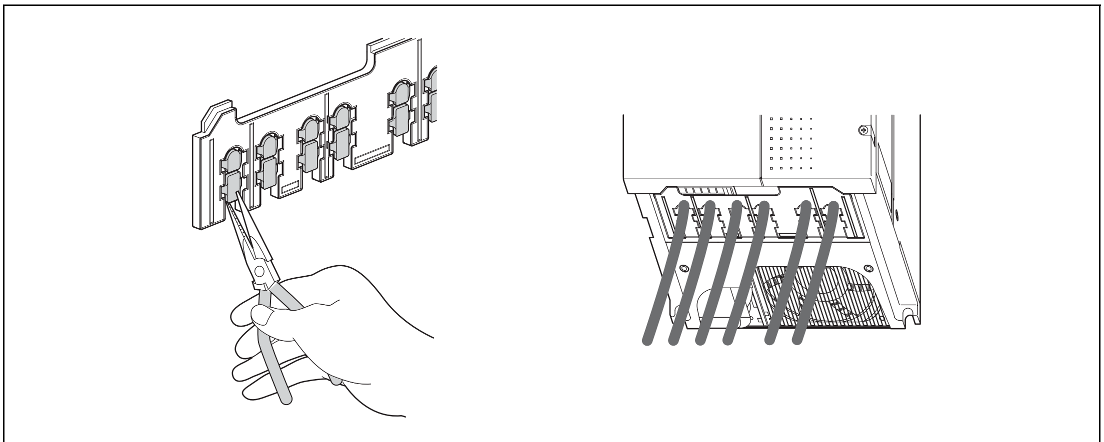


Fig. 3-4:
Connection to the conductors

I001346E

Wiring cover

The frequency inverters FR-F740-00470 and 00620 are equipped with a combed shaped wiring cover. For the hook of the wiring cover, cut off the necessary parts using a pair of long-nose pliers etc.



I000999E

Fig. 3-5: *Combed shaped wiring cover*

NOTE

Cut off the same numbers of lugs as wires. If you cut off unnecessary parts and no wires are connected, the protective structure (JEM 1030) of the inverter becomes open type (IP00).

Cable bushing FR-F746

Remove the rubber bushing and use the cable gland (equivalent for SKINTOPST-M series, locknuts GMP-GL-M series and Gaskets GMP series, LAPP) so that cable wiring satisfies IP54.

For a hole in which the cable is not led, the rubber bush may be used without replacing.

Cables and wiring length

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 a rated current for 110% overload for 1 minute)

Applicable Inverter Type	Terminal Screw Size ④	Tightening Torque [Nm]	Crimping Terminal		Cable Size							
					HIV, etc. [mm²] ①			AWG ②		PVC, etc. [mm²] ③		
			L1, L2, L3, P1, P	U, V, W	L1, L2, L3, P1, P	U, V, W	Earth cable gauge	L1, L2, L3, P1, P	U, V, W	L1, L2, L3, P1, P	U, V, W	Earth cable gauge
FR-F740/746-00023 to 00083-EC	M4	1.5	2-4	2-4	2	2	2	14	14	2.5	2.5	2.5
FR-F740/746-00126-EC	M4	1.5	2-4	2-4	2	2	3.5	12	14	2.5	2.5	4
FR-F740/746-00170-EC	M4	1.5	5.5-4	5.5-4	3.5	3.5	3.5	12	12	4	4	4
FR-F740/746-00250-EC	M4	1.5	5.5-4	5.5-4	5.5	5.5	8	10	10	6	6	10
FR-F740/746-00310-EC	M5	2.5	8-5	8-5	8	8	8	8	8	10	10	10
FR-F740/746-00380-EC	M5	2.5	14-5	8-5	14	8	14	6	8	16	10	16
FR-F740/746-00470-EC	M6	4.4	22-6	14-6	22	14	14	4	6	25	16	16
FR-F740/746-00620-EC	M6	4.4	22-6	22-6	22	22	14	4	4	25	25	16
FR-F740/746-00770-EC	M6	4.4	22-6	22-6	22	22	14	4	4	25	25	16
FR-F740/746-00930-EC	M8	7.8	38-8	38-8	38	38	22	1	2	50	50	25
FR-F740/746-01160-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	60-10	60-10	60	60	38	1/0	1/0	50	50	25
FR-F740-02160-EC	M10	14.7	100-10	100-10	100	100	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

Tab. 3-4: *Cable size*

① For the 01160 or less, the recommended cable size is that of the 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 LMFC (heat resistant flexible cross-linked polyethylene insulated cable) with continuous maximum permissible temperature of 95°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 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 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.

③ For the 00930 or less, the recommended cable size is that of the 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 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.

④ The terminal screw size indicates the terminal size for R/L1, S/L2, T/L3, U, V, W, P/+, N/–, P1 and a screw for earthing.

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

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

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

Notes on earthing

Leakage currents flow in the inverter or the EMC filter respectively. To prevent an electric shock, the inverter, input filter and motor must be earthed. (This inverter must be earthed. Earthing must conform to the requirements of national and local safety regulations and electrical codes. (JIS, NEC section 250, IEC 536 class 1 and other applicable standards)).

Use the dedicated earth terminal to earth the inverter. (Do not use the screw in the casing, chassis, etc.)

Use the thickest possible earth cable. Use the cable whose size is equal to or greater than that indicated in Tab. 3-4, and minimize the cable length. The earthing point should be as near as possible to the inverter.

Always earth the motor and inverter

- 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.
- 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:
  - 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.
  - This inverter must be earthed. Earthing must conform to the requirements of national and local safety regulations and electrical codes. (JIS, NEC section 250, IEC 536 class 1 and other applicable standards).
  - Use the thickest possible earth cable. The earth cable should be of not less than the size indicated in Tab. 3-4.
  - The grounding point should be as near as possible to the inverter, and the ground wire length should be as short as possible.
  - 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.

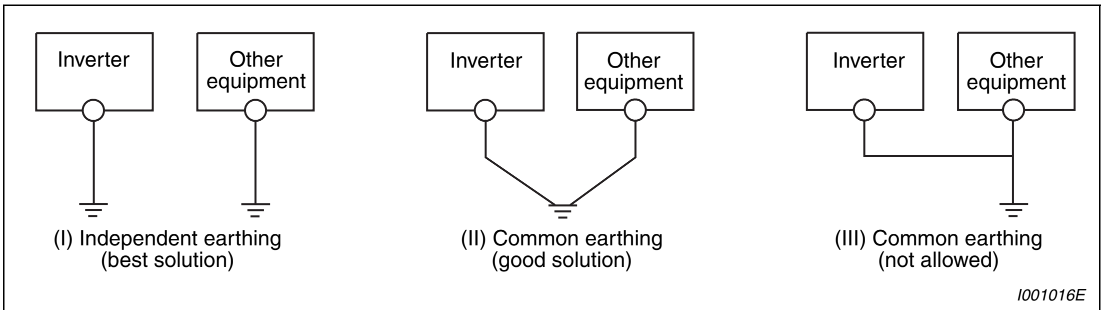


Fig. 3-6: *Earthing the drive*

Total wiring length

The maximum possible length of the motor cables depends on the capacity of the inverter and the selected carrier frequency. The cables should never be longer than 500m (unshielded).

The lengths in the following table are for unshielded cables. When shielded cables are use divide the values listed in the table by 2. Note that the values are for the total wiring length – if you connect more than one motor in parallel you must add the lengths of the individual motor cables.

Pr. 72 "PWM frequency selection" setting (carrier frequency)	00023	00038	≥ 00052
≤ 2 (2kHz)	300m	500m	500m
3 (3kHz), 4 (4kHz)	200m	300m	500m
5 (5kHz) to 9 (9kHz)	100m		
≥ 10 (10kHz)	50m		

Tab. 3-5: *Total wiring length*

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

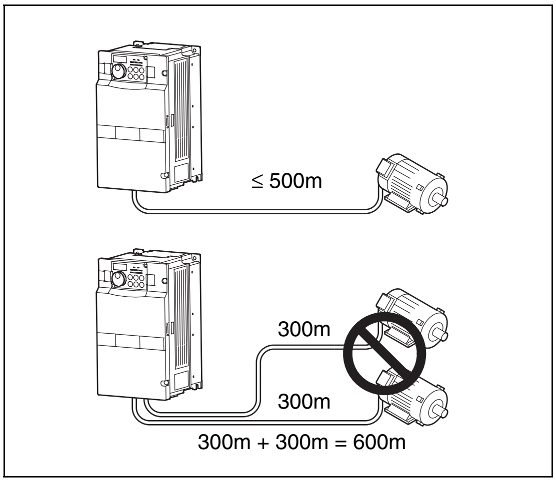


Fig. 3-7:
Total wiring length (00038 or more)

Note that the motor windings are subjected to significantly higher loads when the motor is operated by inverter than with normal mains operation. The motors must be approved for inverter operation by the manufacturer (refer also to section 3.8.5).

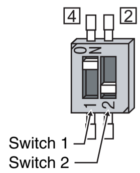
3.4 Control circuit specifications

The functions of the terminals highlighted in grey can be adjusted with parameters 178 to 196 "Input/Output terminal function assignment" (refer to section 6.9). The listed settings show the default configuration as shipped, which you can restore by resetting to the factory defaults.

Input signals

	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 27V DC Contacts at short-circuited: 4 to 6mA DC	6-96
	STR	Reverse rotation start	Turn on the STR signal to start reverse rotation and turn it off to stop.		6-96
	STOP	Start self holding selection	Turn on the STOP signal to self-hold the start signal.		6-96
	RH, RM, RL	Multi-speed selection	Multi-speed can be selected according to the combination of RH, RM and RL signals.		6-96
	JOG	Jog mode selection	Turn on the JOG signal to select Jog operation (initial setting) and turn on the start signal to start Jog operation.		6-96
	RT	Second function	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.		6-96
	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.		6-96
	RES	Reset	Used to reset alarm output provided when protective function 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.		6-96
	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 4 and 20mA DC.) Turning the AU signal on makes terminal 2 (voltage input) invalid.		6-170
		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 and assign the PTC function to the AU input terminal.		6-80
	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 in section 6.11.)		6-96
	SD	External transistor common, contact input common (sink)	A determined control function is activated, if the corresponding terminal is connected to the terminal SD (sink logic). The SD terminal is isolated from the digital circuits via opto couplers. The terminal is isolated from the reference potential of the analog circuit (terminal 5). Common reference potential (0V) for 24V DC/ 0.1A output (PC terminal).	—	—

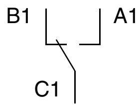
Tab. 3-6: *Input signals (1)*

	Terminal	Name	Description	Rated Specifications	Refer to
Contact input	PC	24V DC power supply, contact input common (source)	24V DC/0.1A output With negative logic and control via open collector transistors (e.g. a PLC) the positive pole of an external power source must be connected to the PC terminal. With positive logic the PC terminal is used as a common reference for the control inputs. This means that when positive logic is selected (default setting of the EC units) the corresponding control function is activated by connecting its terminal to the PC terminal.	Power supply voltage range: 19.2 to 28.8V DC Current consumption: 100mA	3-26
Frequency setting	10E (Output voltage 10V DC)	Frequency setting power supply	When connecting the frequency setting potentiometer at an initial status, connect it to terminal 10. Change the input specifications with Pr. 73 when connecting it to terminal 10E. (Refer to section 6.15.2.) Recommended potentiometer: 1 kΩ, 2 W linear, multi turn potentiometer	10V DC ± 0,4V, Permissible load current 10mA	6-170
	10 (Output voltage 5V DC)			5,2V DC ± 0,2V, Permissible load current 10mA	6-170
	2	Frequency setting (voltage)	Inputting 0 to 5V DC (or 0 to 10V, 0/4 to 20mA) provides the maximum output frequency at 5V (10V, 20mA) and makes input and output proportional. Use Pr.73 to switch from among input 0 to 5V DC (initial setting), 0 to 10V DC, and 0/4 to 20mA. Set the voltage/current input switch in the ON position to select current input (0/4 to 20mA). ①	Voltage input: Input resistance: 10kΩ ± 1kΩ Maximum permissible voltage: 20V DC Current input: Input resistance: 245Ω ± 5Ω (while power is on) Maximum permissible current: 30mA (while power is off) Voltage/current input switch 	6-170
	4	Frequency setting (current)	Inputting 0/4 to 20mA DC (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 between the input 0/4 to 20mA (initial value) and 0 to 5V DC, 0 to 10V DC. Set the voltage/current input switch in the OFF position to select voltage input (0 to 5V/0 to 10V). ①		6-170
	1	Frequency setting auxiliary 0–±5 (10)V DC	Inputting 0 to ±5V DC or 0 to ±10V DC adds this signal to terminal 2 or 4 frequency setting signal. Use Pr. 73 to switch between the input 0 to ±5V DC and 0 to ±10V DC (initial setting).	Input resistance: 10kΩ ± 1kΩ Maximum permissible voltage: ±20V DC	6-170
	5	Frequency setting common and analog outputs	Terminal 5 provides the common reference potential (0V) for all analog set point values and for the analog output signals CA (current) and AM (voltage). The terminal is isolated from the digital circuit's reference potential (SD). This terminal should not be grounded. If local regulations require grounding of the reference potential note that this can propagate any noise in the ground potential to the control electronics, thus increasing sensitivity to interference.	—	6-170

Tab. 3-6: *Input signals (2)*

① Set Pr. 73, Pr. 267, and a voltage/current input switch correctly, then input an analog signal in accordance with the setting.
Applying a voltage signal with voltage/current input switch on (current input is selected) or a current signal with switch off (voltage input is selected) could cause component damage of the inverter or analog circuit of signal output devices. (For details, refer to section 6.15.1.)

Output signals

<table>
<tr><th></th><th>Terminal</th><th>Name</th><th colspan="2">Description</th><th>Rated Specifications</th><th>Refer to</th></tr>
<tr><td rowspan="2">Relay</td><td>A1, B1, C1</td><td>Relay output 1 (alarm output)</td><td colspan="2" rowspan="2">The alarm is output via relay contacts. The block diagram shows the normal operation and voltage free status. If the protective function is activated, the relay picks up.

</td><td rowspan="2">Contact capacity: 230V/0,3A AC (Power factor: 0,4) or 30V/0,3A DC.</td><td>6-107</td></tr>
<tr><td>A2, B2, C2</td><td>Relay output 2</td><td>6-107</td></tr>
<tr><td rowspan="7">Open collector</td><td>RUN</td><td>Inverter running</td><td colspan="2">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.</td><td rowspan="6">Permissible load: 24V DC, 0,1A (A voltage drop is 3.4V maximum when the signal is on.)</td><td>6-107</td></tr>
<tr><td>SU</td><td>Up to frequency</td><td>The SU output supports a monitoring of frequency setting value and frequency current value. The output is switched low, once the frequency current value (output frequency of the inverter) approaches the frequency setting value (determined by the setting value signal) within a preset range of tolerance (Pr. 41). Switched high during acceleration/deceleration and at a stop.</td><td rowspan="5">Alarm code (4 bit) (Refer to section 6.12.2)</td><td>6-107</td></tr>
<tr><td>OL</td><td>Overload alarm</td><td>The OL is switched low, if the output current of the inverter exceeds the current limit preset in Pr. 22 and the stall prevention is activated. If the output current of the inverter falls below the current limit preset in Pr. 22, the signal at the OL output is switched high.</td><td>6-107</td></tr>
<tr><td>IPF</td><td>Instantaneous power failure</td><td>The output is switched low for a temporary power failure within a range of 15ms ≤ tIPF ≤ 100ms or for under voltage.</td><td>6-107</td></tr>
<tr><td>FU</td><td>Frequency detection</td><td>The output is switched low once the output frequency exceeds a value preset in Pr. 42 (or 43). Otherwise the FU output is switched high.</td><td>6-107</td></tr>
<tr><td>SE</td><td>Open collector output common</td><td colspan="2">Reference potential for the signals RUN, SU, OL, IPF, and FU. This terminal is isolated from the reference potential of the control circuit SD.</td><td>—</td><td>—</td></tr>
</table>

Tab. 3-7: *Output signals (1)*

	Terminal	Name	Description		Rated Specifications	Refer to
Analog output	CA	Analog current output	Select one e.g. output frequency from monitor items. The output signal is proportional to the magnitude of the corresponding monitoring item. Not output during inverter reset.	Output item: Output frequency (initial setting)	Load impedance: 200Ω–450Ω Output signal: 0–20mA	6-130
	AM	Analog voltage output			Output signal: 0–10V DC Permissible load current: 1 mA (load impedance: ≥ 10kΩ) Resolution: 8 bit	6-130

Tab. 3-7: *Output signals (2)*

Communication

	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	6-225
	RS-485 terminal	TXD+	Inverter transmission terminal	With the RS-485 terminal, 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	6-228
		TXD–			
		RXD+	Inverter reception terminal		
		RXD–			
		SG	Earth		

Tab. 3-8: *Communication signals*

3.4.1 Control circuit terminals

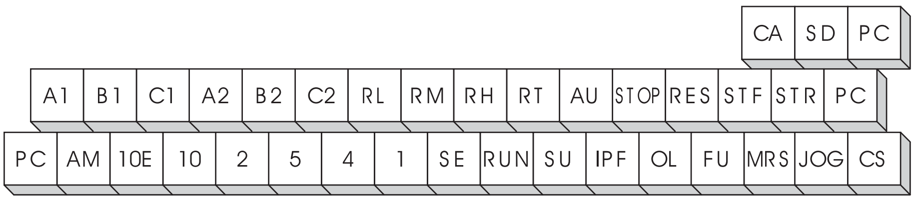


Fig. 3-8: *Terminal layout*

Wiring method

① Remove about 6mm of the cable insulation. Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it.

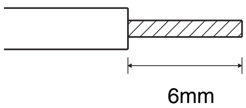


Fig. 3-9:
Preparation of the cable

I001326E

② Loosen the terminal screw and insert the cable into the terminal.

Item	Description
Screw size	M3
Tightening torque	0.5Nm–0.6Nm
Cable size	$0.3mm^2$–$0.75mm^2$
Screwdriver	Flat blade screw driver Edge thickness: 0.4mm × 2.5mm

Tab. 3-9: *Connection to the terminals*

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

Common terminals of the control circuits PC, 5, SE

Terminals PC, 5, and SE are all common terminals (0V) for I/O signals and are isolated from each other. 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.

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 below.

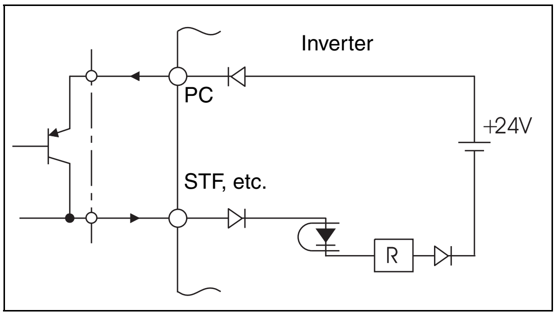


Fig. 3-10:
External signal input using transistor

I001220E

3.4.2 Wiring instructions

- Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 230V relay sequence circuit).
- 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.

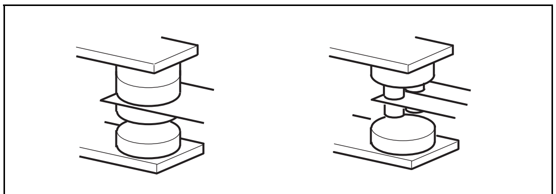


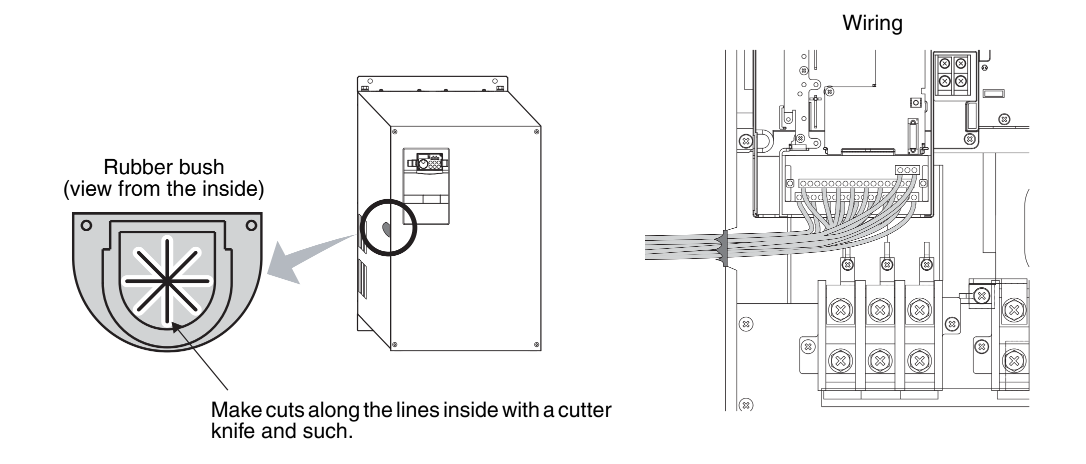
Fig. 3-11: *Contacts*

I001021E

- Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.
- Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp, etc.
- It is recommended to use the cables of 0.75mm² gauge for connection to the control circuit terminals.
- If the cable gauge used is 1.25mm² or more, the front cover may be lifted when there are many cables running or the cables are run improperly, resulting in an operation panel contact fault.
- The wiring length should be 30m 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.



I001022E

Fig. 3-12: *Wiring of the control circuit of the 01800 or more*

3.4.3 Separate power supply for the control circuit

In an alarm condition the frequency inverter's integrated alarm relay only remains active as long as there is a mains power supply on terminals R/L1, S/L2 and T/L3. If you want the alarm signal to remain active after the frequency inverter has been switched off a separate power supply for the control circuit is required, which should be connected as shown in the circuit diagram below. Remove the shortening jumpers from the terminal block and connect the 380–500V AC, 50/60Hz mains power supply to terminals R1/L11 and S1/L21. The control circuit power consumption on L11/L21 is 60VA for 00380 or less and 80VA for 00470 to 02160.

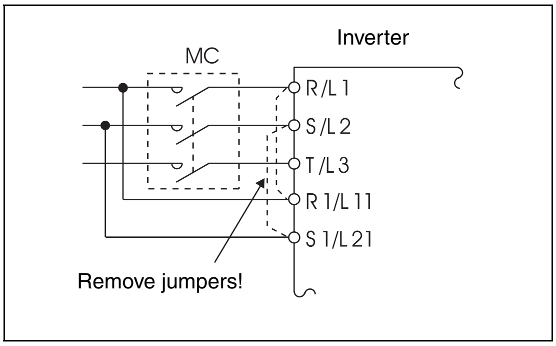


Fig. 3-13:
Power supply for control and main circuit

I001023E

FR-F740/746-00023 to 00126-EC

① Loosen the upper screws ❶ and then the lower screws ❷.

② Remove the jumpers ❸.

③ Connect the separate power supply cable for the control circuit to the lower terminals ❹ R1/L11 and S1/L21.

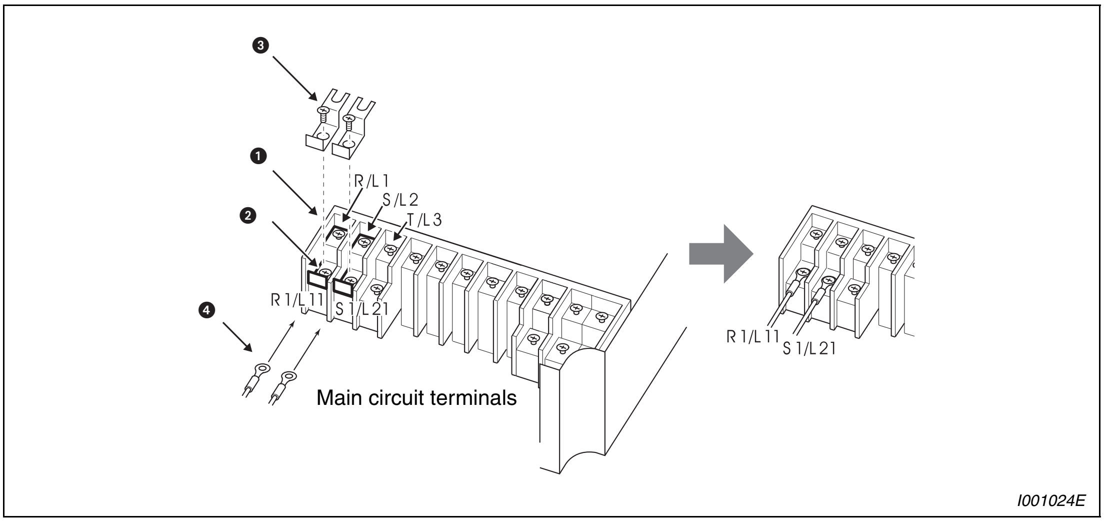


Fig. 3-14: *Detailed view of the terminals*

FR-F740/746-00170 to 00250-EC

① Loosen the upper screws ❶ and then the lower screws ❷.

② Remove the jumpers ❸.

③ Connect the separate power supply cable for the control circuit to the upper terminals ❹ R1/L11 and S1/L21.

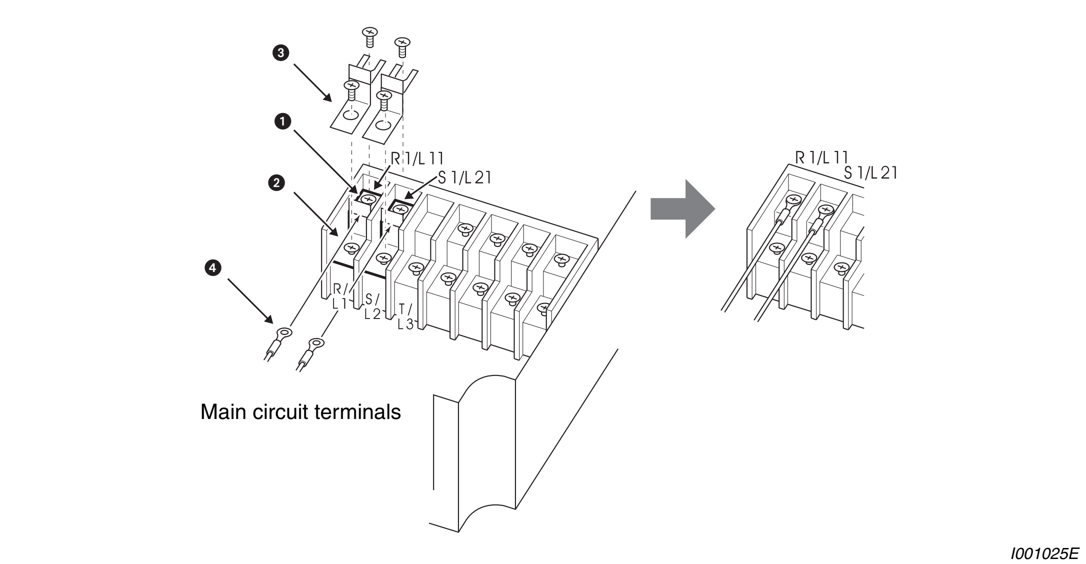


Fig. 3-15: *Detailed view of the terminals*

FR-F740-00310 to 12120-EC and FR-F746-00310 to 01160-EC

① Loosen the upper screws ❶ and then the lower screws ❷.

② Remove the jumpers ❸.

③ Connect the separate power supply cable for the control circuit to the upper terminals ❹ R1/L11 and S1/L21.

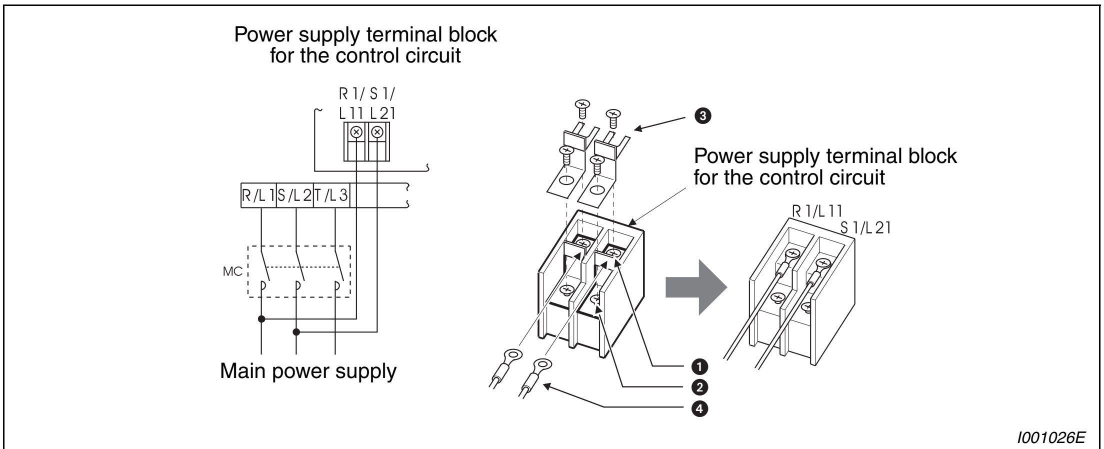


Fig. 3-16: *Detailed view of the terminals*

CAUTION:

Never connect the power cable to the terminals in the lower stand. Doing so will damage the inverter.

Position of the power supply terminal block for the control circuit

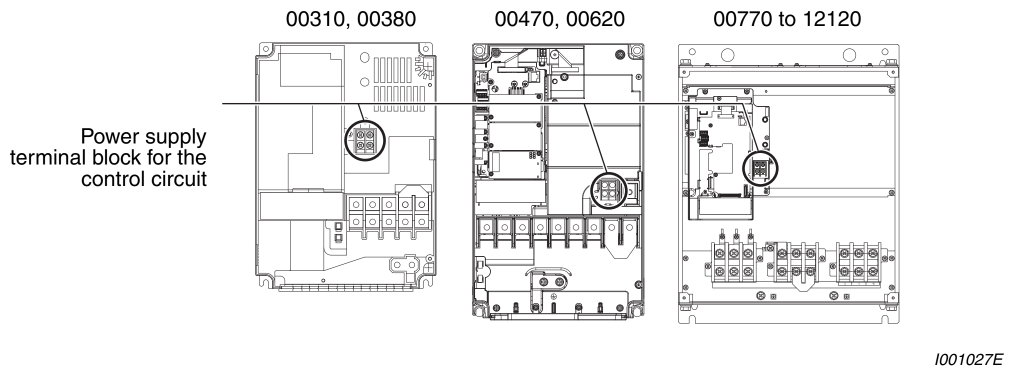


Fig. 3-17: *Position of the power supply terminal block for the control circuit*

CAUTION:

- ***Do not turn off the control power (terminals R1/L11 and S1/L21) with the main circuit power (R/L1, S/L2, T/L3) on. Doing so may damage the inverter.***
- ***Be sure to use the inverter with the jumpers across terminals R/L1-R1/L11 and S/L2-S1/L21 removed when supplying power from other sources. The inverter may be damaged if you do not remove the jumper.***
- ***The voltage should be the same as that of the main control circuit when the control circuit power is supplied from other than the primary side of the MC.***
- ***The power capacity is 60VA or more for 00380 or 80VA or more for 00470 to 12120 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.***

3.4.4 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.)

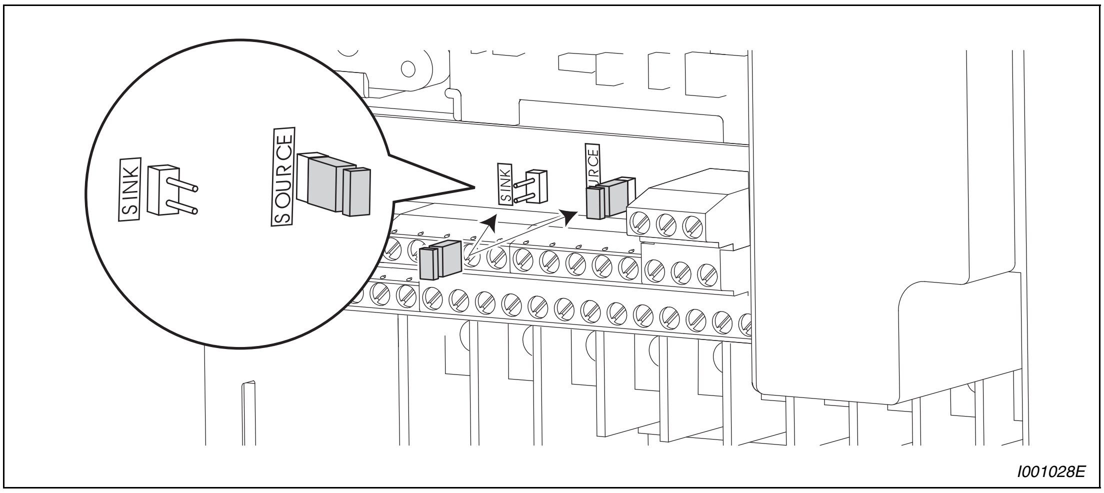


Fig. 3-18: *Changing the control logic*

NOTE 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.

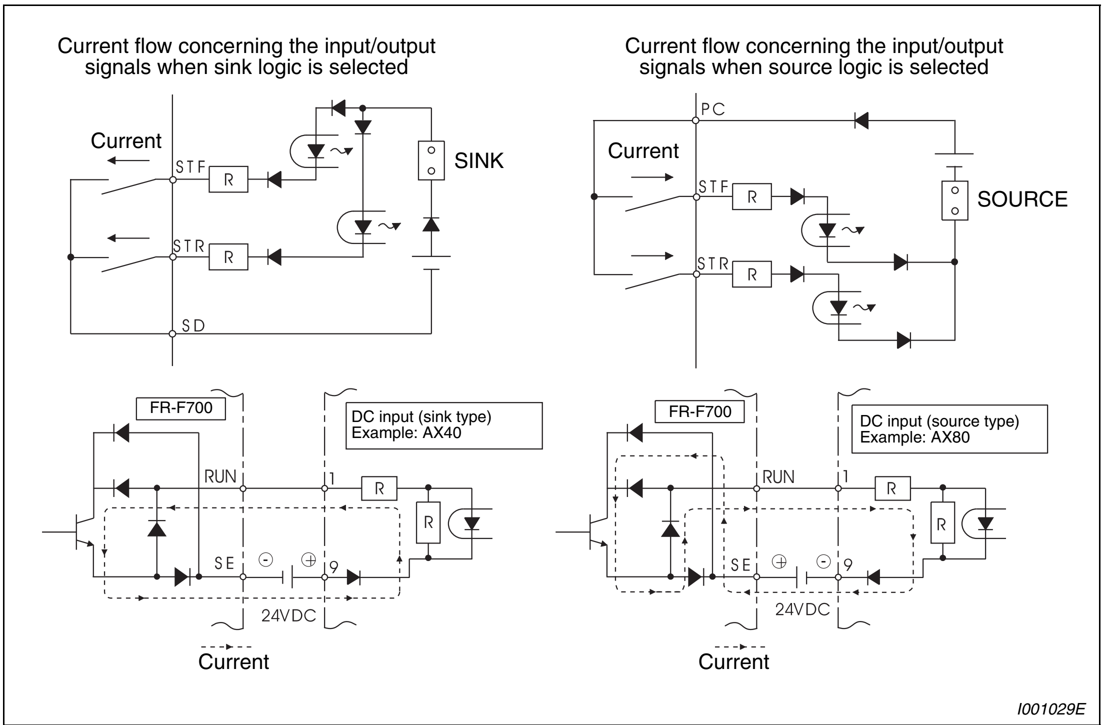


Fig. 3-19: *Changing the control logic*

Using an external power supply

- 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 24V DC 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.)

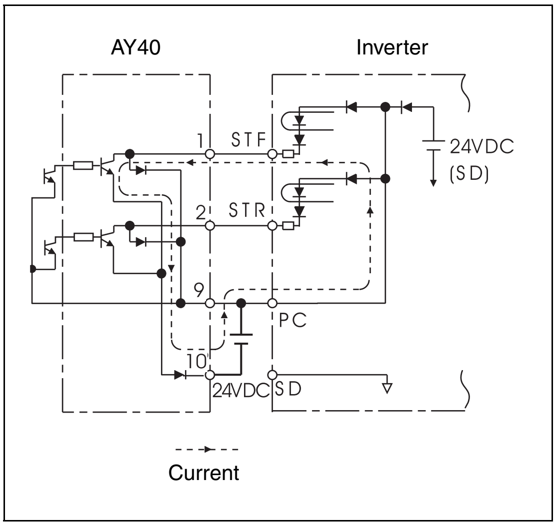


Fig. 3-20:
Using an external power supply in connection with the outputs of a PLC

- 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.

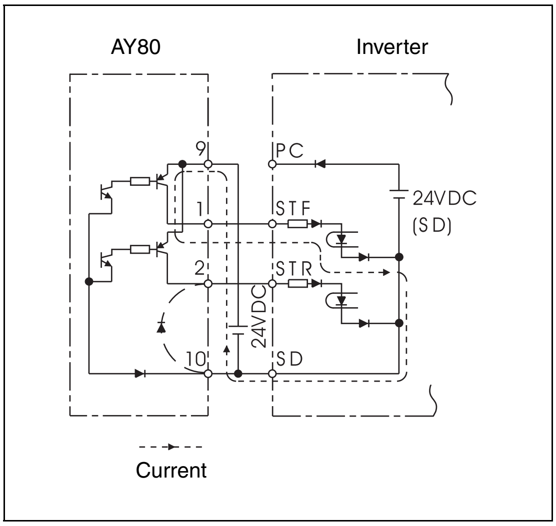


Fig. 3-21:
Using an external power supply in connection with the outputs of a PLC

3.5 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 operationally improves.

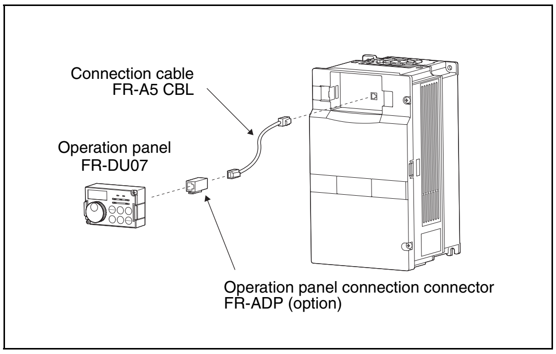


Fig. 3-22:
Connecting the operation panel using a connection cable

I001032E

NOTES

Overall wiring length when the operation panel is connected: 20m.

Using the PU connector, the frequency inverter can be connected to a RS-485 interface of a personal computer, etc. (refer to section 6.18).

3.6 RS-485 terminal block

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

Tab. 3-10: *Specifications of the RS-485 terminal block*

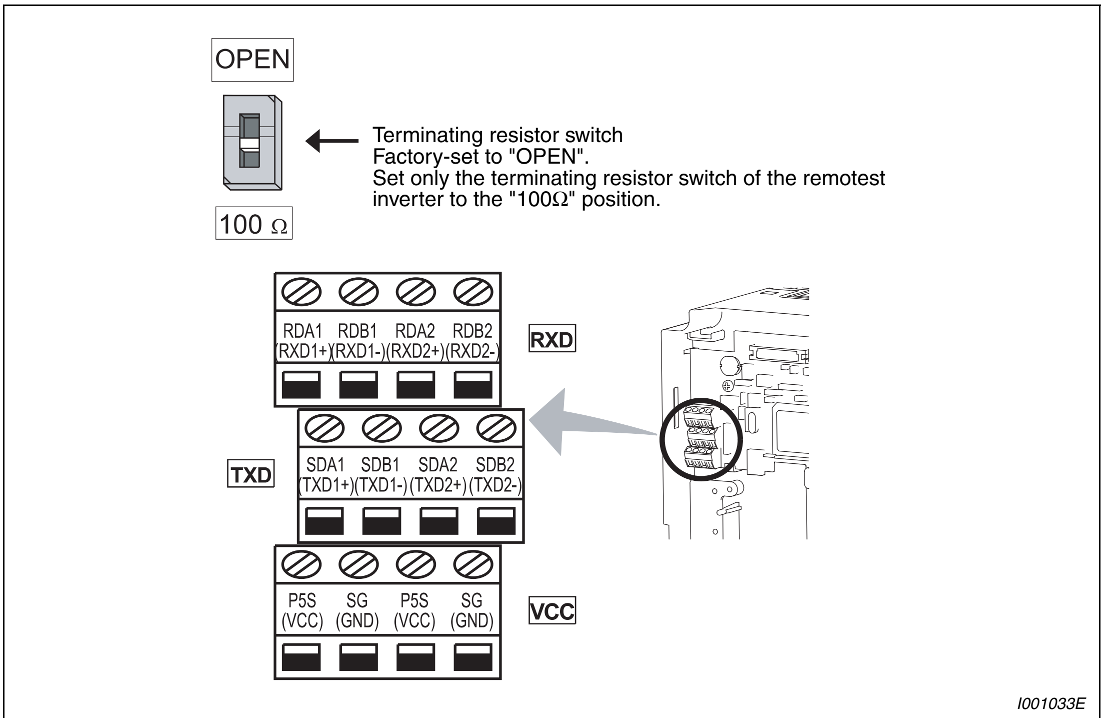


Fig. 3-23: *RS-485 terminal block*

3.6.1 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 Mod bus RTU protocol, communication can be performed with the RS-485 terminal. (Refer to section 6.18.)

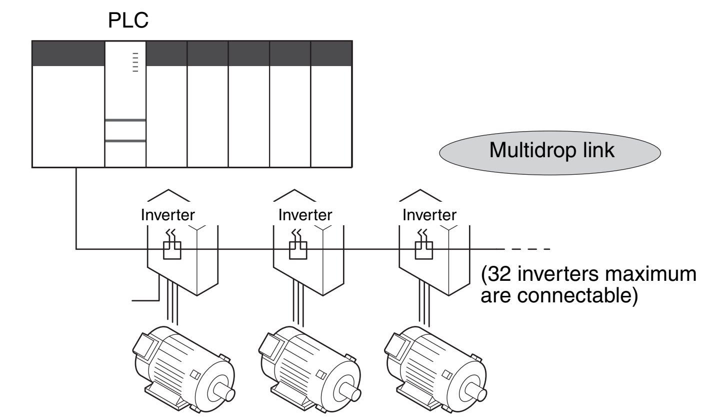


Fig. 3-24: *RS-485 terminal block of the frequency inverter*

3.7 Connection of stand-alone option units

The inverter accepts a variety of stand-alone option units as required.

CAUTION:
Incorrect connection will cause inverter damage or accident. Connect and operate the option unit carefully in accordance with the corresponding option unit manual.

3.7.1 Magnetic contactors (MC)

Inverter input side magnetic contactor (MC)

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

- 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 operation).
- To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure.
- 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.
- To separate the inverter from the power supply to ensure safe maintenance and inspection work.

NOTE

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

Example ▽ As shown below, always use the start signal (ON or OFF across terminals STF or STR-PC) to make a start or stop. (Refer to section 6.9.4.)

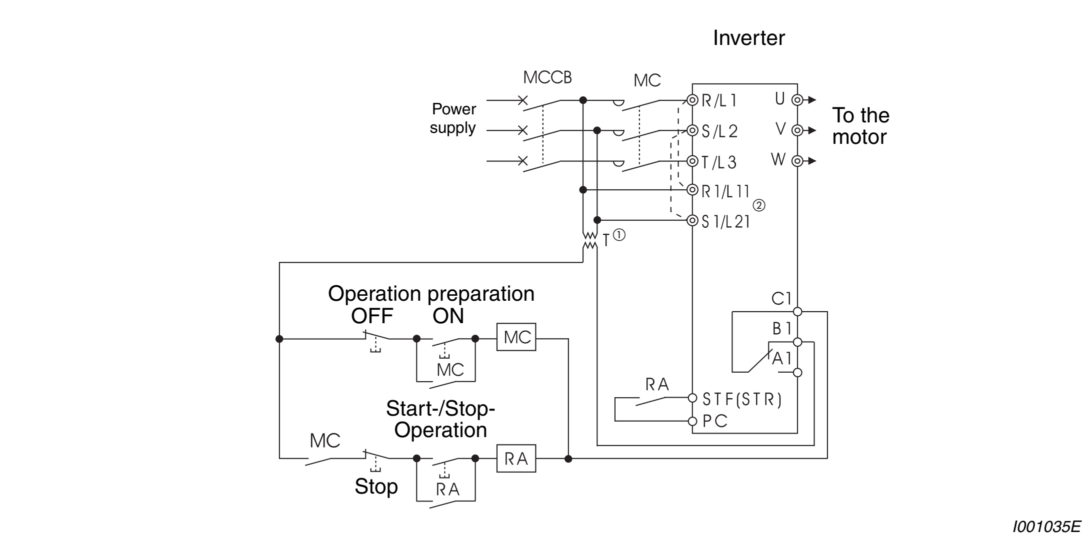


Fig. 3-25: *Start and stop of the inverter*

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 section 3.4.3.)

△

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, over current 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 commercial power supply-inverter switch over operation Pr. 135 to Pr. 139.

3.7.2 Connection of a brake unit (FR-BU/MT-BU5)

When connecting a brake unit to improve the brake capability at deceleration, make connection as shown below.

Connection with the brake unit FR-BU (01160 or less)

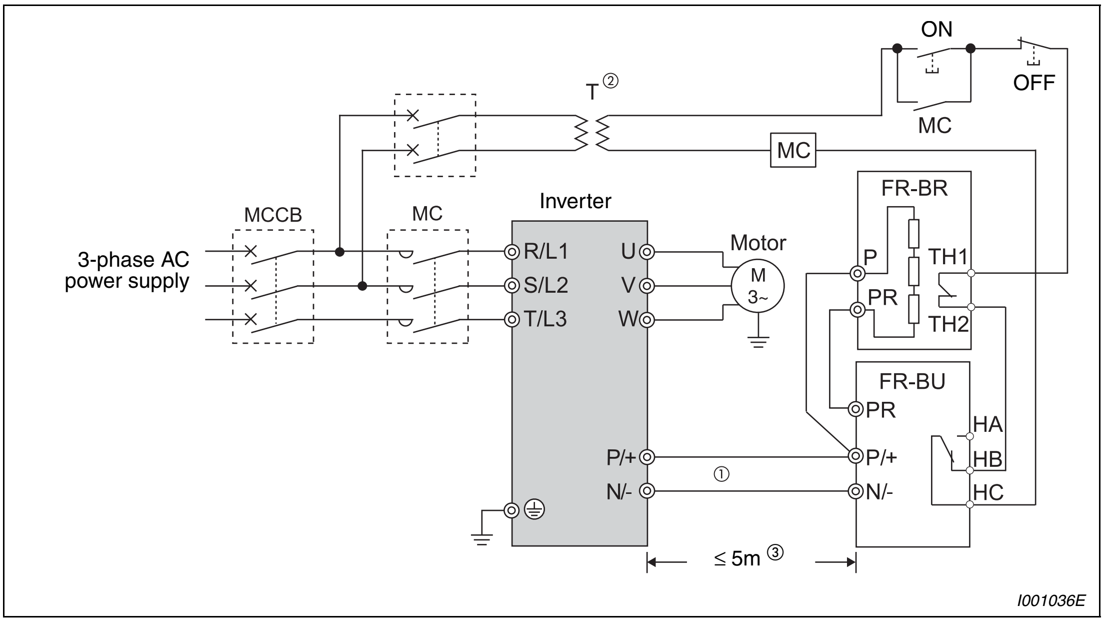


Fig. 3-26: *Connection with the brake unit FR-BU*

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

② If the control contacts are only specified for 230V control power you must install a transformer when using a 400V power supply.

③ The wiring distance between the inverter, brake unit and resistor unit 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 inverters input side to configure a circuit so that a current is shut off in case of fault.

Connection with the brake unit MT-BU5 (01800 or more)

After making sure that the wiring is correct, set "1" in Pr. 30 "Regenerative function selection". (Refer to section 6.8.2)

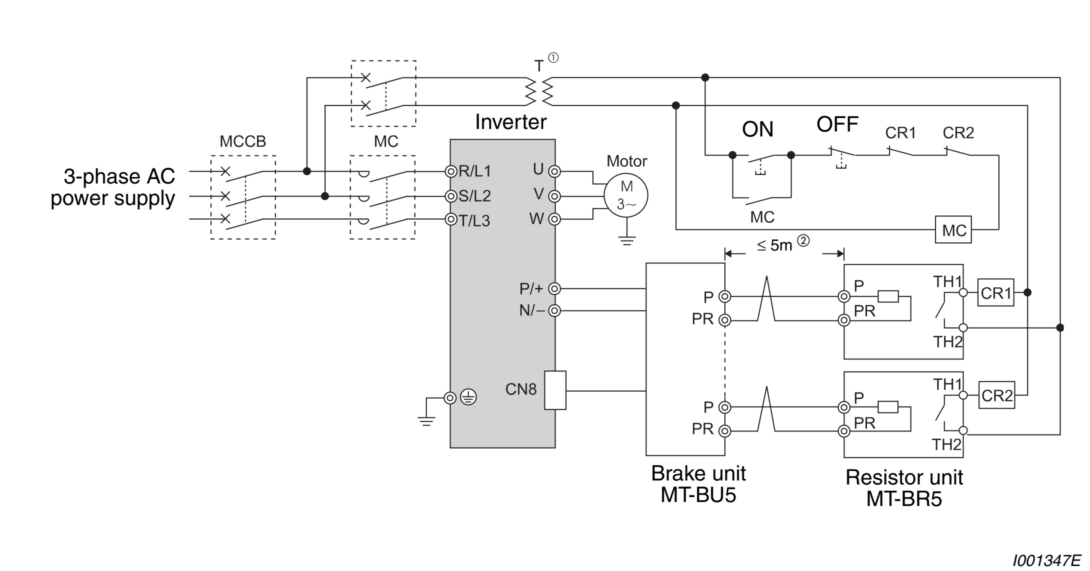


Fig. 3-27: *Connection with the brake unit MT-BU5*

① If the control contacts are only specified for 230V control power you must install a transformer when using a 400V power supply.

② The wiring distance between the inverter, brake unit and resistor unit should be within 5m. If twisted wires are used, the distance should be within 10m.

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

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

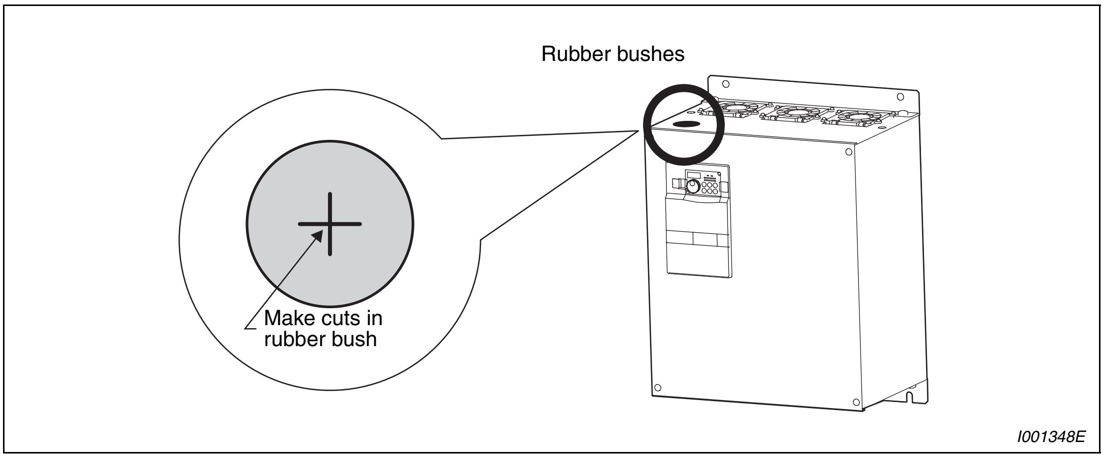


Fig. 3-28: *Rubber bush*

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

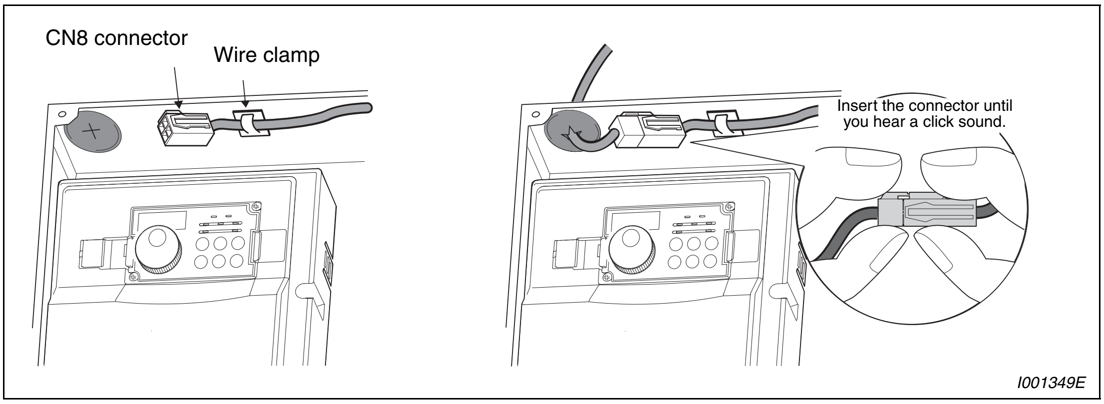


Fig. 3-29: *Connection of the CN8 connector*

③ Clamp the CN8 connector cable on the inverter side with a wire clamp securely.

3.7.3 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.

CAUTION:
Perform wiring of the high power factor converter (FR-HC) 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 section 6.8.2.)

Connection with the FR-HC (01160 or less)

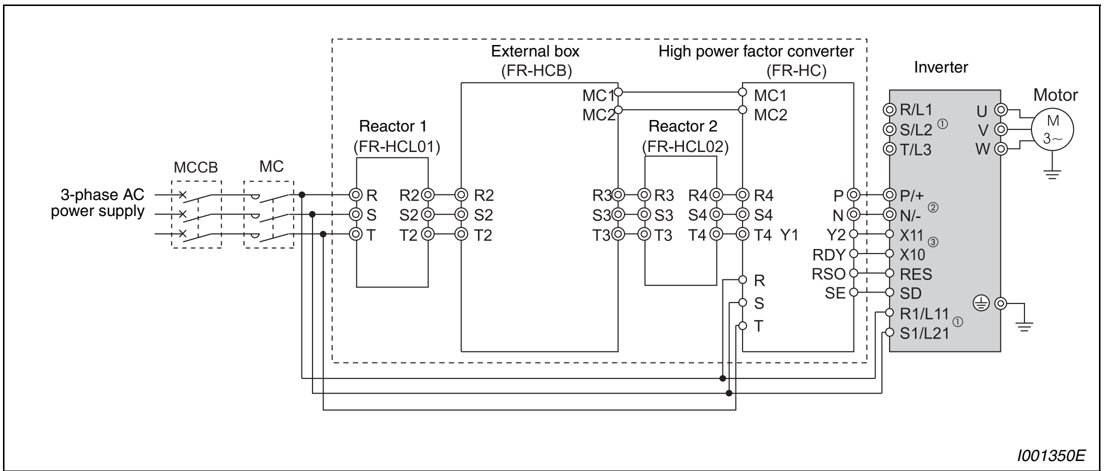


Fig. 3-30: *Connection of the high power factor converter FR-HC*

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 7-14.)
Opposite polarity of terminals N/–, P/+ will damage the inverter.

② Do not insert the MCCB between terminals P/+-N/– (P/+-P/+, N/–-N/–).

③ Use Pr. 178 to Pr. 189 "input terminal function selection" to assign the terminals used for the X10 (X11) signal. (Refer to section 6.9.1.)
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 section 6.8.2.)

NOTES

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 (factory setting) is selected.

Connection with the MT-HC (01800 or more)

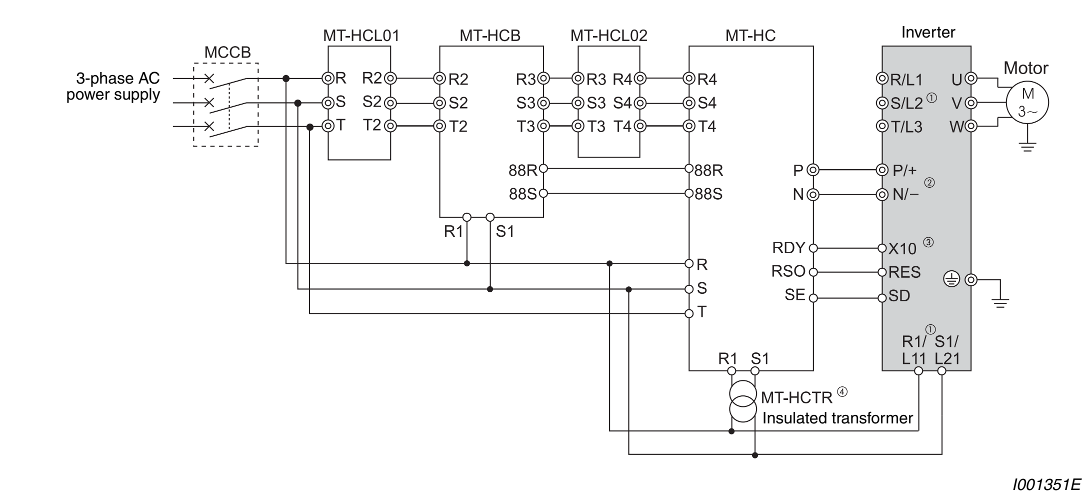


Fig. 3-31: *Connection with the MT-HC*

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 7-14.)

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 section 6.9.1.)
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 section 6.8.2.)

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

NOTES

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.

3.7.4 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 section 6.8.2).

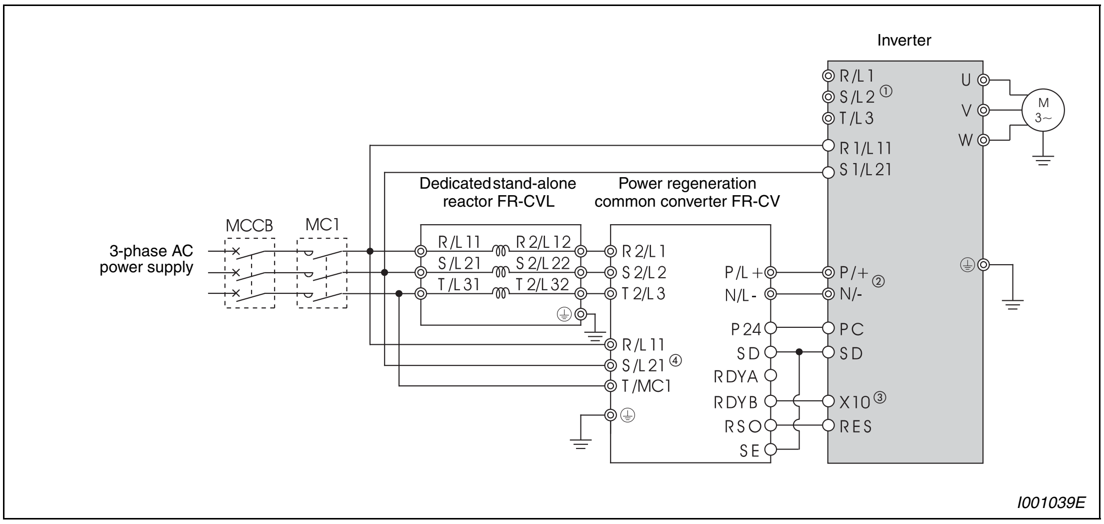


Fig. 3-32: *Connection of the power regeneration common converter FR-CV*

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 7-14.)
Opposite polarity of terminals N/–, P/+ will damage the inverter.

② Do not insert the MCCB between terminals P/+-N/– (P/L+-P/+, N/L–-N/–).

③ Assign the terminal for X10 signal using any of Pr. 178 to Pr. 189 "input terminal function selection". (Refer to section 6.9.1.)

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.

NOTES

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 (factory setting) is selected.

3.7.5 Connection of power regeneration converter (MT-RC) (01800 or more)

When connecting a power regeneration converter (MT-RC), perform wiring securely as shown below.

CAUTION:
Perform wiring of the power regeneration converter (MT-RC) securely as shown below. Incorrect connection will damage the power regeneration converter and inverter.

After connecting securely, set "1" in Pr. 30 "Regenerative function selection" and "0" in Pr. 70 "Special regenerative brake duty".

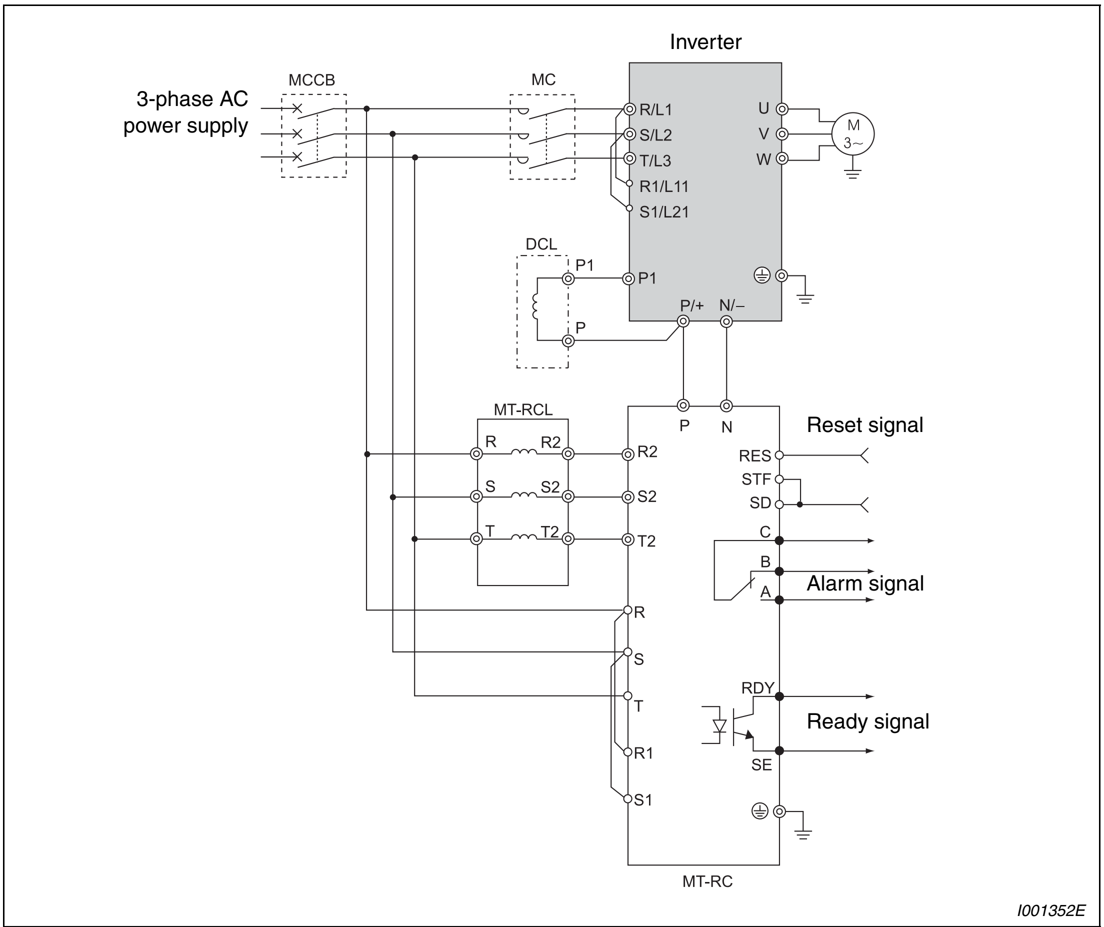


Fig. 3-33: *Connection of the power regeneration converter MT-RC*

NOTE

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

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

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

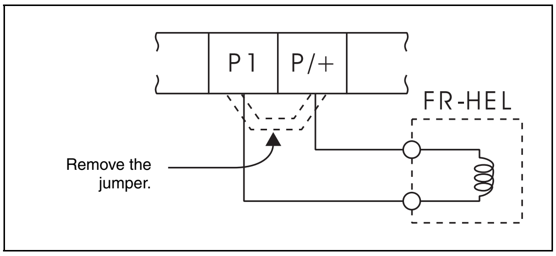


Fig. 3-34: *Connection of a DC reactor*

NOTES

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).

For inverters ≥ 01800 the supplied DC reactor has to be installed to the mentioned terminals.

3.7.7 Installation of a reactor

When the inverter is connected near a large-capacity power transformer (1000kVA or more and wiring length 10m max.) or when a power capacitor is to be switched over, an excessive peak current may flow in the power input circuit, damaging the converter circuit. To prevent this, always install the optional DC reactor (FR-HEL) or AC reactor (FR-HAL).

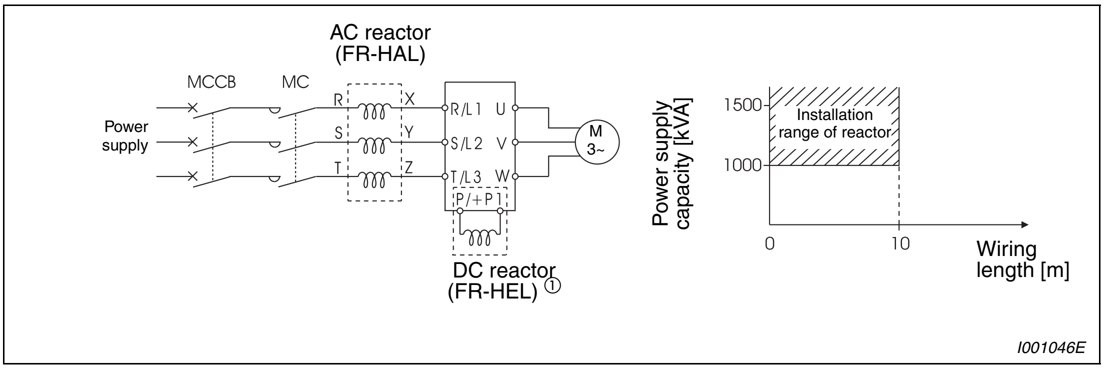


Fig. 3-35: *Installation of a reactor*

① 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.

NOTES

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 3-11).

3.8 Electromagnetic compatibility (EMC)

3.8.1 Leakage currents and countermeasures

Mains filters, shielded motor cables, the motor, and the inverter itself cause stationary and variable leakage currents to PE. 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.

To-earth (ground) leakage currents

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

- Countermeasures
  - 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.
  - Increasing the motor capacity increases the leakage current.
  - Shielded motor cables significantly increase the leakage current to PE (approx. double the value generated with unshielded motor cables of the same length).

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 (FR-F700-00170 or less), the external thermal relay is likely to operate unnecessarily because the ratio of the leakage current to the rated motor current increases.

Example ▽

Line-to-line leakage current data example
Dedicated motor: SF-JR 4P
Carrier frequency: 14.5kHz
Used wire: 2.5mm², 4 cores, cab tyre cable

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

Tab. 3-11: *Line-to-line leakage current data example*

△

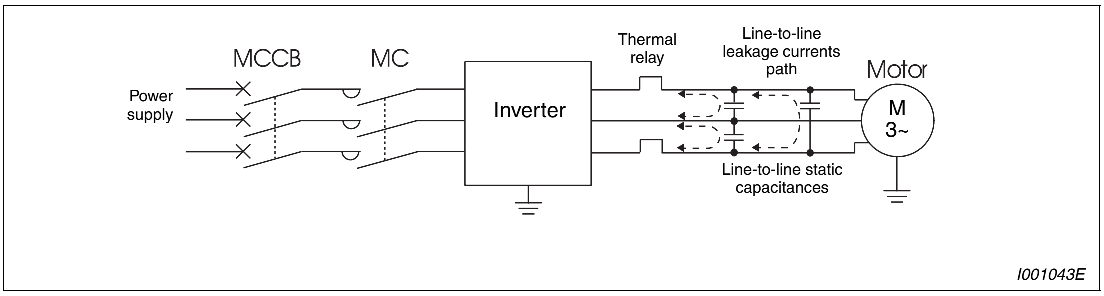


Fig. 3-36: *Line-to-line leakage currents*

- 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 (e.g. PTC element) to directly detect motor temperature.
- Selecting a power supply circuit breaker:
  You can also use a circuit breaker (MCCB) to protect the power supply lines against short circuits and overloads. However, note that this does not protect the inverter (rectifiers, IGBT). Select the capacity of the circuit breaker on the basis of the cross-sectional area of the power supply lines. To calculate the required mains current trip point you need to know the power required by the inverter (Refer to Rated Input Capacity in Appendix A, Specifications) and the mains supply voltage. Select a circuit breaker with a trip point that is slightly higher than calculated, particularly in the case of breakers with electromagnetic tripping, since the trip characteristics are strongly influenced by the harmonics in the power supply line.
  The earth leakage breaker must be either a Mitsubishi earth leakage breaker (ELB, for harmonics and surges) or an ELB with breaker designed for harmonic and surge suppression that is approved for use with frequency inverters.

Note on selecting a suitable power supply ELCB

If your application requires by installation standards an RCD (residual current device) as up stream protection please select according to DIN VDE 0100-530 as following:
Single phase inverter type A or B
Three phase inverter only type B

Additionally, when selecting a residual current device (RCD), leakage current caused by the mains filter, the length of the shielded motor cable and the carrier frequency must be taken into consideration.

When connecting AC current using switches without a step function, brief asymmetrical loads may result in unwanted triggering of the residual current device (RCD). It is recommendable here to use a Type B residual current device (RCD) with delayed actuation or to switch on all three phases simultaneously using a main contactor.

Calculate the trip current sensitivity of the ELB as follows:

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

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

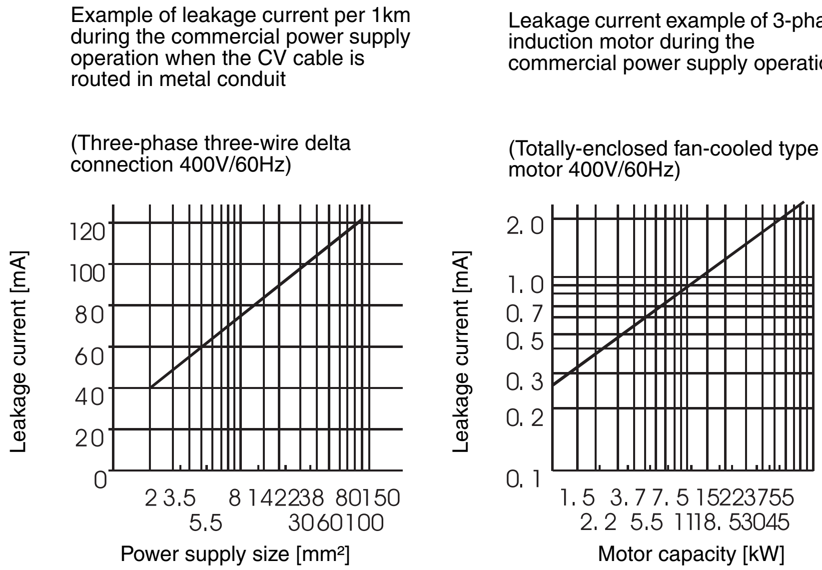
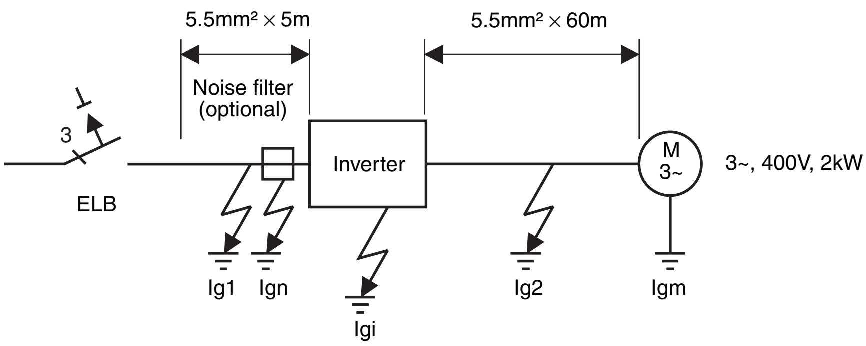


Fig. 3-37: *Leakage currents*

NOTE For star connection, the amount of leakage current is 1/3.

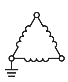
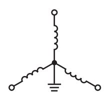
Example ▽



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

Tab. 3-12: *Estimation of the permanent flowing leakage current*

① Refer to section 3.8.3 for the presence/absence of the built-in EMC filter.
Inverter leakage current (with and without EMC filter)
Input power conditions (400V class: 440V/60Hz, power supply unbalance within 3%)

	Voltage [V]	Built-in EMC Filter	
		ON [mA]	OFF [mA]
Phase grounding 	400	30	1
Earth-neutral system 	400	1	1

Tab. 3-13: *Inverter leakage current (with and without built-in EMC filter)*

△

NOTES

The frequency inverter monitors its own output for ground faults up to a frequency of 120Hz. However, it is important to understand that this feature only protects the inverter itself. It cannot be used to provide protection against shock hazards for personnel.

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. (JIS, NEC section 250, IEC 536 class 1 and other applicable standards)

When the breaker is installed on the output side of the inverter, it may be unnecessarily operated by harmonics even if the effective value is less than the rating. In this case, do not install the breaker since the eddy current and hysteresis loss will increase, leading to temperature rise.

The following models are standard breakers: BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA and NV-2F earth leakage relay (except NV-ZHA), NV with AA neutral wire open-phase protection.
The other models are designed for harmonic and surge suppression: NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, earth leakage alarm breaker (NF-Z), NV-ZHA, NV-H.

3.8.2 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.

- 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. Earth the shield.
  - Earth the inverter, motor, etc. at one point.
- 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.
- 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.

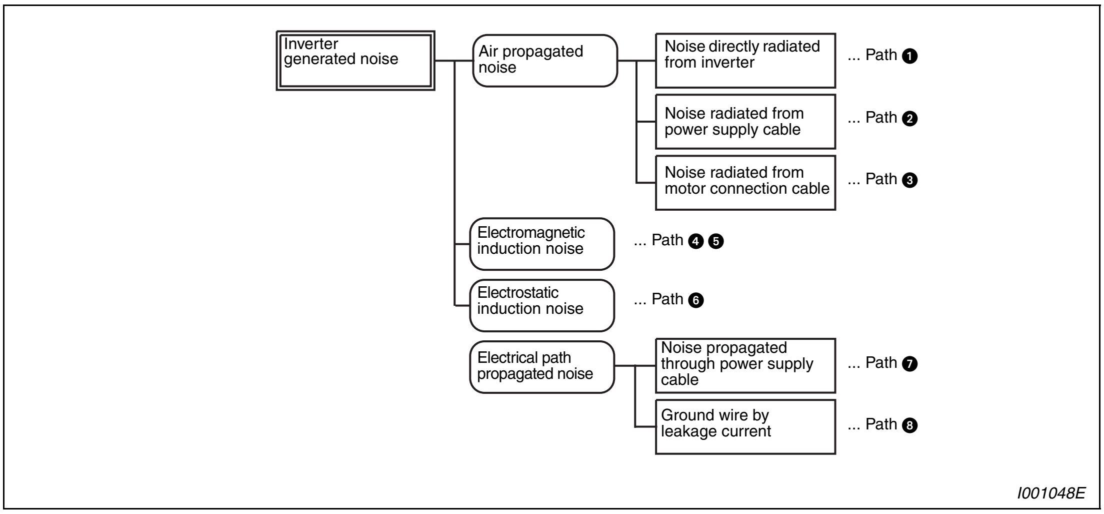


Fig. 3-38: *Noise propagation*

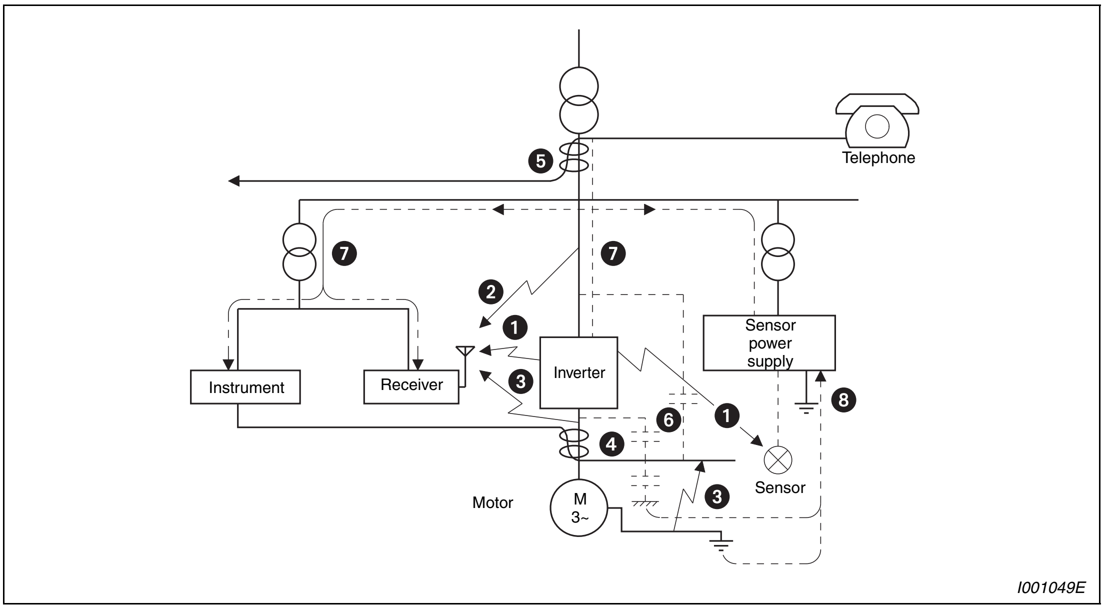


Fig. 3-39: *Noise paths*

Noise Propagation Path	Measures
❶❷❸	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: ● Install easily affected devices as far away as possible from the inverter. ● Run easily affected signal cables as far away as possible from the inverter and its I/O cables. ● Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. ● Use the inverter with the ON/OFF connector of the EMC filter set to ON. (Refer to section 3.8.3.) ● Inserting a filter (dU/dt, sine wave filter) into the output suppresses the radiation noise from the cables. ● Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
❹❺❻	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: ● Install easily affected devices as far away as possible from the inverter. ● Run easily affected signal cables as far away as possible from the I/O cables of the inverter. ● Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. ● Use shield cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
❼	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: ● Use the inverter with the ON/OFF connector of the EMC filter set to ON. (Refer to section 3.8.3.) ● Use additional (optional) noise filters as required. ● Install output filters to the power cables of the inverter after you consulted MITSUBISHI.
❽	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.

Tab. 3-14: *Noise and Countermeasures*

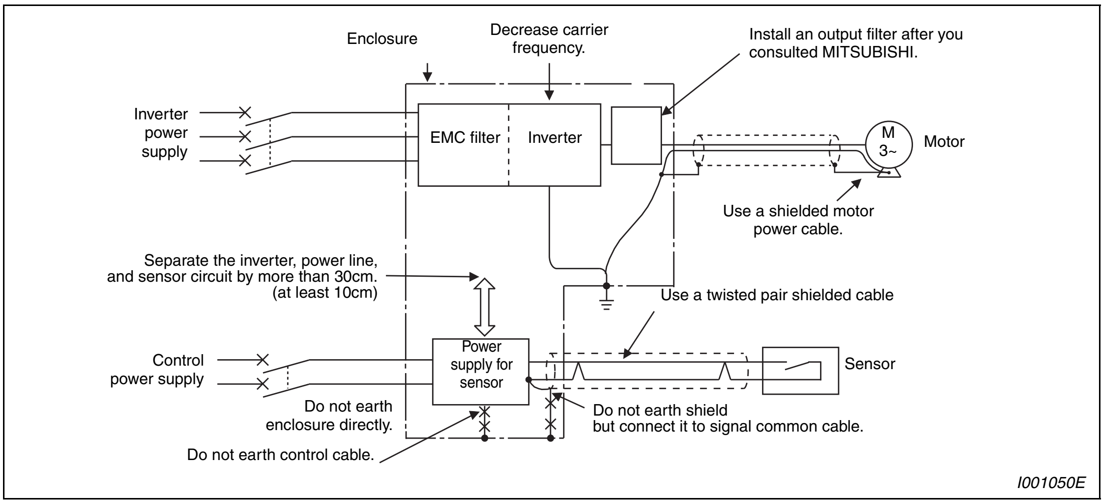


Fig. 3-40: *Noise reduction examples*

3.8.3 EMC filter

The inverter is equipped with a built-in EMC filter. 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 filter must be deactivated when the inverter is used in networks with an isolated neutral (IT networks).

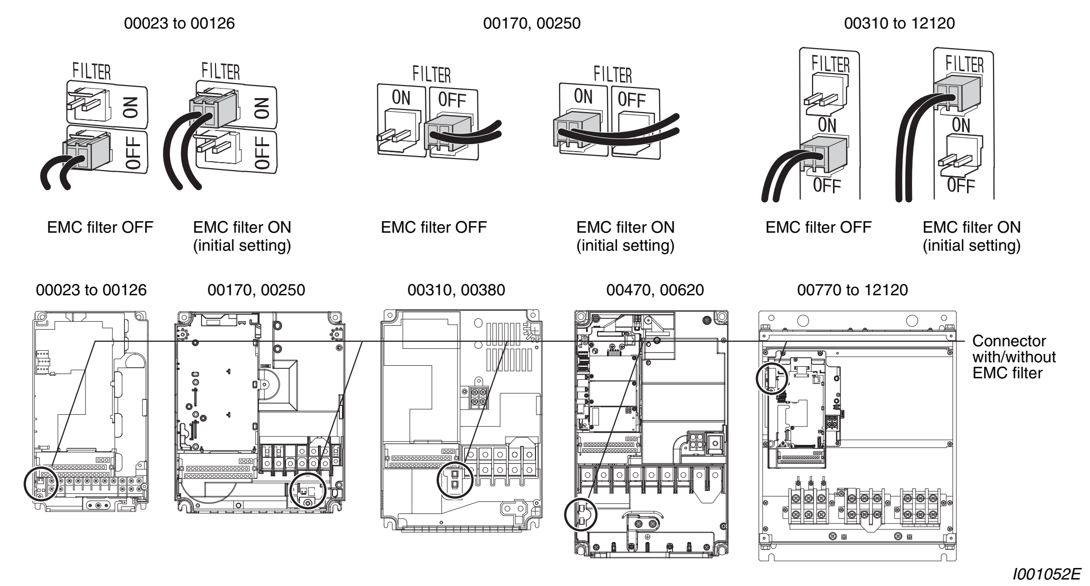


Fig. 3-41: *Built-in EMC filter*

How to disconnect the connector

① After confirming that the power supply is off, remove the front cover. (For the front cover removal method, refer to section 2.2).

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.

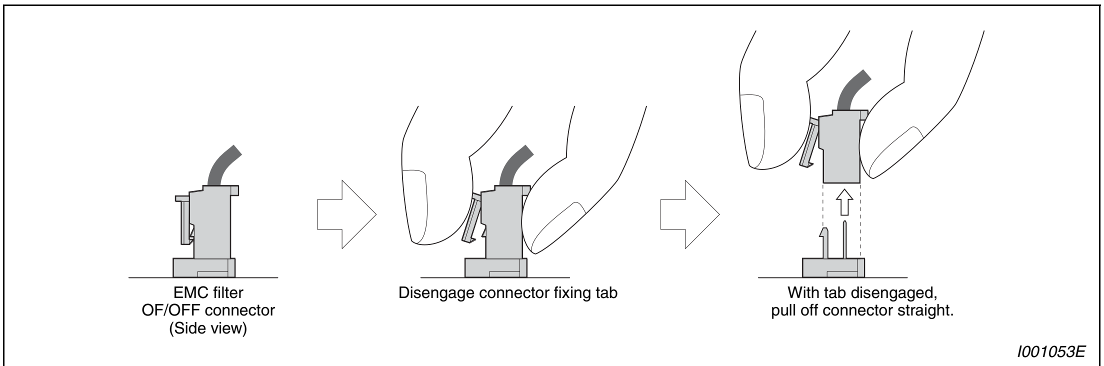


Fig. 3-42: *Activating the built-in EMC filter*

NOTE 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.

3.8.4 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.

Item	Harmonics	Noise
Frequency	Maximum 50 (≤ 3kHz)	Several 10kHz to 1GHz
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

Tab. 3-15: *Differences between harmonics and noises*

- 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.

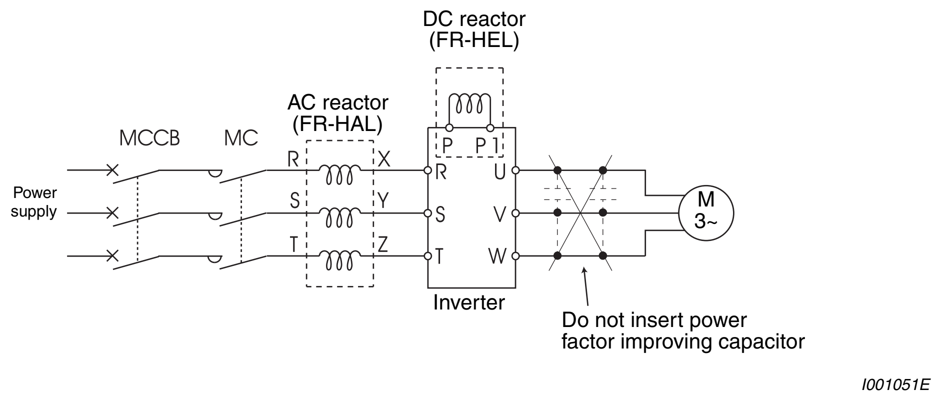


Fig. 3-43: *Reduction of power supply harmonics*

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 over current 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.

3.8.5 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:

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

	Wiring length		
	≤ 50m	**50m to 100m**	**≥ 100m**
Parameter 72	≤ 15 (14.5kHz)	≤ 9 (9kHz)	≤ 4 (4kHz)

Tab. 3-16: *Setting of Pr. 72 according to the wiring length*

- Limiting the voltage rise speed of the frequency inverter output voltage (dU/dT):
  If the motor requires a rise speed of 500V/µs or less you must install a filter in the output of the inverter. Please contact your Mitsubishi dealer for more details.

NOTE For details of Pr. 72 "PWM frequency selection", refer to section 6.14.

4 Operation

4.1 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.

- Use crimping terminals with insulation sleeve to wire the power supply and motor.
- Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.
- 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 a control box etc., take care not to allow chips and other foreign matter to enter the inverter.
- 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 3-11 for the recommended cable sizes.)
- The overall wiring length should be 500m maximum.
  Especially for long distance wiring, the fast-response current limit function may be reduced or the equipment connected to the inverter output side may malfunction or become faulty under the influence of a charging current due to the stray capacity of the wiring. Therefore, note the overall wiring length. (Refer to page 3-14.)
- Electromagnetic Compatibility
  Operation of the frequency inverter can cause electromagnetic interference in the input and output that can be propagated by cable (via the power input lines), by wireless radiation to nearby equipment (e.g. AM radios) or via data and signal lines.
  Activate the integrated EMC filter (and an additional optional filter if present) to reduce air propagated interference on the input side of the inverter. Use AC or DC reactors to reduce line propagated noise (harmonics). Use shielded motor power lines to reduce output noise (refer also to section 3.8 Electromagnetic Compatibility).
- 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.
- 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.

- 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.
- 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.
- 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 (10, respectively) -5.
- Provide electrical and mechanical interlocks for MC1 and MC2 which are used for commercial power supply-inverter switch-over.
  When the wiring is incorrect or if there is a commercial power supply-inverter switch-over circuit as shown below, 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.

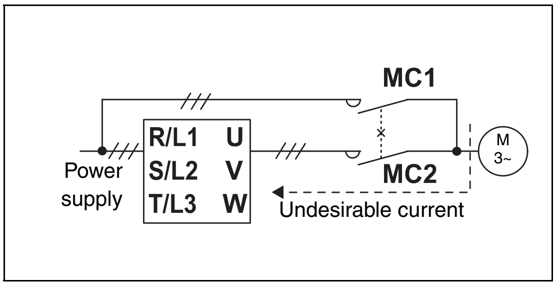


Fig. 4-1:
Mechanical interlocks for MC1 and MC2

I001042E

- 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.
- Instructions for overload operation
  When performing operation 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.
- Make sure that the specifications and rating match the system requirements.

4.2 Drive the motor

The inverter needs frequency command and start command. Refer to the flow chart below to perform setting.

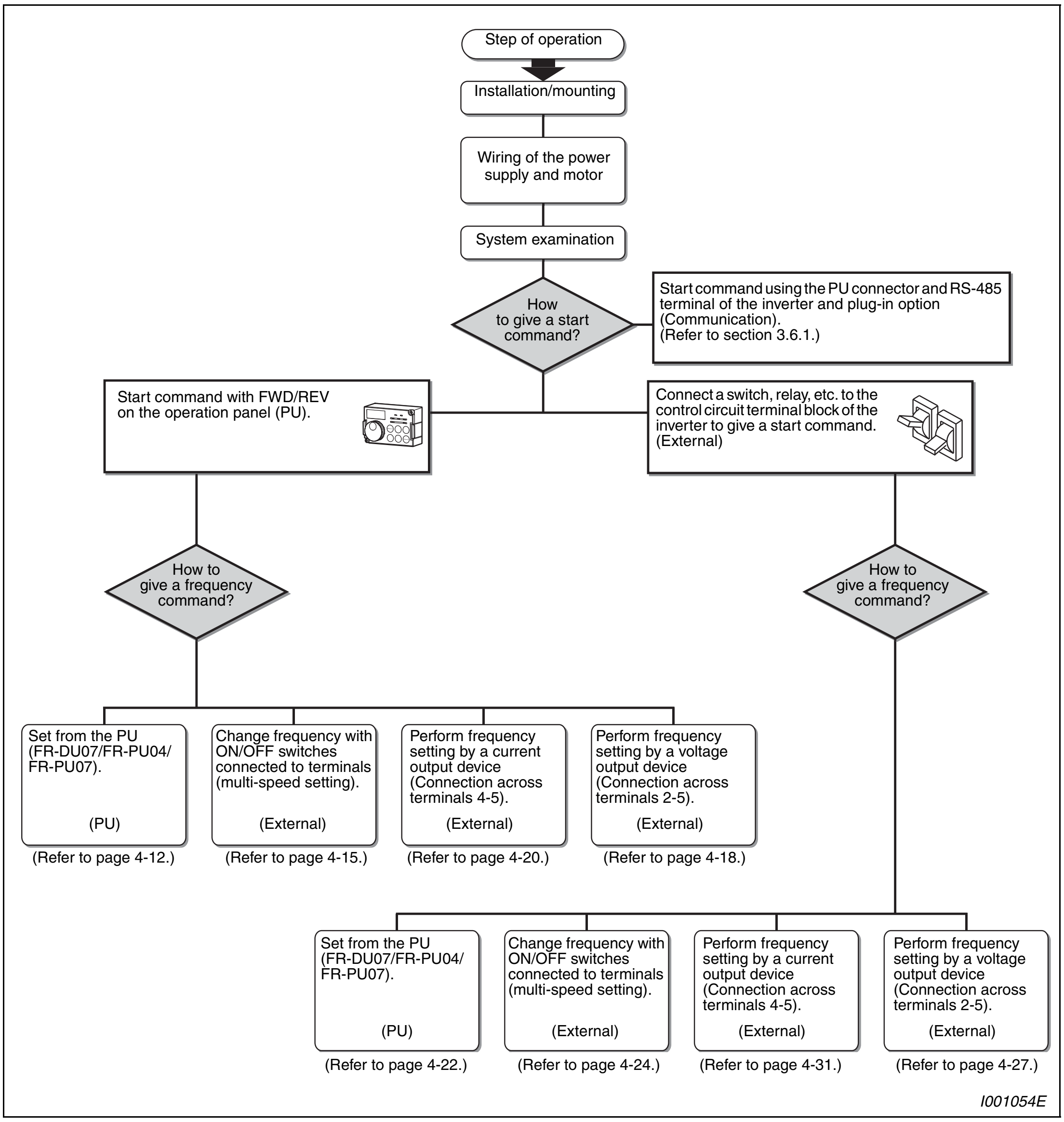


Fig. 4-2: *Steps of operation*

Check the following items before powering on the inverter:

- Check that the inverter is installed correctly in a correct place. (Refer to section 2.3.)
- Check that wiring is correct. (Refer to section 3.2.)
- Check that no load is connected to the motor.

NOTES

When protecting the motor from overheat by the inverter, set Pr. 9 "Electronic thermal O/L relay". (Refer to section 4.4.)

When the rated frequency of the motor is 60Hz, set Pr. 3 "Base frequency" (Refer to section 5.4.)

4.3 Operation panel FR-DU07

4.3.1 Parts of the operation panel

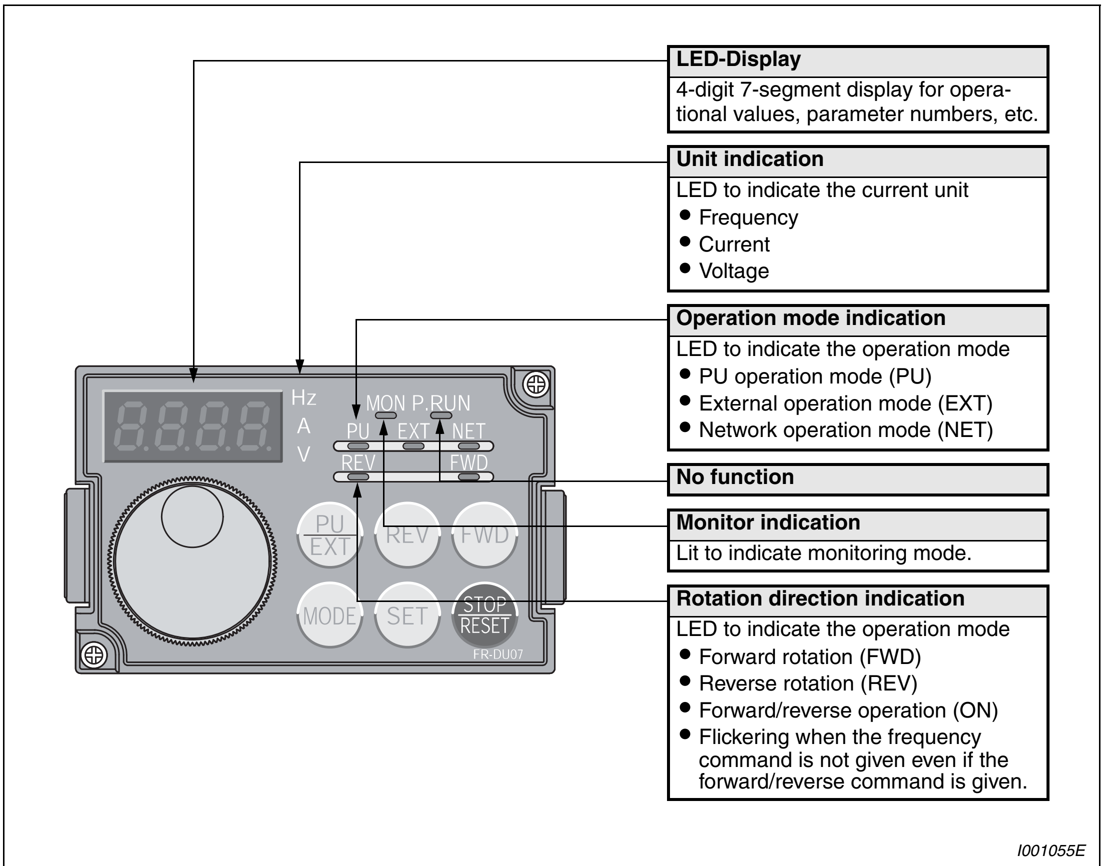
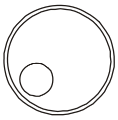


Fig. 4-3: *Parts of the operation panel FR-DU07*

Key	Function	Description
	Digital dial	Used to change the frequency setting and parameter values. Push the setting dial to display the set frequency currently set.
FWD	Rotation direction	Run command forward rotation
REV	Rotation direction	Run command reverse rotation
STOP RESET	Stop operation	Alarms can be reset. (Malfunctions of the inverter can be acknowledged.)
SET	Write settings	If pressed during operation, monitor changes as below: Running frequency → Output current → Output voltage ① ① Energy saving monitor is displayed when the energy saving monitor of Pr. 52 is set.
MODE	Mode switchover	Use to change the 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

Tab. 4-1: *Keys of the operation panel*

4.3.2 Basic operation (factory setting)

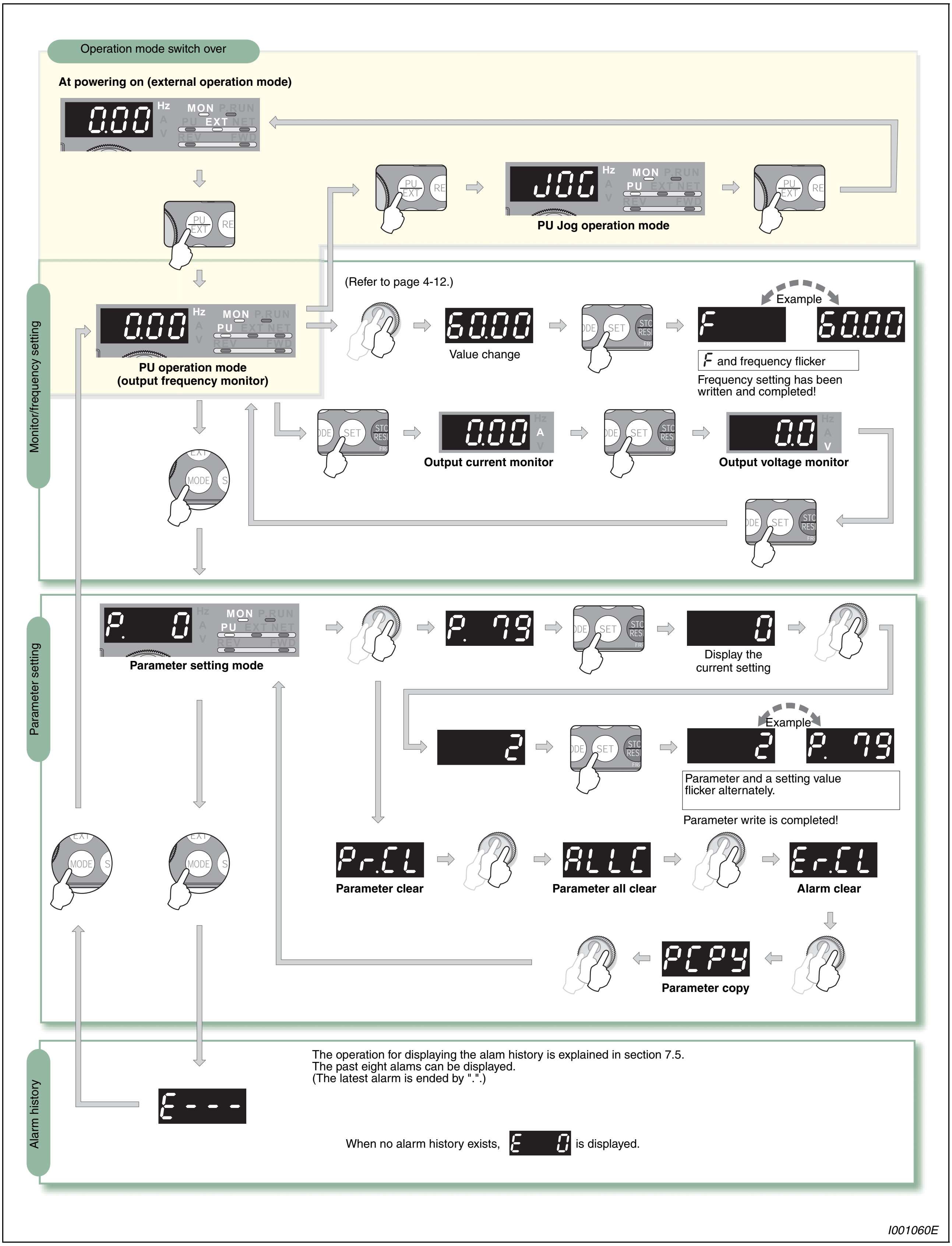


Fig. 4-4: Overview of the basic functions of the operation panel FR-DU07

4.3.3 Operation lock

Operation using the digital dial and key of the operation panel can be made invalid to prevent parameter change and unexpected start and stop.

Operation procedure:

① Set "10" or "11" in Pr. 161, then press the MODE key for 2s to make the digital dial key operation invalid.

② When the digital dial and key operation is made invalid, "HOLD" appears on the operation panel.

③ When the digital dial and key operation is invalid, "HOLD" appears if the digital dial or key operation is performed. (When the digital dial or key operation is not performed for 2s, the monitor display appears.)

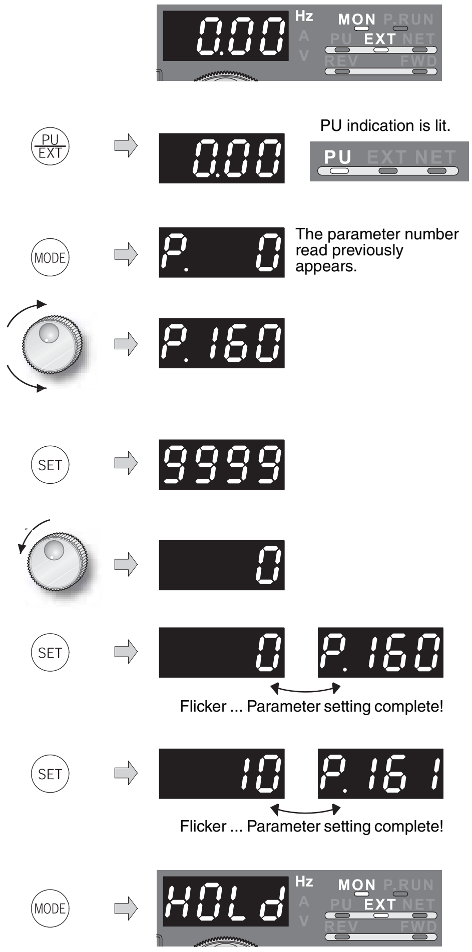
④ To make the digital dial and key operation valid again, press the MODE key for 2s.

NOTES

Set "0" (extended mode parameter valid) in Pr. 160 "User group read selection".

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

Operation	Display
① Screen at powering on The monitor display appears.	
② Press the PU/EXT key to choose the PU operation mode.	PU indication is lit.
③ Press the MODE key to choose the parameter setting mode.	The parameter number read previously appears.
④ Turn the digital dial until P.160 (Pr. 160) appears.	
⑤ Press the SET key to show the currently set value. The initial value "9999" appears.	
⑥ Turn the digital dial counter clockwise to change it to the setting value of "0".	
⑦ Press the SET key to set.	Flicker ... Parameter setting complete!
⑧ Change Pr. 161 to the setting value of "10" in the similar manner (Refer to step ④ to ⑦.)	Flicker ... Parameter setting complete!
⑨ Press the MODE key for 2s to show the key lock mode.	



I001061E

Fig. 4-5: *Operation lock*

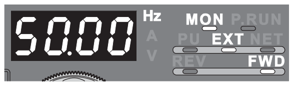
NOTE The STOP/RESET key is valid even in the operation lock status.

4.3.4 Monitoring of output current and output voltage

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

Operation | **Display**

① Press the MODE key during operation to choose the output frequency monitor.
(Hz indication is lit.)



② Independently of whether the inverter is running in any operation mode or at a stop, the output current monitor appears by pressing the SET key.
(A indication is lit.)

③ Press the SET key to show the output voltage monitor.
(V indication is lit.)

I001066E

Fig. 4-6: *Monitoring of output current and output voltage*

4.3.5 First priority monitor

Hold down the SET key for 1s to set monitor description to be appeared first in the monitor mode. (To return to the output frequency monitor, hold down the SET key for 1s after displaying the output frequency monitor.)

4.3.6 Digital dial push

Push the digital dial to display the set frequency currently set.

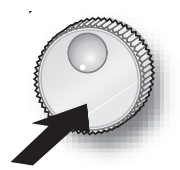


Fig. 4-7:
Display the set frequency currently set

I001067E

4.4 Overheat protection of the motor by the inverter

Set this parameter when using a motor other than the Mitsubishi standard motor (SF-JR) and Mitsubishi constant torque motor (SF-HRCA). Set the rated motor current in Pr. 9 "Electronic thermal O/L relay" to protect the motor from overheat.

Pr. No.	Name	Initial Value	Setting Range ②		Description
9	Electronic thermal O/L relay	Rated inverter output current ①	01160 or less	0–500A	Set the rated motor current.
			01800 or more	0–3600A	

① Refer to appendix A for the rated inverter current value.

② The minimum setting increments are 0.01A for the 01160 or less and 0.1A for the 01800 or more.

Example ▽ Change the Pr. 9 "Electronic thermal O/L relay" setting to 2.5A according to the motor rated current.

Operation / **Display**

① Screen at powering on
The monitor display appears.

② Press the PU/EXT key to choose the PU operation mode.

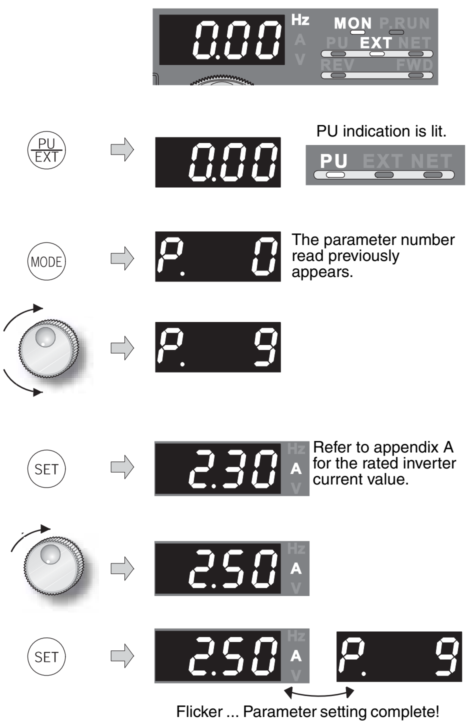
③ Press the MODE key to choose the parameter setting mode.

④ Turn the digital dial until P.9 (Pr. 9) appears.

⑤ Press the SET key to show the currently set value.
The setting 2.3A for 00023 appears.

⑥ Turn the digital dial clockwise to change the set value to "2.5" (2.5A).

⑦ Press the SET key to set.



- By turning the digital dial, you can read another parameter.
- Press the SET key to show the setting again.
- Press the SET key twice to show the next parameter.

I001068E

Fig. 4-8: *Setting of the electronic thermal O/L relay*

△

NOTES

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

When two or more motors are connected to the inverter, they cannot be protected by the electronic thermal relay function. Install an external thermal relay to each motor.

When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic over current protection will be deteriorated. In this case, use an external thermal relay.

A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.

PTC thermistor output built-in the motor can be input to the PTC signal (AU terminal). (For details refer to section 3.3.)

4.5 PU operation mode

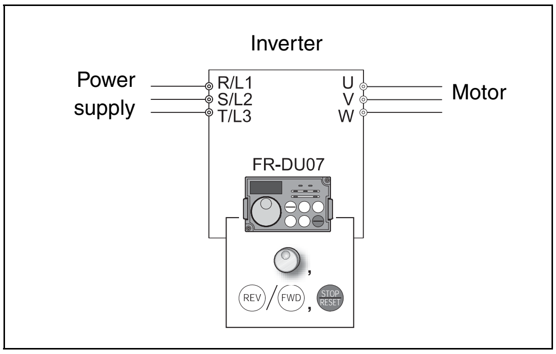


Fig. 4-9:
PU operation mode

I001069E

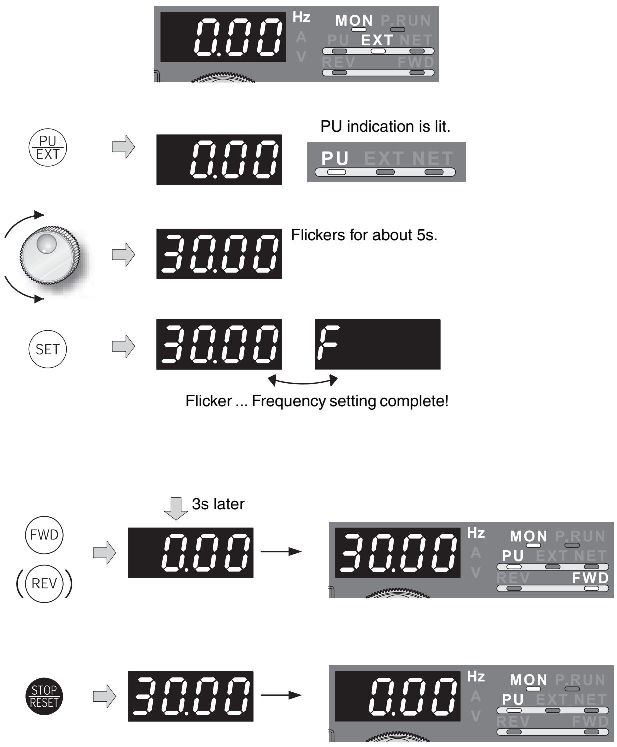
From where is the frequency command given?

- Operation at the frequency set in the frequency setting mode of the operation panel. (Refer to section 4.5.1.)
- Operation using the digital dial as the volume. (Refer to section 4.5.2.)
- Change of frequency with ON/OFF switches connected to terminals. (Refer to section 4.5.3.)
- Frequency setting with a voltage output device. (Refer to section 4.5.4.)
- Frequency setting with a current output device. (Refer to section 4.5.5.)

4.5.1 Set the set frequency to operate

Example ▽ Performing operation at 30Hz

Operation	Display
① Screen at powering on The monitor display appears.	
② Press the PU/EXT key to choose the PU operation mode.	
③ Turn the digital dial to show the frequency you want to set. The frequency flickers for about 5s.	
④ While the value is flickering press the SET key to set the frequency. (If you do not press the SET key, the value flickers for about 5s and the display returns to 0.00 (display) Hz. At this time, return to step ③ and set the frequency again.)	
⑤ After the value flickered for about 3s, the display returns to 0.00 (monitor display). Press the FWD (or REV) key to start operation.	
⑥ To change the set frequency, perform the operation in above steps ③ and ④. (Starts from the previously set frequency.)	
⑦ Press the STOP/RESET key to stop.	



I001070E

Fig. 4-10: Frequency setting with the digital dial

Possible faults:

- Operation cannot be performed at the set frequency.
  - Did you press the SET key within 5s after turning the digital dial?
- The frequency does not change by turning the digital dial.
  - Check to see if the operation mode selected is the external operation mode. (Press the PU/EXT key to change to the PU operation mode.)
- Operation does not change to the PU operation mode.
  - Check that "0" (initial value) is set in Pr. 79 Operation mode selection.
  - Check that the start command is not on.

Change the acceleration time using Pr. 7 (refer to section 5.5) and the deceleration time using Pr. 8 (refer to section 5.5).
The maximum output frequency is set in Pr. 1. (Refer to section 5.3).

NOTES

Press the digital dial to show the set frequency.

The digital dial can also be used like a potentiometer to perform operation. (Refer to section 4.5.2.)

△

4.5.2 Use the digital dial like a potentiometer to perform operation

- Set "0" (extended mode parameter valid) in Pr. 160 "User group read selection".
- Set "1" (setting dial potentiometer mode) in Pr. 161 "Frequency setting/key lock operation selection".

Example ▽ Change the frequency from 0Hz to 50Hz during operation.

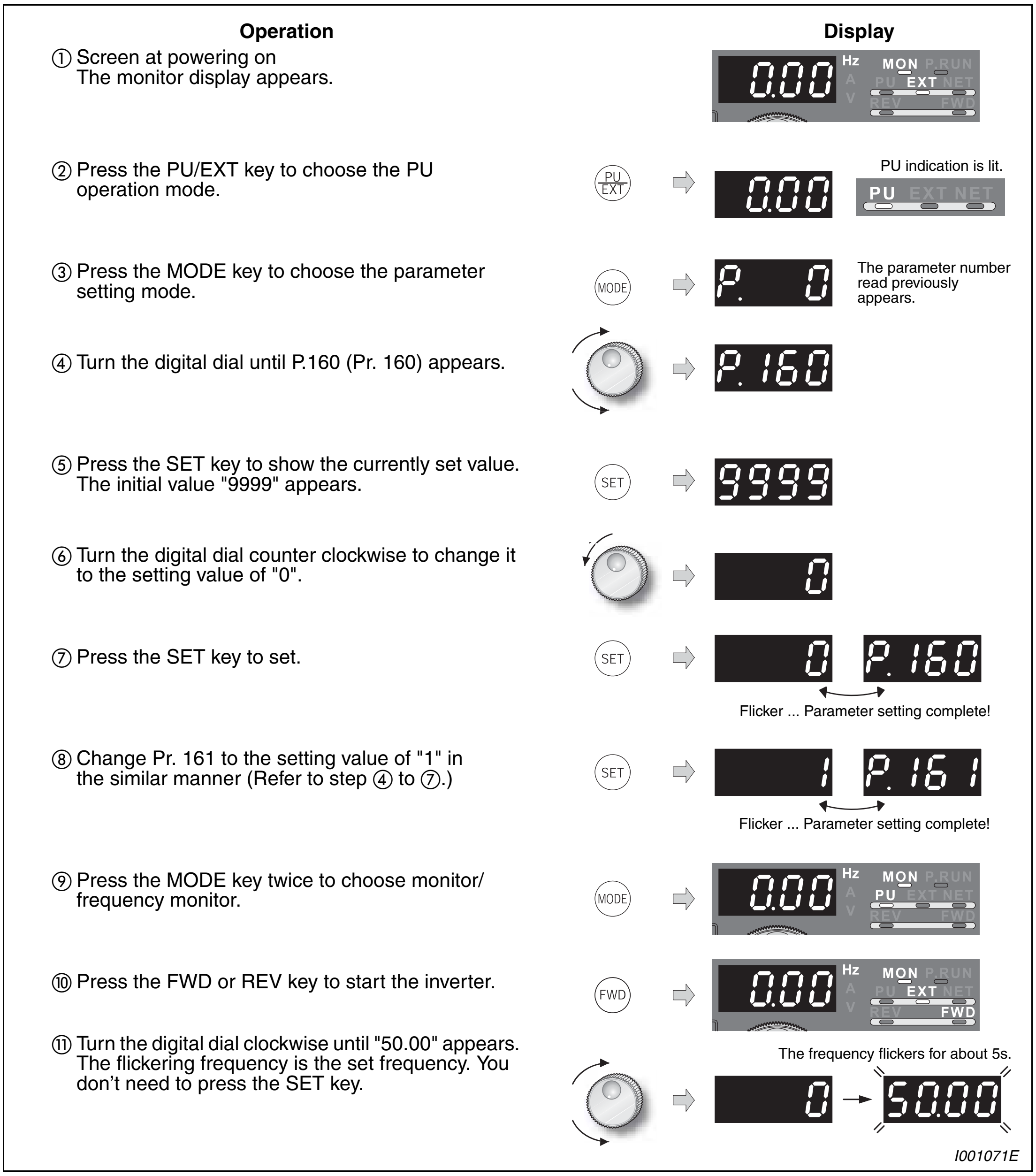


Fig. 4-11: Use the digital dial like a potentiometer to perform operation

NOTES

If flickering "50.00" turns to "0.0", the Pr. 161 "Frequency setting/key lock operation selection" setting may not be "1".

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

△

4.5.3 Use switches to give the frequency command (multi-speed setting)

- Pr. 79 "Operation mode selection" must be set to "4" (external/PU combined operation mode 2).
- Use the FWD or REV key to give a start command.
- The initial values of the terminals RH, RM, RL are 50Hz, 30Hz, and 10Hz. (Refer to section 4.6.2 to change frequencies using Pr. 4, Pr. 5 and Pr. 6.)
- Operation at 15-speed can be performed by turning on two (or three) terminals simultaneously.

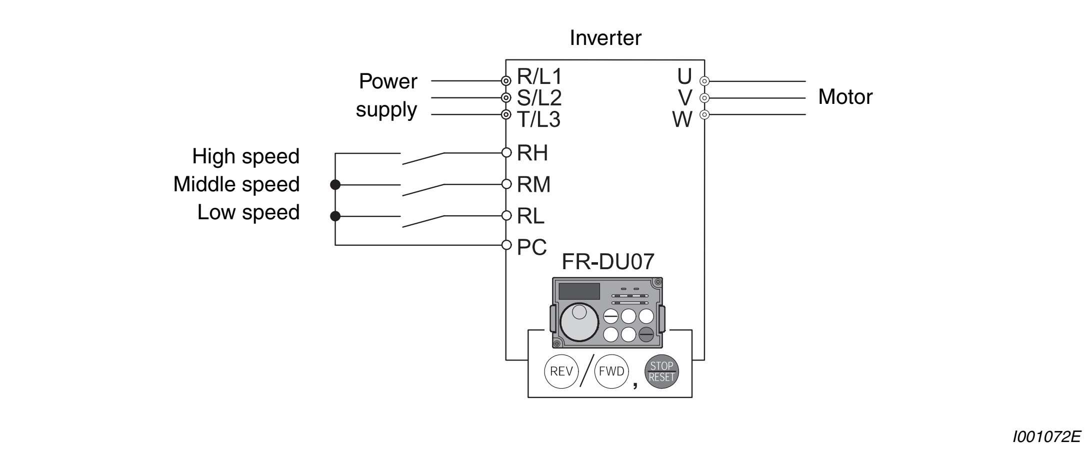


Fig. 4-12: *Use switches to give the frequency command*

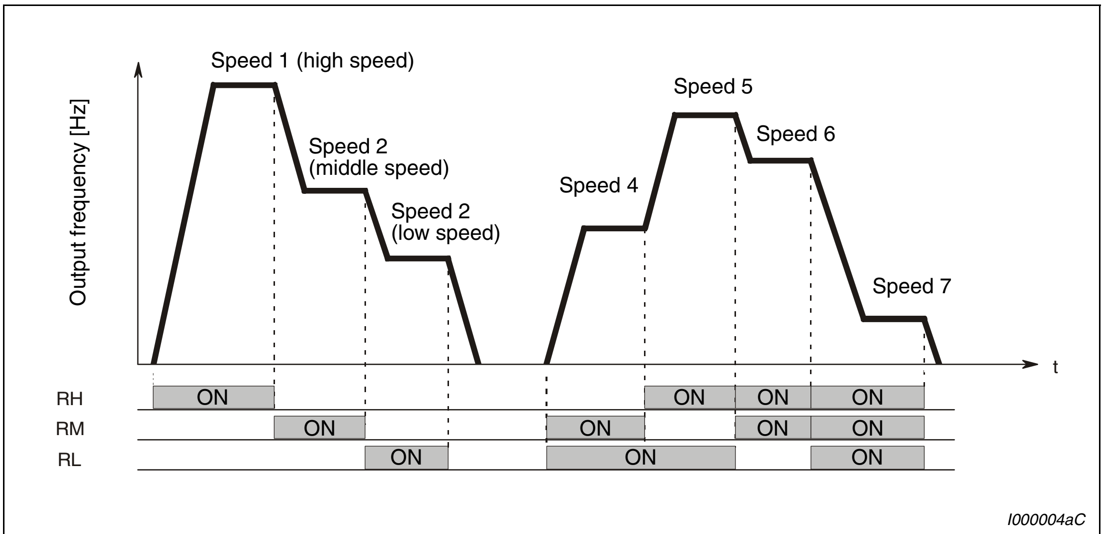
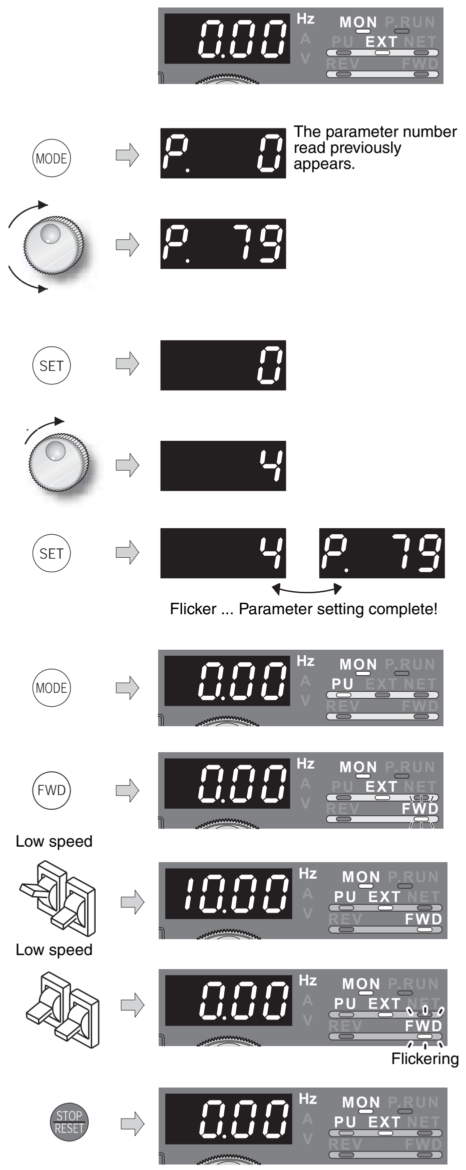


Fig. 4-13: *Multi-speed selection by external terminals*

Operation	Display
① Screen at powering on The monitor display appears.	
② Press the MODE key to choose the parameter setting mode.	
③ Turn the digital dial until P.79 (Pr. 79) appears.	
④ Press the SET key to show the currently set value. The initial value "0" appears.	
⑤ Turn the digital dial clockwise to change it to the setting value of "4".	
⑥ Press the SET key to set.	
⑦ Press the MODE key twice to choose monitor/ frequency monitor.	
⑧ Press the start switch FWD or REV to give the start command.	
⑨ Turn on the low speed switch (RL). The output frequency increases to 10Hz according to Pr. 7 "Acceleration time".	
⑩ Turn off the low speed switch (RL). The output frequency decreases to 0Hz according to Pr. 8 "Deceleration time".	
⑪ Turn off the start switch STOP/RESET.	



I001073E

Fig. 4-14: *Operate the inverter by using multi-speed setting*

Possible faults:

- 50Hz for the RH, 30Hz for the RL and 10Hz for the RL are not output when they are turned on.
  - Check for the setting of Pr. 4, Pr. 5, and Pr. 6 once again.
  - Check for the setting of Pr. 1 "Maximum frequency" and Pr. 2 "Minimum frequency" once again. (Refer to section 5.3.)
  - Check that Pr. 180 "RL terminal function selection" = "0", Pr. 181 "RM terminal function selection" = "2", Pr.182 "RH terminal function selection" and Pr. 59 "Remote function selection" = "0" (all are initial values).
- FWD (or REV) lamp is not lit.
  - Check that wiring is correct. Check the wiring once again.
  - Check for the Pr. 79 setting once again. (Pr. 79 must be set to "4".) (Refer to section 5.7.)

NOTE

Refer to section 4.6.2 to change the running frequency at each terminal in Pr. 4 "Multi-speed setting (highspeed)", Pr. 5 "Multi-speed setting (middle speed)", and Pr. 6 "Multi-speed setting (low speed)".

4.5.4 Perform frequency setting by analog voltage input

- Pr. 79 "Operation mode selection" must be set to "4" (external/PU combined operation mode 2).
- Use the FWD or REV key to give a start command.

The frequency setting potentiometer is supplied with 5V of power from the inverter (terminal 10).

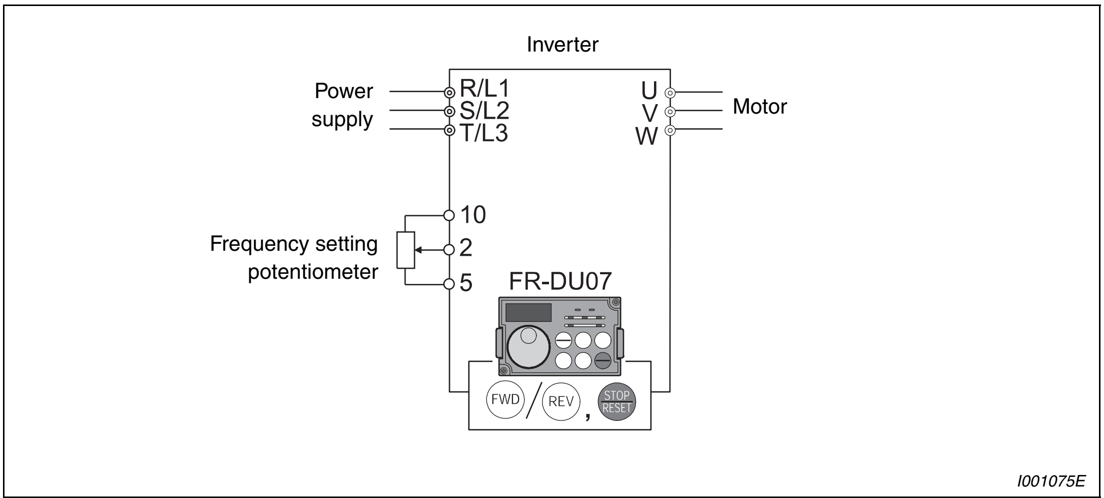


Fig. 4-15: *Frequency setting by analog voltage input*

Operation

① Screen at powering on
The monitor display appears.

② Press the MODE key to choose the parameter setting mode.

③ Turn the digital dial until P.79 (Pr. 79) appears.

④ Press the SET key to show the currently set value.
The initial value "0" appears.

⑤ Turn the digital dial clockwise to change it to the setting value of "4".

⑥ Press the SET key to set.

⑦ Press the MODE key twice to choose monitor/frequency monitor.

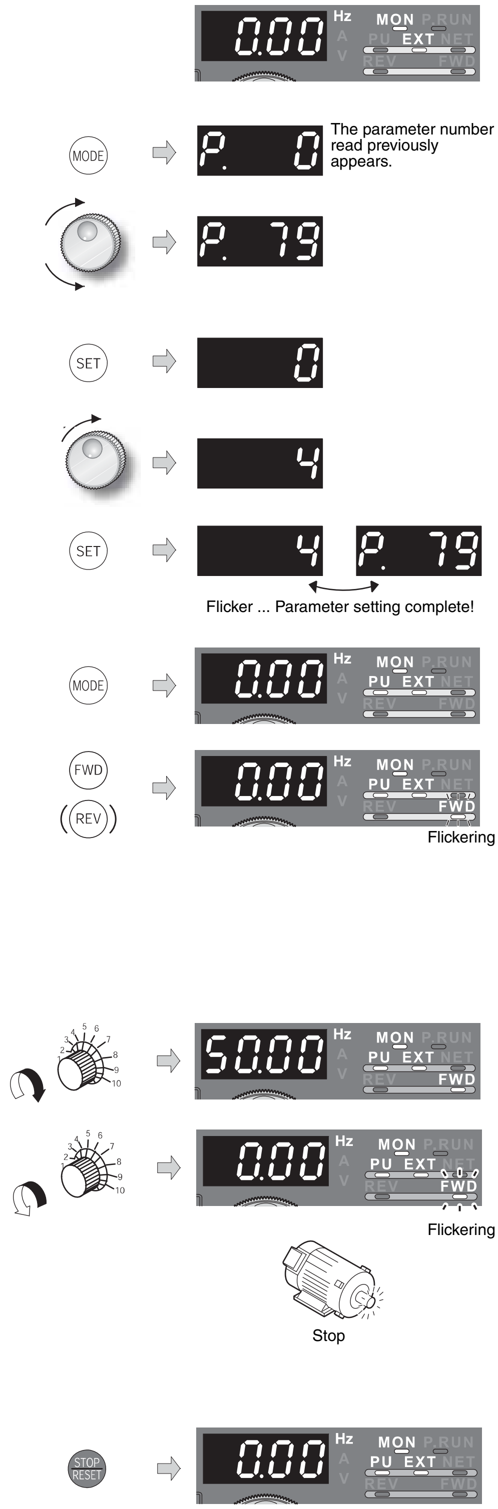
⑧ Press the start key FWD or REV. Operation status indication FWD or REV flickers.
CAUTION:
When both the forward and reverse key are pushed, the inverter will not start. Also, if both switches are pushed while running, the inverter stops.

⑨ Acceleration → constant speed
Turn the volume (frequency setting potentiometer) clockwise slowly to full. The frequency value on the indication increases according to Pr. 7 "Acceleration time" until 50Hz is displayed.

⑩ Deceleration
Turn the volume (frequency setting potentiometer) counter clockwise slowly to full. The frequency value on the indication decreases according to Pr. 8 "Deceleration time" until 0.00Hz is displayed and operation status indication of FWD or REV flickers.
The motor stops.

⑪ Press the STOP/RESET switch.
Operation status indication of FWD (or REV) turns off.

Display



I001076E

Fig. 4-16: *Operate the inverter by using the analog voltage input*

NOTES

Change the frequency (50Hz) of the maximum value of potentiometer (at 5V) by adjusting the frequency in Pr. 125 "Terminal 2 frequency setting gain frequency". (Refer to section 4.6.4.).

Change the frequency (0Hz) of the minimum value of potentiometer (at 0V) by adjusting the frequency in calibration parameter C2 "Terminal 2 frequency setting bias frequency". (Refer to section 6.15.4.)

4.5.5 Perform frequency setting by analog current input

- Pr. 79 "Operation mode selection" must be set to "4" (external/PU combined operation mode 2).
- Turn the AU signal on.
- Use the FWD or REV key to give a start command.

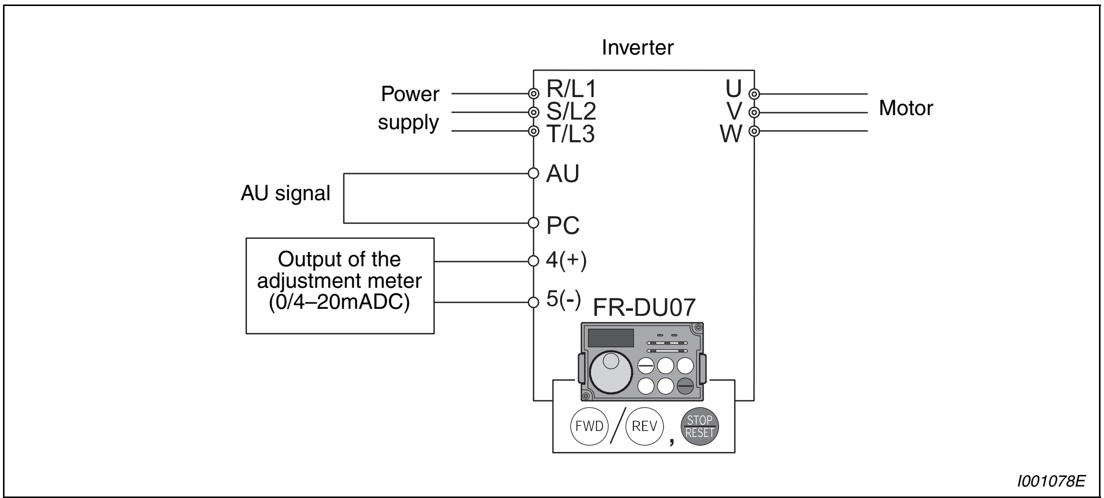


Fig. 4-17: *Frequency setting by analog current input*

Operation

① Screen at powering on
The monitor display appears.

② Press the MODE key to choose the parameter setting mode.

③ Turn the digital dial until P.79 (Pr. 79) appears.

④ Press the SET key to show the currently set value.
The initial value "0" appears.

⑤ Turn the digital dial clockwise to change it to the setting value of "4".

⑥ Press the SET key to set.

⑦ Press the MODE key twice to choose monitor/ frequency monitor.

⑧ Check that the terminal 4 input selection signal (AU) is on.
Press the start key FWD or REV. Operation status indication FWD or REV flickers.
CAUTION:
When both the forward and reverse key are pushed, the inverter will not start. Also, if both keys are pushed while running, the inverter stops.

⑨ Acceleration → constant speed
Perform 20mA input. The frequency value on the indication increases according to Pr. 7 "Acceleration time" until 50Hz is displayed.

⑩ Deceleration
Perform 4mA input. The frequency value on the indication decreases according to Pr. 8 "Deceleration time" until 0.00Hz is displayed and operation status indication of FWD or REV flickers.
The motor stops.

⑪ Press the STOP/RESET switch.
Operation status indication of FWD (or REV) turns off.

Display

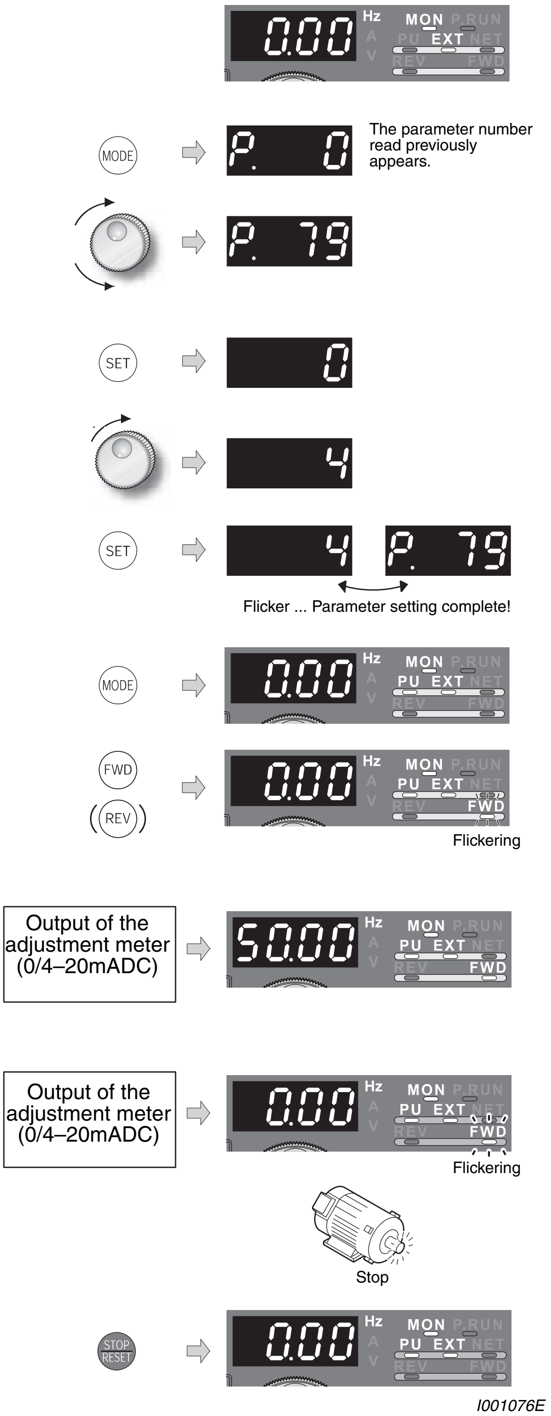


Fig. 4-18: Operate the inverter by using the analog current input

NOTES

Pr. 184 "AU terminal function selection" must be set to "4" (AU signal) (initial value). (Refer to section 6.9.1.)

Change the frequency (50Hz) at the maximum value of potentiometer (at 20mA) by adjusting the frequency in Pr. 126 "Terminal 4 frequency setting gain frequency". (Refer to section 4.6.6.)

Change the frequency (0Hz) at the minimum value of potentiometer (at 4mA) by adjusting the frequency in calibration parameter C5 "Terminal 4 frequency setting bias frequency". (Refer to section 6.15.4.)

4.6 External operation

From where is the frequency command given?

- Operation at the frequency set in the frequency setting mode of the operation panel. (Refer to section 4.6.1.)
- Give a frequency command by switch (multi-speed setting). (Refer to section 4.6.2.)
- Perform frequency setting by a voltage output device. (Refer to section 4.6.3.)
- Perform frequency setting by a current output device. (Refer to section 4.6.4.)

4.6.1 Use the set frequency set by the operation panel (Pr. 79 = 3)

- Set "3" in Pr. 79 (External/PU combined operation mode 1).
- Switch terminal STF (STR)-PC on to give a start command.
- Refer to section 4.5.1 for the set frequency by the operation panel.

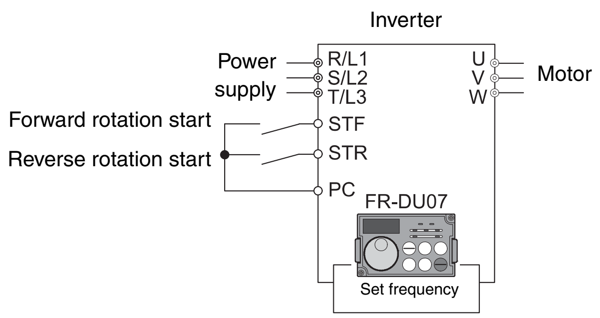


Fig. 4-19: *External operation*

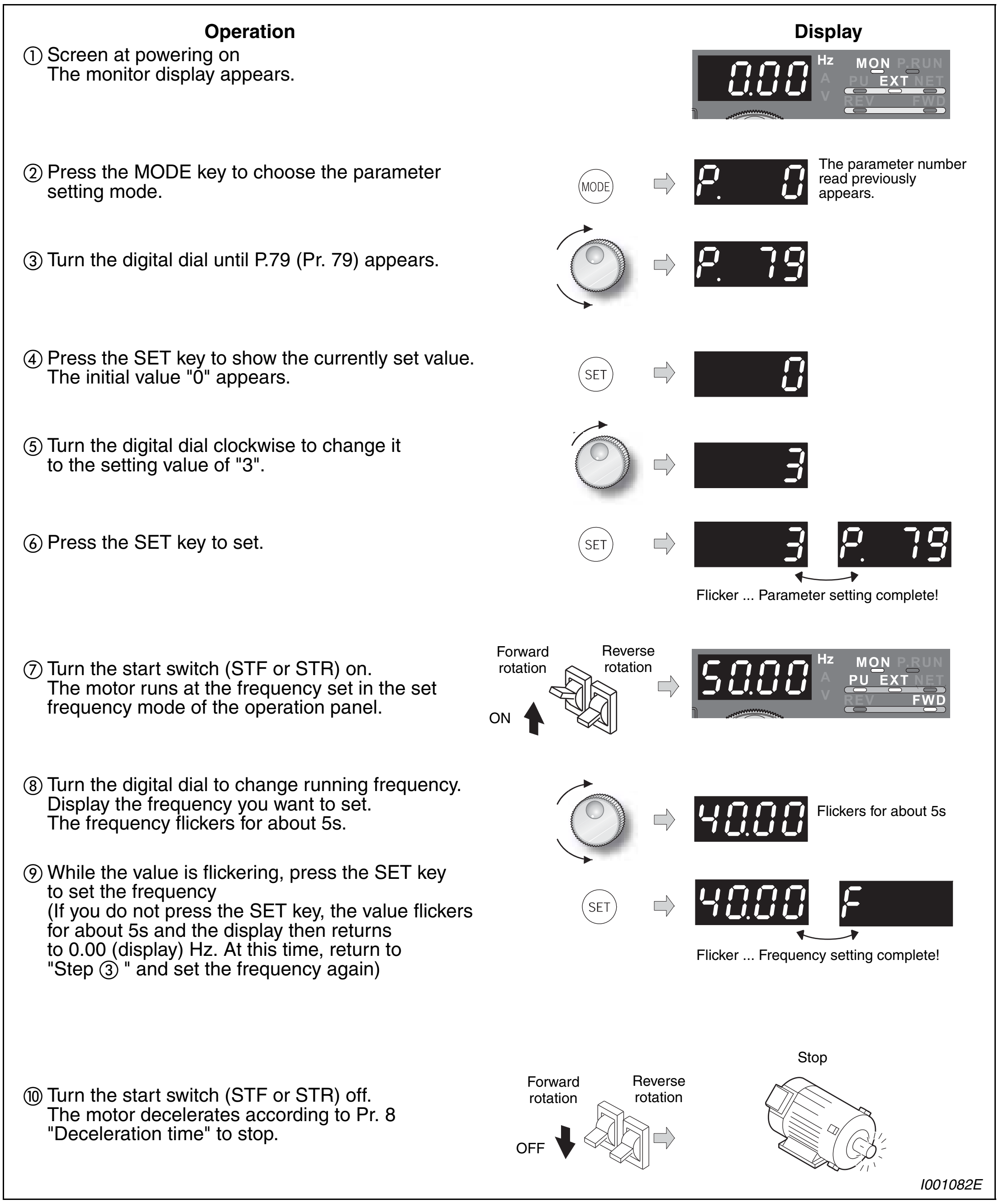


Fig. 4-20: *Operate the inverter by using external signals*

NOTES

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

When Pr. 79 "Operation mode selection" is set to "3", multi-speed operation (Refer to section 4.6.2) is also made valid.

Possible faults:

- When the inverter is stopped by the STOP/RESET key of the operation panel (FR-DU07),  and  Flickering are displayed alternately.
  - Turn the start switch (STF or STR) off.
  - The display can be reset by PU/EXT.

4.6.2 Use switches to give a start command and a frequency command (multi-speed setting) (Pr. 4 to Pr. 6)

- Start command by terminal STF (STR)-PC.
- Frequency command by terminal RH, RM, RL and STR-PC.
- "EXT" must be lit. (When "PU" is lit, switch it to "EXT" with the PU/EXT key.
- The initial values of the terminals RH, RM, RL are 50Hz, 30Hz, and 10Hz. (Use Pr. 4, Pr. 5 and Pr. 6 to change.)
- Operation at 15-speed can be performed by turning two (or three) terminals simultaneously. (Refer to section 6.5.1.)

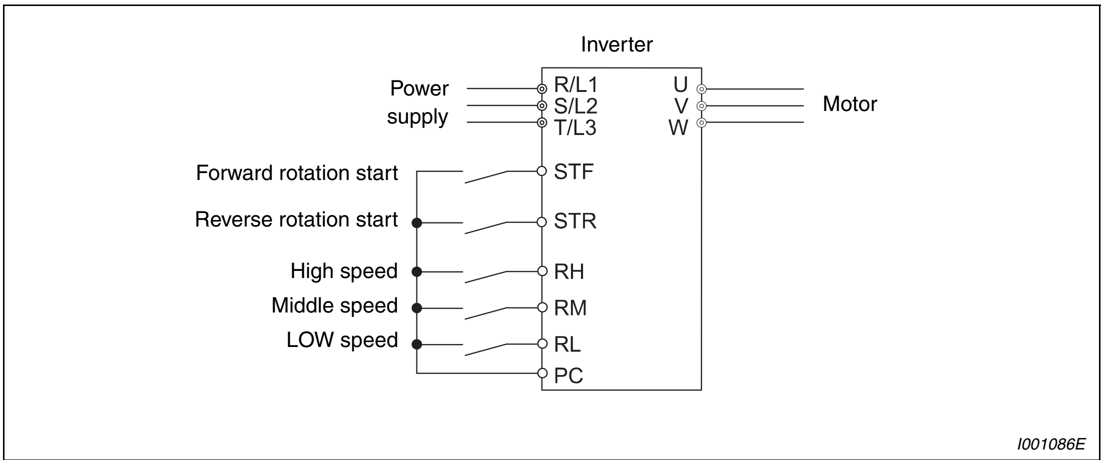


Fig. 4-21: *Frequency and start command by switches*

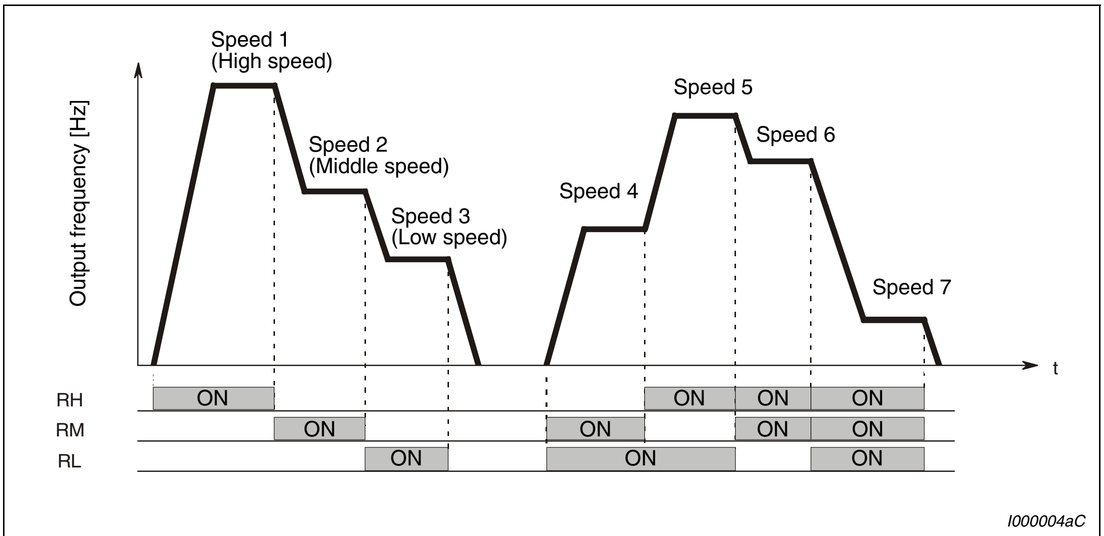


Fig. 4-22: *Multi-speed setting in dependence on the terminals*

Example ▽ Set "40Hz" in Pr. 4 "Multi-speed setting (high speed)" and turn on terminals RH and STF (STR)-SD to operate.

Operation	Display

① Power on → operation mode check
For the initial setting, the inverter operates in the external operation mode "EXT" when powering on. Check that the operation command indication is "EXT". If not displayed, press the PU/EXT key 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. (Refer to section 5.7.)

② Press the MODE key to choose the parameter setting mode.

③ Turn the digital dial until P.4 (Pr. 4) appears.

④ Press the SET key to show the currently set value. The initial value "50.00" (50.00Hz) appears.

⑤ Turn the digital dial clockwise to change it to the setting value of "40.00" (40.00Hz).

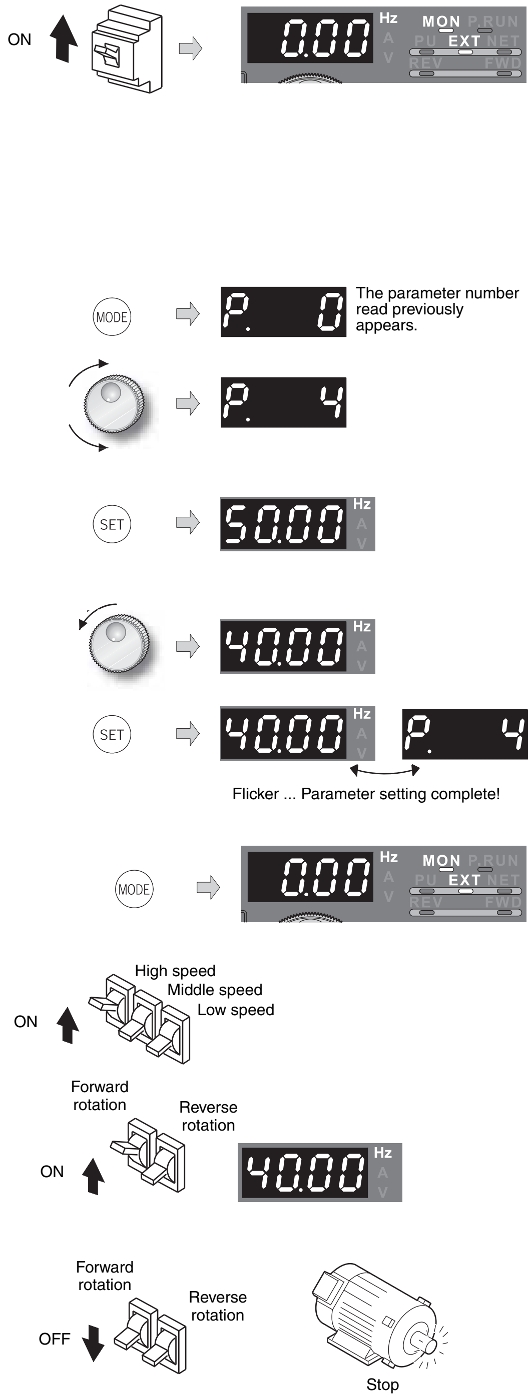
⑥ Press the SET key to set.

⑦ Press the MODE key twice to choose monitor/ frequency monitor.

⑧ Turn on the high speed switch (RH).

⑨ Turn the start switch (STF or STR) on.
40Hz appears (30Hz appears when RM is on and 10Hz appears when RL is on.)

⑩ Turn the start switch (STF or STR) off.
The motor stops according to Pr. 8 "Deceleration time".



I001088E

Fig. 4-23: *Operate the inverter by using external signals*

△

Possible faults:

- The EXT lamp is not lit even when the PU/EXT key is pressed.
  - Switchover of the operation mode with is valid when Pr. 79 = 0 (initial value).
- 50Hz, 30Hz and 10Hz are not output from RH, RM and RL respectively when they are turned on.
  - Check for the setting of Pr. 4, Pr. 5, and Pr. 6 once again.
  - Check for the setting of Pr. 1 "Maximum frequency" and Pr. 2 "Minimum frequency" once again. (Refer to section 5.3.)
  - Check for the Pr. 79 setting once again. (Pr. 79 must be set to "0" or "2".) (Refer to section 5.7.)
  - Check that Pr. 180 "RL terminal function selection" = "0", Pr. 181 "RM terminal function selection" = "1", Pr. 182 "RH terminal function selection" = "2" and Pr. 59 "Remote function selection" = "0". (All are initial values.)
- The FWD or REV lamp is not lit.
  - Check that wiring is correct. Check it again.
  - Check that "60" is set in Pr. 178 "STF terminal function selection" (or "61" is set in Pr. 179 "STR terminal function selection"). (All are initial values.)
- How is the frequency setting from 4 to 7 speed?
  - The setting differs according to Pr. 24 to Pr. 27 (multi-speed setting). (Refer to section 6.5.1).
- How is a multi-speed operation higher than 8 speed performed?
  - Use the REX signal to perform the operation. (Refer to section 6.5.1).

NOTE

External operation is fixed by setting "2" (external operation mode) in Pr. 79 "Operation mode selection" when you do not want to take time pressing the PU/EXT key or when you want to use the current start command and frequency command.

4.6.3 Perform frequency setting by analog voltage input

The frequency setting potentiometer is supplied with 5V of power from the inverter (terminal 10).

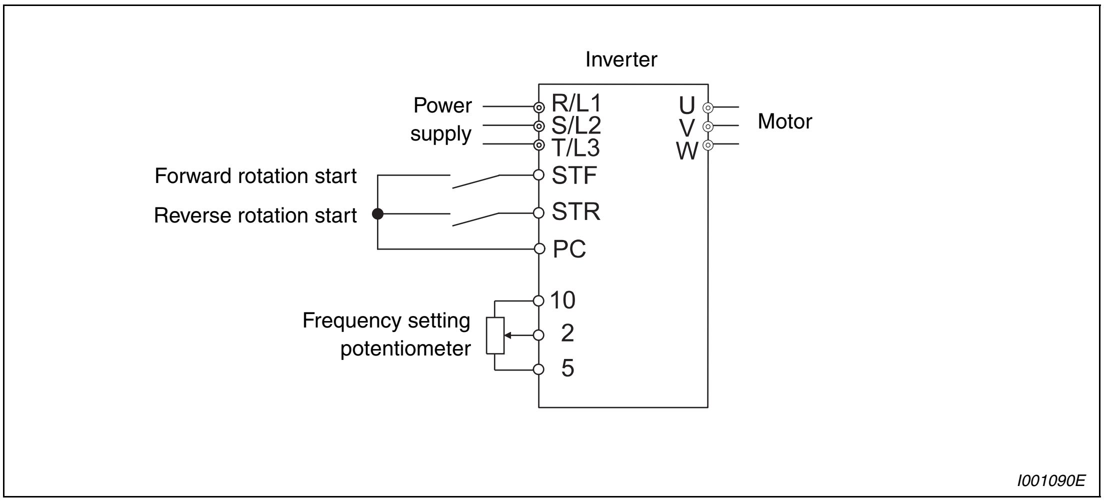


Fig. 4-24: *Frequency setting by analog voltage input*

Operation | **Display**

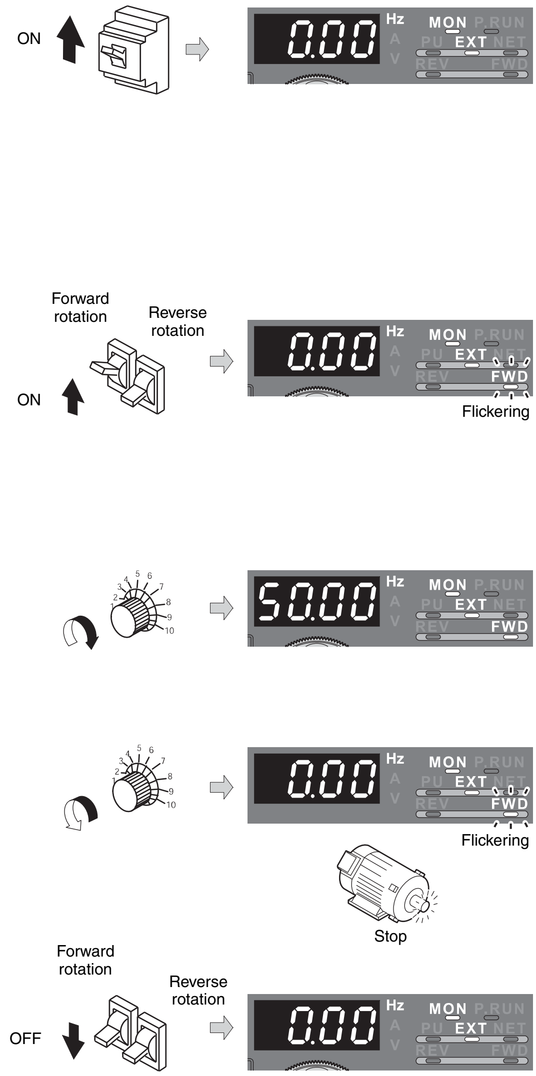
① Power on → operation mode check
For the initial setting, the inverter operates in the external operation mode "EXT" when powering on. Check that the operation command indication is "EXT". If not displayed, press the PU/EXT key to change to the external "EXT" operation mode. If the operation mode still does not change, set Pr. 79 to "0" to change to the external operation mode. (Refer to section 5.7.)

② Turn the start signal STF or STR on. Operation status indication FWD or REV flickers.
CAUTION:
When both the forward and reverse signal are turned on, the inverter will not start. Also, if both switches turn on while running, the inverter stops.

③ Acceleration → constant speed
Turn the volume (frequency setting potentiometer) clockwise slowly to full.
The frequency value on the indication increases according to Pr. 7 "Acceleration time" until 50Hz is displayed.

④ Deceleration
Turn the volume (frequency setting potentiometer) counter clockwise slowly to full.
The frequency value of the indication decreases according to Pr. 8 "Deceleration time" until 0.00Hz is displayed.
The motor stops.

⑤ Stop
Turn the start switch STF or STR off.



I001091E

Fig. 4-25: *Operate the inverter by using the analog voltage input*

NOTES

When you want to operate in the external operation mode always at powering on or when you want to save the trouble of input, set "2" (external operation mode) in Pr. 79 "Operation mode selection" to choose external operation mode always.

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

Possible faults:

- The motor will not rotate.
  - Check that the EXT lamp is lit. The external operation mode is valid when Pr. 79 = 0 (initial value). Use the PU/EXT key to change into the external operation mode.
  - Check that wiring is correct. Check once again.

NOTES

Change the frequency (0Hz) of the minimum value of potentiometer (at 0V) by adjusting the frequency in calibration parameter C2 "Terminal 2 frequency setting bias frequency". (Refer to section 6.15.4.)

When you want to compensate frequency setting, use terminal 1.

4.6.4 Change the frequency (50Hz) of the maximum value of potentiometer (at 5V)

Example ▽

The frequency of the maximum analog voltage of the potentiometer (at 5V) has to be changed from the initial setting of 50Hz to 40 Hz. Set 40Hz in Pr. 125.

Operation

① Turn the digital dial until P.125 (Pr. 125) appears.

② Press the SET key to show the currently set value. The initial value "50.00" (50.00Hz) appears.

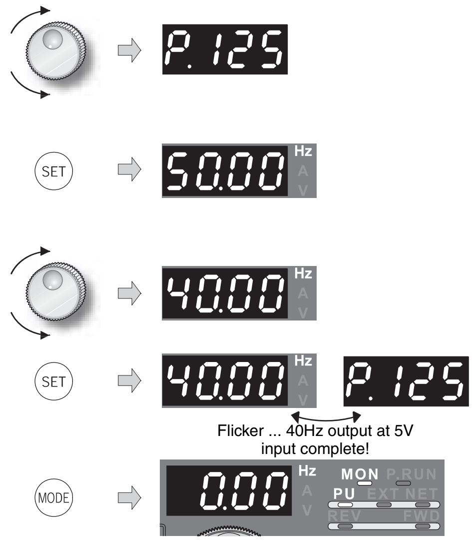
③ Turn the digital dial to change the set value to "40.00" (40.00Hz).

④ Press the SET key to set.

⑤ Press the MODE key twice to choose monitor/ frequency monitor.

⑥ Turn the start switch (STF or STR) on and turn the volume (frequency setting potentiometer) clockwise to full slowly. (Refer to Fig. 4-25, step ② to ⑤).

Display



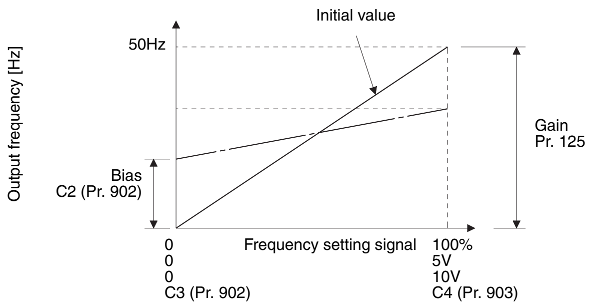
I001092E

Fig. 4-26: *Change the frequency of the maximum analog value*

△

NOTES

Set the frequency at 0V using calibration parameter C2.



As other adjustment methods of frequency setting voltage gain, there are methods to adjust with a voltage applied to across terminals 2-5 and adjust at any point without a voltage applied. (Refer to section 6.15.4 for the setting method of calibration parameter C4.)

4.6.5 Perform frequency setting by analog current input

- Switch terminal STF (STR)-PC on to give a start command.
- Turn the AU signal on.
- Pr. 79 "Operation mode selection" must be set to "2" (external operation mode).

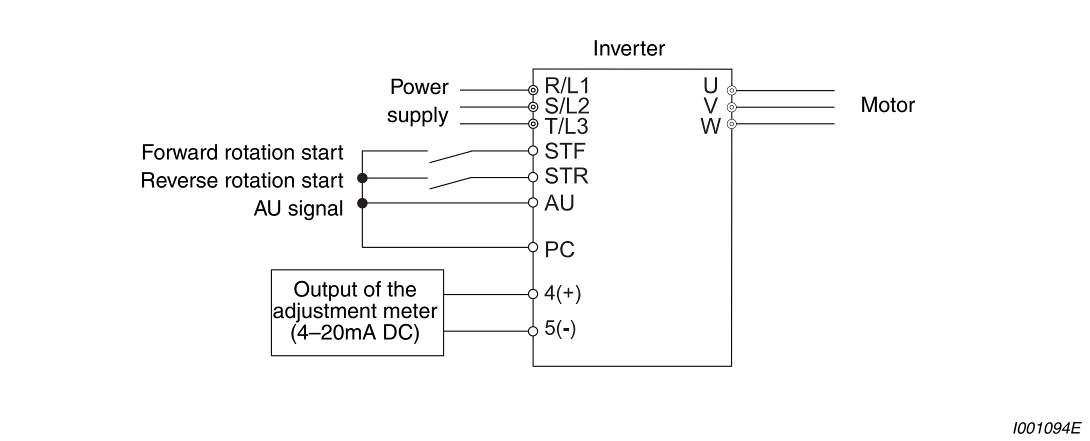
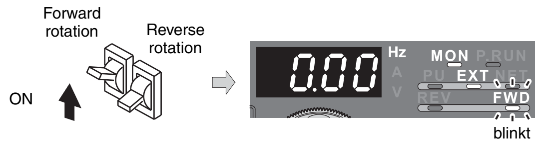


Fig. 4-27: *Frequency setting by analog current input*

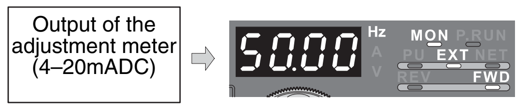
Operation / **Display**

① Power on → operation mode check
For the initial setting, the inverter operates in the external operation mode "EXT" when powering on. Check that the operation command indication is "EXT". If not displayed, press the PU/EXT key 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. (Refer to section 5.7.)

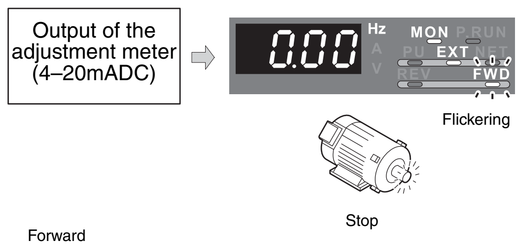
② Turn the start signal STF or STR on. Operation status indication FWD or REV flickers.
CAUTION:
When both the forward and reverse signal are turned on, the inverter will not start. Also, if both switches turned while running, the inverter stops.



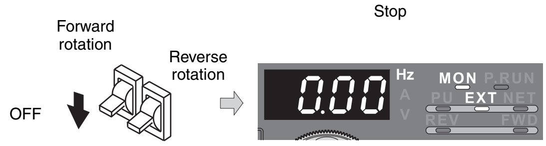
③ Acceleration → constant speed
Perform 20mA input. The frequency value on the indication increases according to Pr. 7 "Acceleration time" until 50.00Hz is displayed.



④ Deceleration
Perform 4mA input. The frequency value on the indication decreases according to Pr. 8 "Deceleration time" until 0.00Hz is displayed and FWD or REV of the operation status indication flickers.
The motor stops.



⑤ Stop
Turn the start switch STF or STR off.



I001095E

Fig. 4-28: *Operate the inverter by using the analog current input*

NOTE

Pr. 184 "AU terminal function selection" must be set to "4" (AU signal) (initial value).

Possible faults:

- The motor will not rotate.
  - Check that the EXT lamp is lit. The external operation mode is valid when Pr. 79 = 0 (initial value). Use the PU/EXT key to change into the external operation mode.
  - The AU signal must be turned on.
  - Check that wiring is correct. Check once again.

NOTE

Change the frequency (0Hz) of the minimum value of potentiometer (at 4mA) by adjusting the frequency in calibration parameter C5 "Terminal 4 frequency setting bias frequency". (Refer to section 6.15.4.)

4.6.6 Change the frequency (50Hz) of the maximum value of potentiometer (at 20mA)

Example ▽

The frequency of the maximum analog current of the potentiometer (at 20mA) has to be changed from the initial setting of 50Hz to 40 Hz. Set 40Hz in Pr. 126.

Operation

① Turn the digital dial until P.126 (Pr. 126) appears.

② Press the SET key to show the currently set value. The initial value "50.00" (50.00Hz) appears.

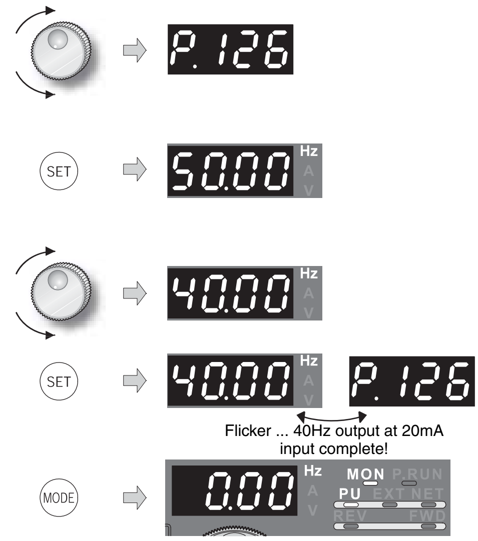
③ Turn the digital dial to change the set value to "40.00" (40.00Hz).

④ Press the SET key to set.

⑤ Press the MODE key twice to choose monitor/ frequency monitor.

⑥ Turn the start switch STF or STR on to allow 20mA current to flow. (Refer to Fig. 4-28, step ② to ⑤.)

Display



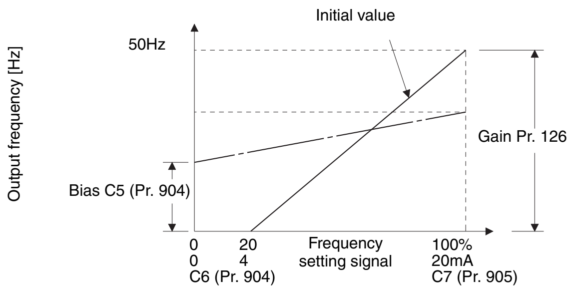
I001096E

Fig. 4-29: Change the frequency of the maximum analog value

△

NOTES

Set the frequency at 4mA using calibration parameter C5.



As other adjustment methods of frequency setting current gain, there are methods to adjust with a current flowing in the terminals 4-5 and adjust at any point without a current flowing. (Refer to section 6.15.4 for the setting method of calibration parameter C7.)

5 Basic settings

5.1 Simple mode parameter list

For simple variable-speed operation of the inverter, the initial setting of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel (FR-DU07). For details of parameters, refer to chapter 6.

NOTE

Only simple mode parameters are displayed by the initial setting of Pr. 160 "User group read selection". Set Pr. 160 "User group read selection" as required. (Refer to section 6.16.4.)

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

Tab. 5-1: *Setting of parameter 160*

Pr.	Name	Incre-ments	Initial Value	Range	Description	Refer to
0	Torque boost	0.1%	6/4/3/ 2/1.5/1 *	0–30%	Set to increase a starting torque or when the motor with a load will not rotate, resulting in an alarm (OL) and a trip (OC1). * *Initial values differ according to the inverter capacity. (00023 / 00038 to 00083 / 00126, 00170 / 00250 to 00770 / 00930, 01160 / 01800 or more)*	5-3
1	Maximum frequency	0.01Hz	120/ 60Hz *	0–120Hz	Set when the maximum output frequency need to be limited. * *Initial values differ according to the inverter capacity. (01160 or less/01800 or more)*	5-5
2	Minimum frequency	0.01Hz	0Hz	0–120Hz	Set when the minimum output frequency need to be limited.	
3	Base frequency	0.01Hz	50Hz	0–400Hz	Check the motor rating plate.	5-7
4	Multi-speed setting (high speed)	0.01Hz	50Hz	0–400Hz	Set when changing the preset speed in the parameter with a terminal.	4-24
5	Multi-speed setting (middle speed)	0.01Hz	30Hz	0–400Hz		
6	Multi-speed setting (low speed)	0.01Hz	10Hz	0–400Hz		
7	Acceleration time	0.1s	5/15s *	0–3600s	Acceleration/deceleration time can be set. * *Initial values differ according to the inverter capacity. (00170 or less/00250 or more)*	5-8
8	Deceleration time	0.1s	10/30s *	0–3600s		

Tab. 5-2: *Simple mode parameters (1)*

Pr.	Name	Incre-ments	Initial value	Range	Description	Refer to
9	Electronic thermal O/L relay	0.01/ 0.1A *	Rated inverter output current	0–500/ 0–3600A *	Protect the motor from overheat by the inverter. Set the rated motor current. * *Initial values differ according to the inverter capacity. (01160 or less/01800 or more)*	4-10
60	Energy saving control selection	1	0	0/4/9	The inverter output voltage is minimized when using for fan and pump applications.	5-10
79	Operation mode selection	1	0	0/1/2/3/4/6/7	Select the start command location and frequency command location.	5-12
125	Terminal 2 frequency setting gain frequency	0.01Hz	50Hz	0–400Hz	Frequency for the maximum value of the potentiometer (at 5V) can be changed.	4-30
126	Terminal 4 frequency setting gain frequency	0.01Hz	50Hz	0–400Hz	Frequency at 20mA input can be changed.	4-33
160	User group read selection	1	9999	0/1/9999	Make extended parameters valid	6-200

Tab. 5-2: *Simple mode parameters (2)*

5.2 Increase the starting torque (Pr. 0)

Set this parameter when the motor with a load does not rotate, an alarm OL is output, resulting in an inverter trip due to OC1, etc.

Pr. No.	Name	Initial Value		Setting Range	Description
0	Torque boost	00023	6%	0–30%	Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
		00038 to 00083	4%		
		00126/00170	3%		
		00250 to 00770	2%		
		00930/01160	1.5%		
		01800 or more	1%		

Example ▽ When the motor with a load does not rotate, increase the Pr. 0 value 1% by 1% unit by looking at the motor movement. (The guideline is for about 10% change at the greatest.)

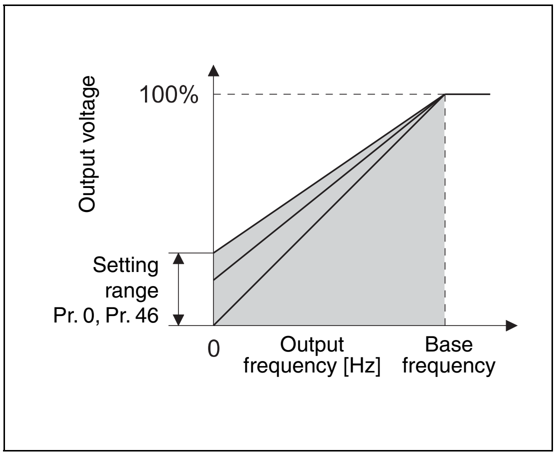


Fig. 5-1:
Relation between output frequency and output voltage

I001098E

Operation

① Screen at powering on
The monitor display appears.

② Press the PU/EXT key to choose the PU operation mode.

③ Press the MODE key to choose the parameter setting mode.

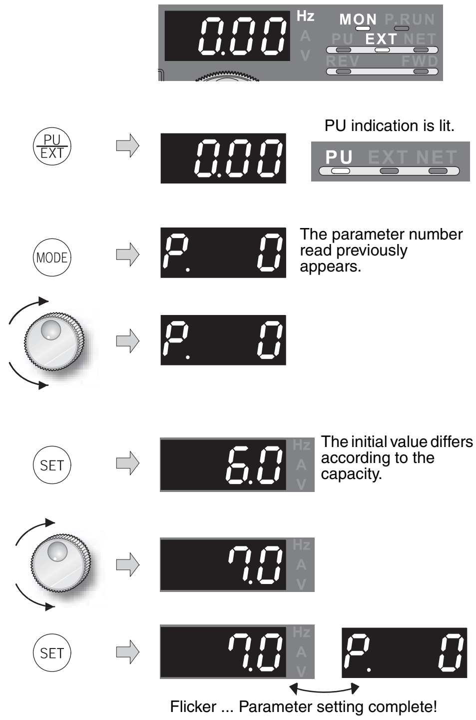
④ Turn the digital dial until P.0 (Pr. 0) appears.

⑤ Press the SET key to show the currently set value. "6.0" (initial value is 6% for the 00023) appears.

⑥ Turn the digital dial to change it to the setting value of "7.0".

⑦ Press the SET key to set.

Display



- By turning the digital dial, you can read another parameter.
- Press the SET key to show the setting again.
- Press the SET key twice to show the next parameter.

I001099E

Fig. 5-2: *Setting the starting torque*

△

NOTES

A too large setting will cause the motor to overheat, resulting in an over current trip (OL (over current alarm) then E.OC1 (over current shutoff during acceleration)), thermal trip (E.THM (Motor overload shutoff), and E.THT (Inverter overload shutoff)).
When an error (E.OC1) occurs, release the start command, and decrease the value 1% by 1%. (Refer to page 7-9.)

If the inverter still does not operate properly after the above measures, adjust the acceleration/deceleration setting or activate the vector control function by Pr. 80 "Simple magnetic vector control" (extended mode). (Refer to section 6.2.2.)

5.3 Limit the maximum and minimum output frequency (Pr. 1, Pr. 2)

Pr. No.	Name	Initial Value		Setting Range	Description
1	Maximum frequency	01160 or less	120Hz	0–120Hz	Set the upper limit of the output frequency.
		01800 or more	60Hz		
2	Minimum frequency	0Hz		0–120Hz	Set the lower limit of the output frequency.

Example ▽ You can limit the motor speed. Limit the frequency set by the potentiometer, etc. to 50Hz maximum. (Set "50"Hz to Pr. 1 "Maximum frequency".)

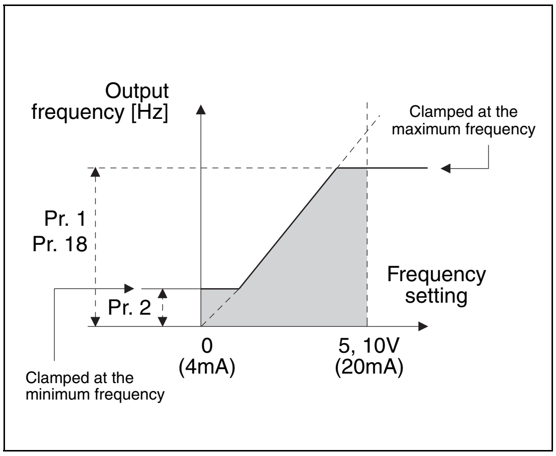


Fig. 5-3:
Minimum and maximum output frequency

I001100E

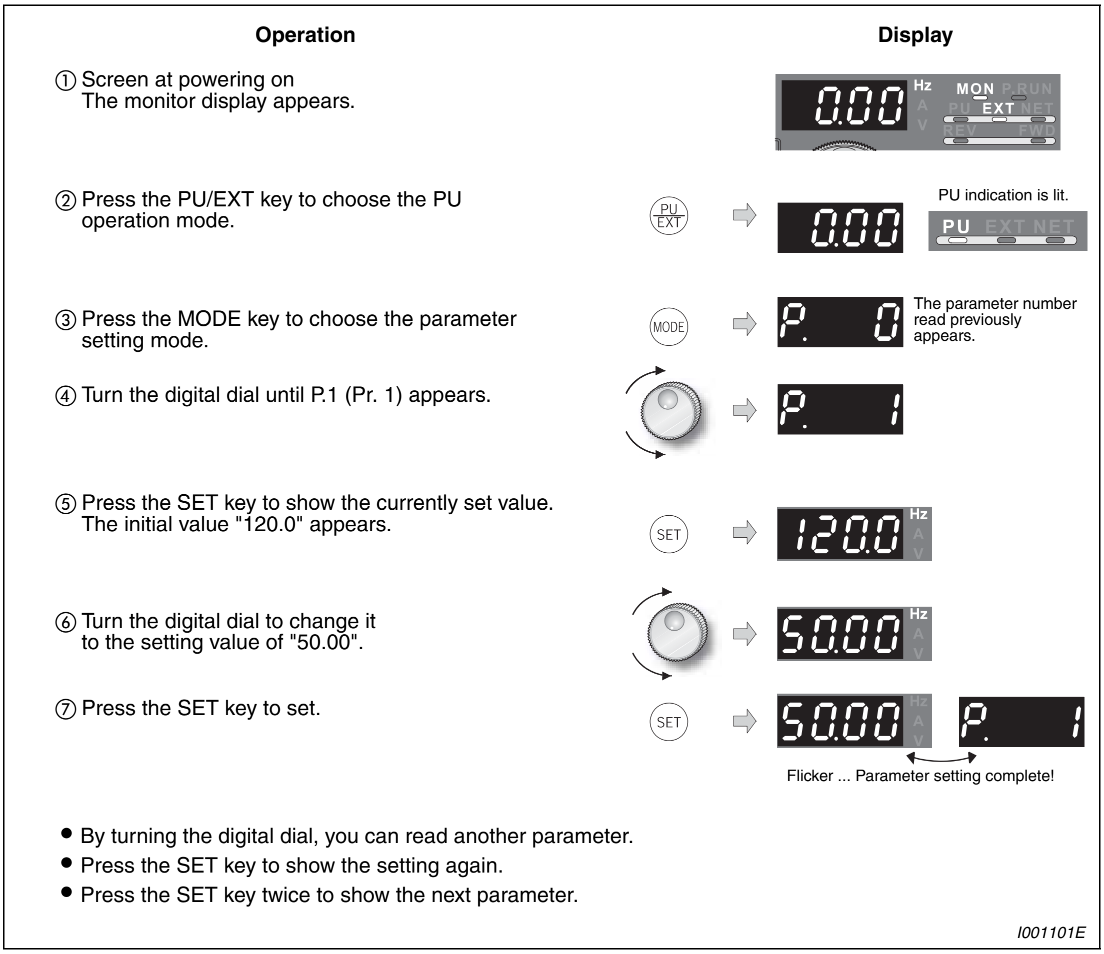


Fig. 5-4: *Setting the maximum frequency*

△

NOTES

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.) Note that Pr.15 "Jog frequency" has higher priority than the minimum frequency.

When the Pr. 1 setting is changed, frequency higher than the Pr. 1 setting can not be set by the digital dial.

When performing a high speed operation at 120Hz or more, setting of Pr. 18 "High speed maximum frequency" is necessary. (Refer to section 6.3.1.)

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.

5.4 When the rated motor frequency is 60Hz (Pr. 3)

First, check the motor rating plate. If a frequency given on the rating plate is "60Hz" only, always set Pr. 3 "Base frequency" to "60Hz".

Pr. No.	Name	Initial Value	Setting Range	Description
3	Base frequency	50Hz	0–400Hz	Set the rated motor frequency.

Example ▽ Change Pr. 3 "Base frequency" to 60Hz according to the motor rated frequency.

Operation

① Screen at powering on
The monitor display appears.

② Press the PU/EXT key to choose the PU operation mode.

③ Press the MODE key to choose the parameter setting mode.

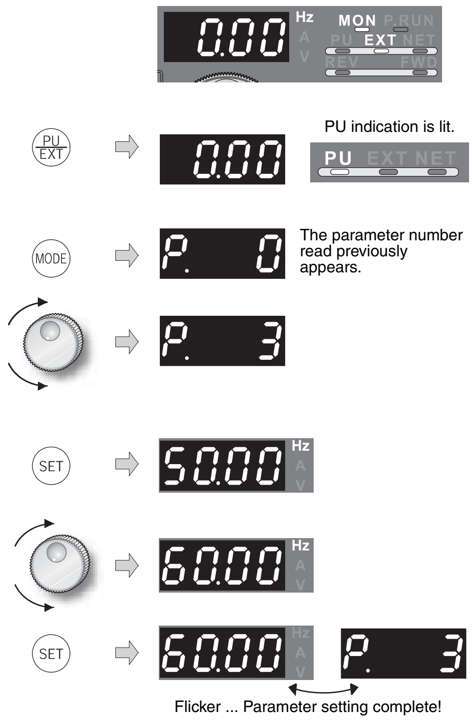
④ Turn the digital dial until P.3 (Pr. 3) appears.

⑤ Press the SET key to show the currently set value.
The initial value "50.00" appears.

⑥ Turn the digital dial to change it to the setting value of "60.00".

⑦ Press the SET key to set.

Display



- By turning the digital dial, you can read another parameter.
- Press the SET key to show the setting again.
- Press the SET key twice to show the next parameter.

I001102E

Fig. 5-5: Setting the base frequency

△

5.5 Change the acceleration/deceleration time (Pr. 7, Pr. 8)

Set in Pr. 7 "Acceleration time" a larger value for a slower speed increase and a smaller value for a faster speed increase.

Set in Pr. 8 "Deceleration time" a larger value for a slower speed decrease and a smaller value for a faster speed decrease.

Pr. No.	Name	Initial Value		Setting Range	Description
7	Acceleration time	00170 or less	5s	0–3600s/ 0–360s ①	Set the motor acceleration time.
		00250 or more	15s		
8	Deceleration time	00170 or less	10s	0–3600s/ 0–360s ①	Set the motor deceleration time.
		00250 or more	30s		

① Depends on the Pr. 21 "Acceleration/deceleration time increments" setting. The initial value for the setting range is "0 to 3600s" and setting increments is "0.1s".

NOTE

Too short acceleration/deceleration times may lead to an inverter shutoff with error message (E.THT, E.THM, E.OCT, E.OVT ...).

Example ▽

Change the Pr. 7 "Acceleration time" setting from "5s" to "10s".

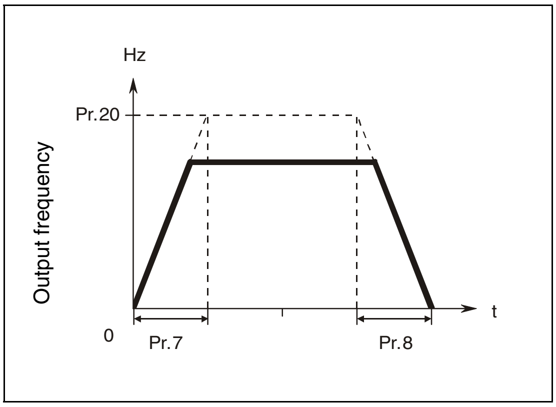


Fig. 5-6:
Acceleration/deceleration time

I000006C

Operation **Display**

① Screen at powering on
The monitor display appears.

② Press the PU/EXT key to choose the PU operation mode.

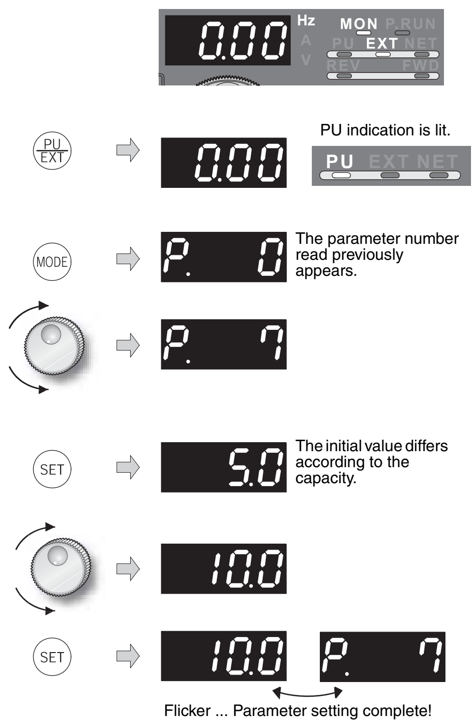
③ Press the MODE key to choose the parameter setting mode.

④ Turn the digital dial until P.7 (Pr. 7) appears.

⑤ Press the SET key to show the currently set value.
The initial value "5.0" appears.

⑥ Turn the digital dial to change it to the setting value of "10.0".

⑦ Press the SET key to set.



- By turning the digital dial, you can read another parameter.
- Press the SET key to show the setting again.
- Press the SET key twice to show the next parameter.

I001104E

Fig. 5-7: *Setting the acceleration time*

△

5.6 Energy saving operation (Pr. 60)

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

Pr. No.	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

Energy saving operation mode (Pr. 60 = 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. Up to 30% energy can be saved by this.

NOTES

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

Optimum excitation control mode (Pr. 60 = 9)

When "9" is set in Pr. 60, the inverter operates in the optimum excitation control mode.

This exclusive Mitsubishi Electric control method reduces motor losses in the low-load operating range and at frequencies below the motor's rated frequency, thus operating the motor with optimum efficiency.

NOTES

When the motor capacity is too small as compared to the inverter capacity or two or more motors are connected to one inverter, the optimum excitation control is not expected.

When the energy saving mode and optimum excitation control mode are selected (parameter 60 = 4 or 9), deceleration time may be longer than the setting value. Since over voltage alarm tends to occur as compared to the constant torque characteristics, set a longer deceleration time.

The energy saving mode and optimum excitation control functions only under V/F control. When a value other than "9999" is set in Pr. 80 "Motor capacity (simple magnetic flux control)", the energy saving mode and optimum excitation control does not function.

When you want to check the energy saving effect, refer to section 6.13 to check the energy saving effect monitor.

Example ▽ Selecting the energy saving operation mode.

Operation

① Screen at powering on
The monitor display appears.

② Press the PU/EXT key to choose the PU operation mode.

③ Press the MODE key to choose the parameter setting mode.

④ Turn the digital dial until P.60 (Pr. 60) appears.

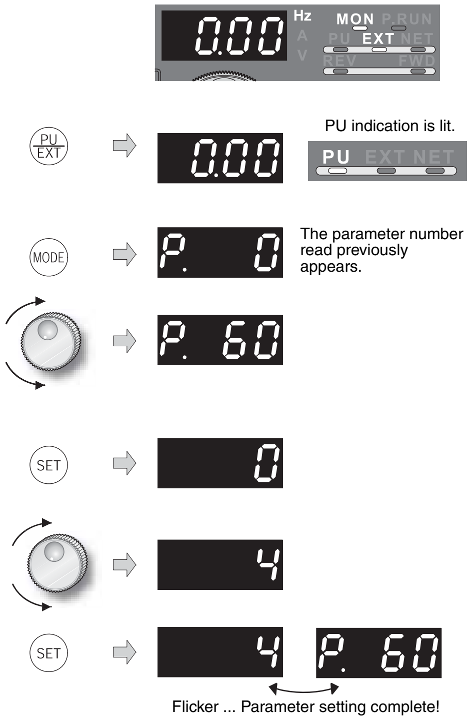
⑤ Press the SET key to show the currently set value.
The initial value "0" appears.

⑥ Turn the digital dial to change it to the setting value of "4".

⑦ Press the SET key to set.

⑧ Perform normal operation.
When you want to check the energy saving effect, refer to section 6.13 to check the energy saving effect monitor.

Display



- By turning the digital dial, you can read another parameter.
- Press the SET key to show the setting again.
- Press the SET key twice to show the next parameter.

I001104E

Fig. 5-8: *Selecting the energy saving operation mode*

NOTE If the motor decelerates to stop in the energy saving operation mode (parameter 60 = 4 or 9), the deceleration time may be longer than the set time. Since over voltage tends to occur as compared to the constant torque characteristics, set a longer deceleration time.

△

5.7 Operation mode (Pr. 79)

Select the operation command location and frequency command location.

<table>
<tr><th>Pr. No.</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="2">Description</th><th>LED Indication
: OFF
: ON</th></tr>
<tr><td rowspan="12">79</td><td rowspan="12">Operation mode selection</td><td rowspan="12">0</td><td>0</td><td colspan="2">External/PU switch over mode
Press the PU/EXT key to switch between the PU and external operation mode. (Refer to section 4.5.)
At power on, the inverter is in the external operation mode.</td><td>External operation mode
PU **EXT** NET
PU operation mode
PU EXT NET</td></tr>
<tr><td>1</td><td colspan="2">PU operation mode</td><td>**PU** EXT NET</td></tr>
<tr><td>2</td><td colspan="2">Fixed to external operation mode
Operation can be performed by switching between the external and Net operation mode.</td><td>External operation mode
PU **EXT** NET
NET operation mode
PU EXT **NET**</td></tr>
<tr><td rowspan="3">3</td><td colspan="2">External/PU combined operation mode 1</td><td rowspan="6">**PU** **EXT** NET</td></tr>
<tr><td>**Running frequency**</td><td>**Start signal**</td></tr>
<tr><td>PU (FR-DU07/FR-PU04/ FR-PU07) setting or external signal input (multi-speed setting, across terminals 4-5 (valid when AU signal turns on)).</td><td>External signal input (terminal STF-, STR)</td></tr>
<tr><td rowspan="3">4</td><td colspan="2">External/PU combined operation mode 2</td></tr>
<tr><td>**Running frequency**</td><td>**Start signal**</td></tr>
<tr><td>External signal input (Terminal 2, 4, 1, JOG, multi-speed selection, etc.)</td><td>Input from the PU (FWD/REV keys)</td></tr>
<tr><td>6</td><td colspan="2">Switch-over mode
Switch among PU operation, external operation, and NET operation while keeping the same operation status.</td><td>PU operation mode
PU EXT NET
External operation mode
PU **EXT** NET
NET operation mode
PU EXT **NET**</td></tr>
<tr><td>7</td><td colspan="2">External operation mode (PU operation interlock)
X12 signal ON ①:
Operation mode can be switched to the PU operation mode.
(output stop during external operation)
X12 signal OFF ①:
Operation mode can not be switched to the PU operation mode.</td><td>PU operation mode
PU EXT NET
External operation mode
PU **EXT** NET</td></tr>
</table>

① For the terminal used for the X12 signal (PU operation interlock signal) input, assign "12" in Pr. 178 to Pr. 189 "input terminal function selection" to assign functions. For Pr. 178 to Pr. 189, refer to section 6.9.1. When the X12 signal is not assigned, function of the MRS signal switches from MRS (output stop) to PU operation interlock signal.

5.8 Parameter clear

- Set "1" in Pr.CL "Parameter clear" to initialize all parameters. (Parameters are not cleared when "1" is set in Pr. 77 "Parameter write selection". In addition, calibration parameters are not cleared.)
- Refer to Tab. 6-1 for parameters to be cleared with this operation.

Operation / **Display**

① Screen at powering on
The monitor display appears.

② Press the PU/EXT key to choose the PU operation mode.

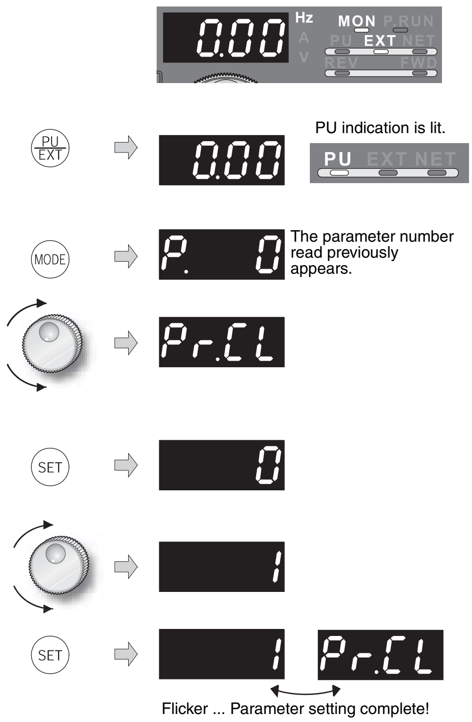
③ Press the MODE key to choose the parameter setting mode.

④ Turn the digital dial until "Pr.CL" (parameter clear) appears.

⑤ Press the SET key to show the currently set value.
The initial value "0" appears.

⑥ Turn the digital dial to change it to the setting value of "1".

⑦ Press the SET key to set.



- By turning the digital dial, you can read another parameter.
- Press the SET key to show the setting again.
- Press the SET key twice to show the next parameter.

I001113E

Fig. 5-9: *Parameter clear*

Possible faults:

- "1" and "Er4" are displayed alternately.
  – The inverter is not in the PU operation mode. Press the PU/EXT key. The PU indication is lit. Carry out operation from step ⑥ again.

5.9 All parameter clear

- Set "1" in ALLC "All parameter clear" to initialize all parameters. (Parameters are not cleared when "1" is set in Pr. 77 "Parameter write selection". In addition, calibration parameters are not cleared.)
- Refer to Tab. 6-1 for parameters to be cleared with this operation.

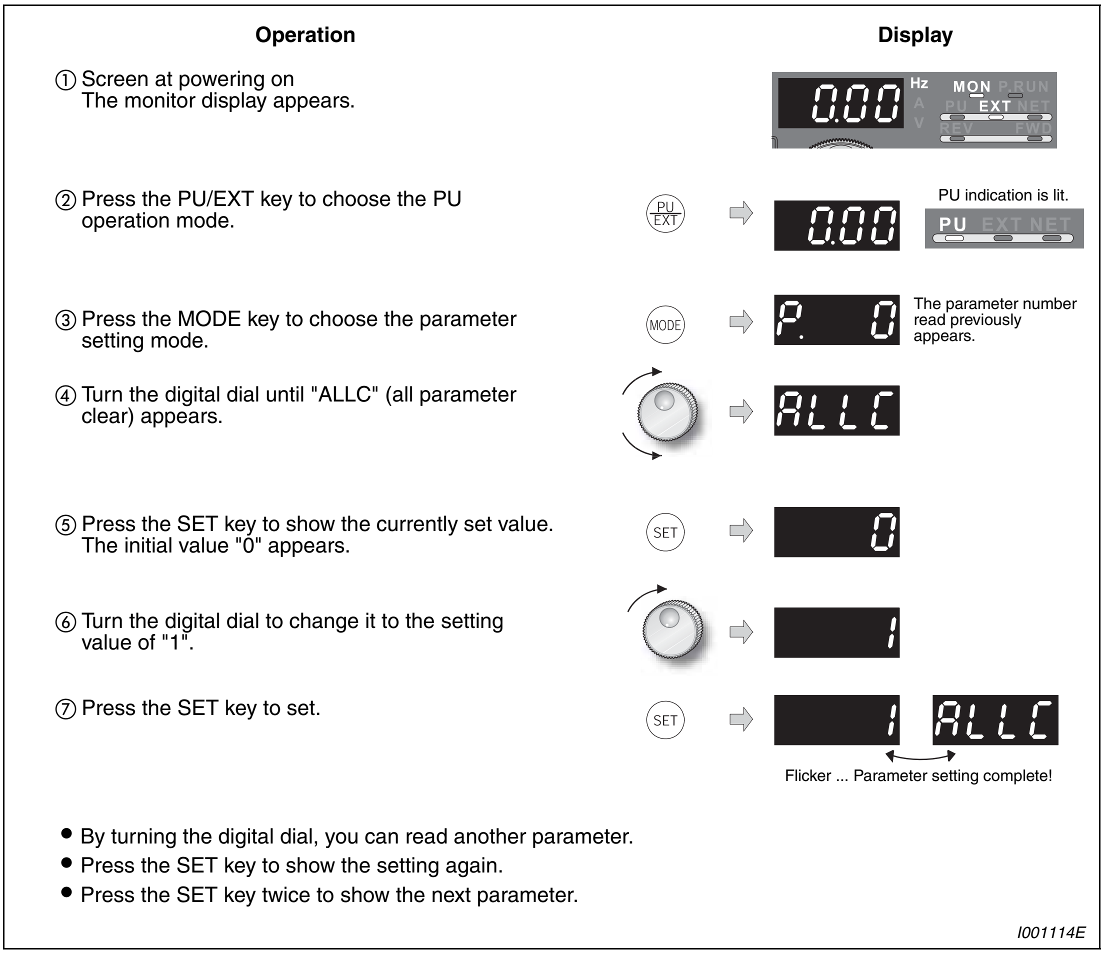


Fig. 5-10: *All parameter clear*

Possible faults:

- "1" and "Er4" are displayed alternately.
  - The inverter is not in the PU operation mode. Press the PU/EXT key. The PU indication is lit. Carry out operation from step ⑥ again.

5.10 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.

Tab. 5-3: *Setting of parameter PCPY*

NOTES

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 extended parameter list Tab. 6-1 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.

5.10.1 Parameter copy

Multiple inverters and parameter settings can be copied.

Operation

① Connect the operation panel to the copy source inverter.
Connect it during a stop.

② Press the MODE key to choose the parameter setting mode.

③ Turn the digital dial until "PCPY" (parameter copy) appears.

④ Press the SET key to show the currently set value. The initial value "0" appears.

⑤ Turn the digital dial to change it to the setting value of "1".

⑥ Press the SET key to copy the source parameters to the operation panel.

⑦ Connect the the operation panel to the copy destination inverter. Check that Pr. 77 of the destination inverter is not set to disable parameter writing.

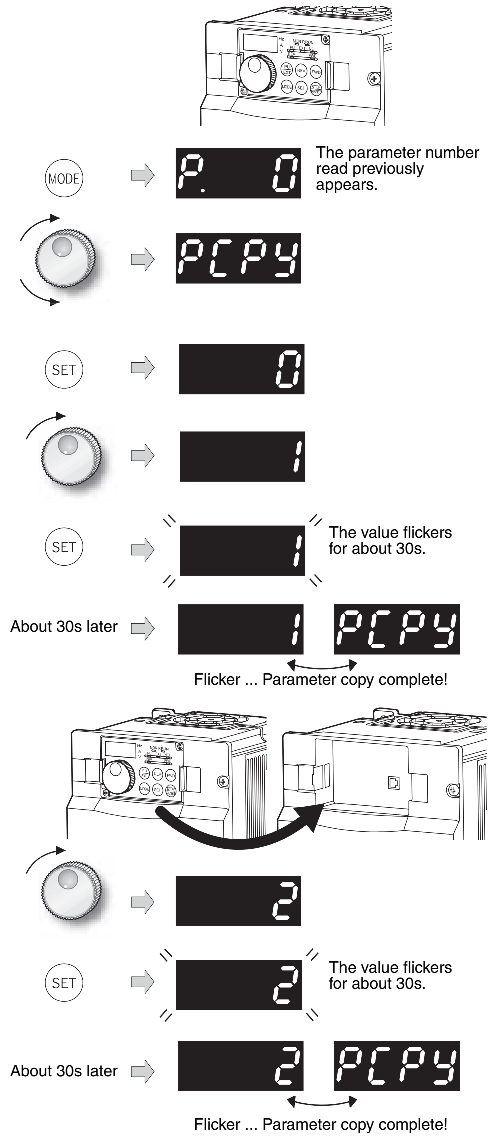
⑧ Perform steps ② to ⑤ again. Turn the digital dial clockwise until "2" appears.

⑨ Press the SET key to write the parameters copied to the operation panel to the destination inverter.

⑩ When copy is completed, "2" and "PCPY" flicker.

⑪ After writing the parameter values to the copy destination inverter, always reset the inverter, e.g. switch power off once, before starting operation.

Display



I001115E

***Fig. 5-11:** Parameter copy*

Possible faults:

- "rE1" appears.
  - A parameter read error has occurred. Perform operation in Fig. 5-11 from step ③ again.
- "rE2" appears.
  - A parameter write error has occurred. Perform operation in Fig. 5-11 from step ⑧ again.
- "rE4" appears.
  - The copy destination inverter is no FR-F700 model or the parameter write disable function is activated in parameter 77. Set "0" in Pr. 160 "User group read selection" and set Pr. 77 "Parameter write selection" to "0" or "2".
- "CP" and "0.00" appear alternately.
  - Appears when parameters are copied between the inverter of 01160 or less and 01800 or more.

    Countermeasure:

    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.

5.10.2 Parameter verification

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

Operation

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 the MODE key to choose the parameter setting mode.

④ Turn the digital dial until "PCPY" (parameter copy) appears.

⑤ Press the SET key to show the currently set value.
The initial value "0" appears.

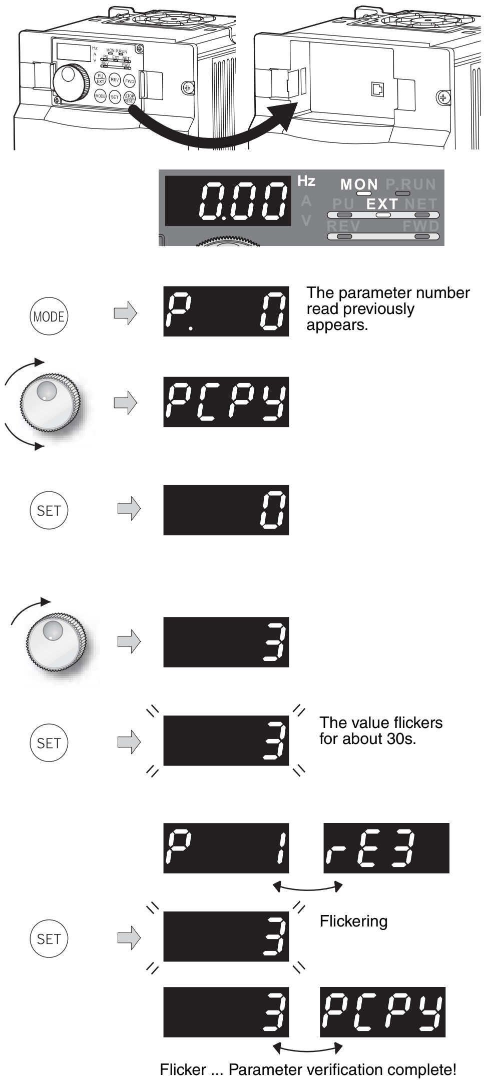
⑥ Turn the digital dial to change it to the setting value of "3" (parameter copy verification mode).

⑦ Press the SET key to read the parameter setting of the verified inverter to the operation panel.

- If different parameter exist, different parameter numbers and "rE3" flicker.
- Hold down the SET key to verify.

⑧ If there is no difference, "PCPY" and "3" flicker to complete verification.

Display



I001116E

Fig. 5-12: Parameter verification

Possible faults:

- "rE3" appears.
  – Set frequencies, etc. may be different. Check set frequencies.

NOTE When the copy destination inverter is not the FR-F700 series, "model error rE4" is displayed.

6 Parameter

6.1 Parameter overview

Parameter 160 is factory set to "9999". That means that only the parameters marked with ◎ in the following table are accessible. Set parameter 160 to "0" to access other or all parameters. The half-tone screened parameters allow its setting to be changed during operation even if "0" (initial value) is set in Pr. 77 "Parameter write selection".

Ver.UP .... Specifications differ according to the date assembled (refer to Appendix A.7)

<table>
<tr><th rowspan="2">Function</th><th colspan="2">Parameter</th><th rowspan="2">Name</th><th rowspan="2">Increments</th><th rowspan="2">Initial Value</th><th rowspan="2">Setting Range</th><th rowspan="2">Description</th><th>Parameter copy</th><th>Parameter clear</th><th>All parameter clear</th><th rowspan="2">Refer to page</th></tr>
<tr><th></th><th>Related parameters</th><th colspan="3">✔: enabled
—: disabled</th></tr>
<tr><td rowspan="3">Manual torque boost</td><td>0</td><td>◎</td><td>Torque boost</td><td>0.1%</td><td>6/4/3/
2/1.5/1 *</td><td>0–30%</td><td>Set the output voltage at 0Hz as %
* Initial values differ according to the inverter capacity:<table><tr><th>Inverter capacity</th><th>Initial value</th></tr><tr><td>00023</td><td>6%</td></tr><tr><td>00038–00083</td><td>4%</td></tr><tr><td>00125/00170</td><td>3%</td></tr><tr><td>00250–00770</td><td>2%</td></tr><tr><td>00930/01160</td><td>1.5%</td></tr><tr><td>01800 or more</td><td>1%</td></tr></table></td><td>✔</td><td>✔</td><td>✔</td><td rowspan="3">6-30</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">46</td><td rowspan="2">Second torque boost</td><td rowspan="2">0.1%</td><td rowspan="2">9999</td><td>0–30%</td><td>Set the torque boost when the RT signal is on.</td><td rowspan="2">✔</td><td rowspan="2">✔</td><td rowspan="2">✔</td></tr>
<tr><td>9999</td><td>Without second torque boost</td></tr>
<tr><td rowspan="3">Minimum/maximum frequency</td><td>1</td><td>◎</td><td>Maximum frequency</td><td>0.01 Hz</td><td>120/
60Hz *</td><td>0–120Hz</td><td>Set the upper limit of the output frequency
* The setting depends on the inverter capacity:
(01160 or less/01800 or more)</td><td>✔</td><td>✔</td><td>✔</td><td rowspan="3">6-45</td></tr>
<tr><td>2</td><td>◎</td><td>Minimum frequency</td><td>0.01Hz</td><td>0Hz</td><td>0–120Hz</td><td>Set the lower limit of the output frequency</td><td>✔</td><td>✔</td><td>✔</td></tr>
<tr><td></td><td>18</td><td>High speed maximum frequency</td><td>0.01Hz</td><td>120/
60Hz *</td><td>120–400Hz</td><td>Set when performing operation at 120 Hz or more
* The setting depends on the inverter capacity:
(01160 or less/01800 or more)</td><td>✔</td><td>✔</td><td>✔</td></tr>
<tr><td rowspan="6">Base frequency, voltage</td><td>3</td><td>◎</td><td>Base frequency</td><td>0.01Hz</td><td>50Hz</td><td>0–400Hz</td><td>Set the frequency when the motor rated torque is generated. (50Hz/60Hz)</td><td>✔</td><td>✔</td><td>✔</td><td rowspan="6">6-49</td></tr>
<tr><td rowspan="3"></td><td rowspan="3">19</td><td rowspan="3">Base frequency voltage</td><td rowspan="3">0.1 V</td><td rowspan="3">8888</td><td>0–1000V</td><td>Maximum inverter output voltage</td><td rowspan="3">✔</td><td rowspan="3">✔</td><td rowspan="3">✔</td></tr>
<tr><td>8888</td><td>95% of power supply voltage</td></tr>
<tr><td>9999</td><td>Same as power supply voltage</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">47</td><td rowspan="2">Second V/f (base frequency)</td><td rowspan="2">0.01Hz</td><td rowspan="2">9999</td><td>0–400Hz</td><td>Set the base frequency when the RT signal is on.</td><td rowspan="2">✔</td><td rowspan="2">✔</td><td rowspan="2">✔</td></tr>
<tr><td>9999</td><td>Second V/f is invalid.</td></tr>
</table>

Tab. 6-1: *Parameter overview (1)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
Multi-speed setting operation	4	◎	Multi-speed setting (high speed)	0.01Hz	50Hz	0–400Hz	Set frequency when the RH signal is on.	✔	✔	✔	6-54
	5	◎	Multi-speed setting (middle speed)	0.01Hz	30Hz	0–400Hz	Set frequency when the RM signal is on.	✔	✔	✔	
	6	◎	Multi-speed setting (low speed)	0.01Hz	10Hz	0–400Hz	Set frequency when the RL signal is on.	✔	✔	✔	
		24–27	Multi-speed setting 4 speed to 7 speed	0.01Hz	9999	0–400Hz/ 9999	Frequency from 4 speed to 15 speed can be set according to the combination of the RH, RM, RL and REX signals. 9999: not selected	✔	✔	✔	
		232–239	Multi-speed setting 8 speed to 15 speed	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
Acceleration/deceleration time setting	7	◎	Acceleration time	0,1/ 0.01s	5/15s *	0–3600/ 360s	Set the motor acceleration time * Initial values differ according to the inverter capacity: (00170 or less/00250 or more)	✔	✔	✔	6-66
	8	◎	Deceleration time	0,1/ 0.01s	10/30s *	0–3600/ 360s	Set the motor deceleration time * Initial values differ according to the inverter capacity: (00170 or less/00250 or more)	✔	✔	✔	
		20	Acceleration/ deceleration reference frequency	0.01Hz	50Hz	1–400Hz	Set the frequency referenced as acceleration/deceleration time. As acceleration/deceleration time, set the frequency change time from stop to Pr. 20.	✔	✔	✔	
		21	Acceleration/ deceleration time increments	1	0	0	Increments: 0.1s Range: 0–3600s — Increments and setting range of acceleration/ deceleration time setting can be changed.	✔	✔	✔	
						1	Increments: 0.1s Range: 0–3600s				
		44	Second acceleration/ deceleration time	0.1/ 0.01 s	5s	0–3600/ 360s	Set the acceleration/deceleration time when the RT signal is on.	✔	✔	✔	
		45	Second deceleration time	0,1/ 0.01s	9999	0–3600/ 360s	Set the deceleration time when the RT signal is on.	✔	✔	✔	
						9999	Acceleration time = deceleration time				

✔: enabled
—: disabled

Tab. 6-1: *Parameter overview (2)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Motor protection from overheat (electronic thermal relay function)	9	◎	Electronic thermal O/L relay	0.01/ 0.1A *	Rated inverter current	0–500/ 0–3600A *	Set the rated motor current. * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	6-76
		51	Second electronic thermal O/L relay	0.01/ 0.1A *	9999	0–500/ 0–3600A *	Made valid when the RT signal is on. Set the rated motor current. * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	
						9999	Second electronic thermal O/L relay invalid				
DC injection brake	10		DC injection brake operation frequency	0.01Hz	3Hz	0–120Hz	Set the operation frequency of the DC injection brake.	✔	✔	✔	6-83
						9999	Operate when the output frequency becomes less than or equal to Pr. 13 "Starting frequency".				
	11		DC injection brake operation time	0.1s	0.5s	0	DC injection brake disabled	✔	✔	✔	
						0.1–10s	Set the operation time of the DC injection brake.				
						8888	Operate DC injection brake for the time X13 signal is on.				
	12		DC injection brake operation voltage	0.1%	4/2/1% *	0	DC injection brake disabled	✔	✔	✔	
						0.1–30%	Set the DC injection brake voltage (torque). * Initial values differ according to the inverter capacity: (00170 or less/00250–01160/ 01800 or more)				
Starting frequency	13		Starting frequency	0.01Hz	0.5Hz	0–60Hz	Starting frequency can be set.	✔	✔	✔	6-70
		571	Holding time at a start	0.1s	9999	0.0–10.0s	Set the holding time of Pr.13 "Starting frequency".				
						9999	Holding function at stat is invalid.				
V/f pattern matching applications	14		Load pattern selection	1	1	0	For constant torque load	✔	✔	✔	6-51
						1	For variable-torque load				
Jog operation	15		Jog frequency	0.01 Hz	5Hz	0–400Hz	Set the frequency for jog operation.	✔	✔	✔	6-57
	16		Jog acceleration/ deceleration time	0,1/ 0.01 s	0.5s	0–3600/ 360s	Set the acceleration/deceleration time for jog operation. Set the time taken to reach the frequency set in Pr. 20 "Acceleration/deceleration reference frequency" for acceleration/deceleration time (initial value is 60Hz). In addition, acceleration/deceleration time can not be set separately.	✔	✔	✔	

Tab. 6-1: *Parameter overview (3)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
MRS input selection	17		MRS input selection	1	0	0	Open input always	✔	✔	✔	6-99
						2	Normally closed input (NC contact input specifications)				
—	18		Refer to Pr. 1 and Pr. 2								
	19		Refer to Pr. 3								
	20 21		Refer to Pr. 7 and Pr. 8								
Stall prevention operation	22		Stall prevention operation level	0.1%	110%	0	Stall prevention operation selection becomes invalid.	✔	✔	✔	6-35
						0.1–120%	Set the current value at which stall prevention operation is started.				
						9999	Analog variable				
	23		Stall prevention operation level compensation factor at double speed	0.1%	9999	0–150%	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	0.1%	110%	0	Second stall prevention operation invalid	✔	✔	✔	
						0.1–120%	The stall prevention operation level can be set.				
		49	Second stall prevention operation frequency	0.01Hz	0 Hz	0	Second stall prevention operation invalid	✔	✔	✔	
						0.01–400Hz	Set the frequency at which stall prevention operation of Pr. 48 is started.				
						9999	Pr. 48 is valid when the RT signal is on.				
		66	Stall prevention operation reduction starting frequency	0.01Hz	50Hz	0–400Hz	Set the frequency at which the stall operation level is started to reduce.	✔	✔	✔	
		148	Stall prevention level at 0V input.	0.1%	110%	0–120%	Stall prevention operation level can be changed by the analog signal input to terminal 1.	✔	✔	✔	
		149	Stall prevention level at 10V input.	0.1%	120%	0–120%		✔	✔	✔	
		154	Voltage reduction selection during stall prevention operation	1	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	1	0	0–31/100/101	Pr. 156 allows you to select whether to use stall prevention or not according to the acceleration/deceleration status.	✔	✔	✔	
		157	OL signal output timer	0.1 s	0 s	0–25s	Set the output start time of the OL signal output when stall prevention is activated.	✔	✔	✔	
						9999	Without the OL signal output				
—	24 – 27		Refer to Pr. 4 to Pr. 6								
Compensation of the set frequency	28		Multi-speed input compensation selection	1	0	0	Without compensation	✔	✔	✔	6-61
						1	With compensation				

✔: enabled
—: disabled

Tab. 6-1: *Parameter overview (4)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Acceleration/deceleration pattern and backlash compensation	29		Acceleration/deceleration pattern selection	1	0	0	Linear acceleration/deceleration	✔	✔	✔	6-72
						1	S-pattern acceleration/ deceleration A				
						2	S-pattern acceleration/ deceleration B				
						3	Backlash measures				
						6	Variable-torque acceleration/ deceleration				
		140	Backlash acceleration stopping frequency	0.01Hz	1Hz	0–400Hz	Set the stopping frequency and time for backlash measures. Valid when Pr. 29 = 3	✔	✔	✔	
		141	Backlash acceleration stopping time	0.1s	0,5s	0–360s		✔	✔	✔	
		142	Backlash deceleration stopping frequency	0.01Hz	1Hz	0–400Hz		✔	✔	✔	
		143	Backlash deceleration stopping time	0.1s	0.5s	0–360s		✔	✔	✔	
Selection of regeneration unit	30		Regenerative function selection	1	0	0, 10, 20	01160 or less: External brake unit / 01800 or more: No external brake unit	✔	✔	✔	6-86
						1, 11, 21	01160 or less: — / 01800 or more: External brake unit MT-BU5, power regeneration converter MT-RC				
						2	High power factor converter (FR-HC, MT-HC), power regeneration common converter (FR-CV)				
		70	Special regenerative brake duty	0.1%	0%	0–10%	You can set the brake duty when a brake unit or power regeneration converter is used. Setting can be made for the 01800 or more.	✔	✔	✔	
Avoid mechanical resonance points	31		Frequency jump 1A	0.01Hz	9999	0–400Hz/ 9999	1A to 1B, 2A to 2B, 3A to 3B are frequency jumps 9999: Function invalid	✔	✔	✔	6-47
	32		Frequency jump 1B	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	33		Frequency jump 2A	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	34		Frequency jump 2B	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	35		Frequency jump 3A	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	36		Frequency jump 3B	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
Speed display and speed setting	37		Speed display	1	0	0	Frequency display, setting	✔	✔	✔	6-121
						1–9998	Set the machine speed at 60Hz.				
		144	Speed setting switch over	1	4	0/2/4/6/ 8/10/102/ 104/106/ 108/110	Set the number of motor poles when displaying the motor speed.	✔	✔	✔	

Tab. 6-1: *Parameter overview (5)*

<table>
<tr><th rowspan="2">Function</th><th colspan="2">Parameter</th><th rowspan="2">Name</th><th rowspan="2">Increments</th><th rowspan="2">Initial Value</th><th rowspan="2">Setting Range</th><th rowspan="2">Description</th><th>Parameter copy</th><th>Parameter clear</th><th>All parameter clear</th><th rowspan="2">Refer to page</th></tr>
<tr><th></th><th>Related parameters</th><th colspan="3">✔: enabled
—: disabled</th></tr>
<tr><td rowspan="5">Detection of output frequency (SU, FU, FU2)</td><td>41</td><td></td><td>Up-to-frequency sensitivity (SU output)</td><td>0.1%</td><td>10%</td><td>0–100%</td><td>Set the level where the SU signal turns on.</td><td>✔</td><td>✔</td><td>✔</td><td rowspan="5">6-113</td></tr>
<tr><td>42</td><td></td><td>Output frequency detection (FU output)</td><td>0.01Hz</td><td>6Hz</td><td>0–400Hz</td><td>Set the frequency where the FU signal turns on.</td><td>✔</td><td>✔</td><td>✔</td></tr>
<tr><td rowspan="3">43</td><td rowspan="2"></td><td rowspan="2">Output frequency detection for reverse rotation</td><td rowspan="2">0.01Hz</td><td rowspan="2">9999</td><td>0–400Hz</td><td>Set the frequency where the FU signal turns on in reverse rotation.</td><td rowspan="2">✔</td><td rowspan="2">✔</td><td rowspan="2">✔</td></tr>
<tr><td>9999</td><td>Same as Pr.42 setting</td></tr>
<tr><td>50</td><td>Second output frequency detection</td><td>0.01Hz</td><td>30Hz</td><td>0–400Hz</td><td>Set the frequency where the FU2 signal turns on.</td><td>✔</td><td>✔</td><td>✔</td></tr>
<tr><td rowspan="4">—</td><td>44
45</td><td></td><td colspan="9">Refer to Pr. 7 and Pr. 8</td></tr>
<tr><td>46</td><td></td><td colspan="9">Refer to Pr. 0</td></tr>
<tr><td>47</td><td></td><td colspan="9">Refer to Pr. 3</td></tr>
<tr><td>48
49</td><td></td><td colspan="9">Refer to Pr. 22 and Pr. 23</td></tr>
<tr><td rowspan="2">—</td><td>50</td><td></td><td colspan="9">Refer to Pr. 41 to Pr. 43</td></tr>
<tr><td>51</td><td></td><td colspan="9">Refer to Pr. 9</td></tr>
<tr><td rowspan="14">Display functions</td><td rowspan="14">52</td><td></td><td>DU/PU main display data selection</td><td>1</td><td>0</td><td>0/5/6/
8–14/17/
20/23–25/
50–57/100</td><td>Select the monitor to be displayed on the operation panel and parameter unit.
The setting value of "9" is available only for the 01800 or more.</td><td>✔</td><td>✔</td><td>✔</td><td rowspan="14">6-123</td></tr>
<tr><td rowspan="3">170</td><td rowspan="3">Watt-hour meter clear</td><td rowspan="3">1</td><td rowspan="3">9999</td><td>0</td><td>Set "0" to clear the watt-hour meter monitor.</td><td rowspan="3">—</td><td rowspan="3">—</td><td rowspan="3">✔</td></tr>
<tr><td>10</td><td>Set the maximum value when monitoring from communication to 0 to 9999kWh.</td></tr>
<tr><td>9999</td><td>Set the maximum value when monitoring from communication to 0 to 65535kWh.</td></tr>
<tr><td>171</td><td>Operation hour meter clear</td><td>1</td><td>9999</td><td>0/9999</td><td>Set "0" in the parameter to clear the watt hour monitor.
Setting "9999" has no effect.</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="3">268</td><td rowspan="3">Monitor decimal digits selection</td><td rowspan="3">1</td><td rowspan="3">9999</td><td>0</td><td>Displays the monitor as integral value.</td><td rowspan="3">✔</td><td rowspan="3">✔</td><td rowspan="3">✔</td></tr>
<tr><td>1</td><td>Displays the monitor in increments of 0.1.</td></tr>
<tr><td>9999</td><td>No fixed decimal position</td></tr>
<tr><td>563</td><td>Energizing time carrying-over times</td><td>1</td><td>0</td><td>0–65535</td><td>The numbers of cumulative energizing time monitor exceeded 65535h is displayed.
Reading only</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>564</td><td>Operating time carrying-over times</td><td>1</td><td>0</td><td>0–65535</td><td>The numbers of operation time monitor exceeded 65535h is displayed.
Reading only</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="2">891</td><td rowspan="2">Cumulative power monitor digit shifted times</td><td rowspan="2">1</td><td rowspan="2">9999</td><td>0–4</td><td>Set the number of times to shift the cumulative power monitor digit.
Clamp the monitor value at maximum.</td><td rowspan="2">✔</td><td rowspan="2">✔</td><td rowspan="2">✔</td></tr>
<tr><td>9999</td><td>No shift
Clear the monitor value when it exceeds the maximum value.</td></tr>
</table>

Tab. 6-1: *Parameter overview (6)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Change of the monitor output from terminal CA and AM	54		CA terminal function selection	1	1	1–3/5/6/ 8–14/17/21/ 24/50/52/53	Select the monitor output to terminal CA. The setting value of "9" is available only for the 01800 or more.	✔	✔	✔	6-130
	55		Frequency monitoring reference	0.01 Hz	50Hz	0–400Hz	Set the full-scale value to output the output frequency monitor value to terminal CA and AM.	✔	✔	✔	
	56		Current monitoring reference	0.01/ 0.1 A *	Rated inverter current	0–500/ 0–3600A *	Set the full-scale value to output the output current monitor value to terminal CA and AM. * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	
		158	AM terminal function selection	1	1	1–3/5/6/ 8–14/17/21/ 24/50/52/53	Select the monitor output to terminal AM. The setting value of "9" is available only for the 01800 or more.	✔	✔	✔	
		867	AM output filter	0.01s	0.01s	0–5s	Set the output filter of terminal AM.	✔	✔	✔	
		869	Current output filter	0.01s	0.02s	0–5s	Adjust response level of current output.	✔	✔	✔	
Restart operation after instantaneous power failure	57		Restart coasting time	0.1s	9999	0	The coasting time is as follows: 00038 or less:...................... 0.5s, 00052–00170: .... 1s, 00250–01160: .... 3.0s, 01800 or more:..................... 5.0s	✔	✔	✔	6-137
						0,1–5s/ 0.1–30s *	Set the waiting time for inverter-triggered restart after an instantaneous power failure. * The setting depends on the inverter capacity: (01160 or less/01800 or more)				
						9999	No restart				
	58		Restart cushion time	0.1s	1s	0–60s	Set a voltage starting time at restart.	✔	✔	✔	
		162	Automatic restart after instantaneous power failure selection	1	0	0	With frequency search	✔	✔	✔	
						1	Without frequency search (Reduced voltage system)				
						10	Frequency search at every start				
						11	Reduced voltage system at every start				
		163	First cushion time for restart	0.1s	0s	0–20s	Set a voltage starting time at restart. Consider according to the magnitude of load (inertia moment/ torque).	✔	✔	✔	
		164	First cushion voltage for restart	0.1%	0%	0–100%		✔	✔	✔	
		165	Stall prevention operation level for restart	0.1%	110%	0–120%	Consider the rated inverter current as 100% and set the stall prevention operation level during restart operation.	✔	✔	✔	
		299	Rotation direction detection selection at restarting	1	9999	0	Without rotation direction detection	✔	✔	✔	
						1	With rotation direction detection				
						9999	When Pr. 78 = "0", the rotation direction is detected. When Pr. 78 = "1", "2", the rotation direction is not detected.				
		611	Acceleration time at a restart	0.1s	5/15s *	0–3600s	Set the acceleration time to reach the set frequency at a restart. * The setting depends on the inverter capacity: (01160 or less/ 01800 or more)	✔	✔	✔	
						9999	Acceleration time for restart is the normal acceleration time (e.g. Pr. 7).				

Tab. 6-1: *Parameter overview (7)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description		Parameter copy	Parameter clear	All parameter clear	Refer to page
									✔: enabled —: disabled			
Remote setting function	59		Remote function selection	1	0		**RH, RM, RL signal function**	**Frequency setting storage function**	✔	✔	✔	6-62
						0	Multi-speed setting	—				
						1	Remote setting	Yes				
						2	Remote setting	No				
						3	Remote setting	No (Turning STF/ STR off clears remote setting frequency.)				
						11	Remote setting	Yes				
						12	Remote setting	No				
						13	Remote setting	No (Turning STF/ STR off clears remote setting frequency.)				
Energy saving control selection	60	◎	Energy saving control selection	1	0	0	Normal operation mode		✔	✔	✔	6-158
						4	Energy saving operation mode					
						9	Optimum excitation control mode (OEC)					
Retry function at alarm occurrence	65		Retry selection	1	0	0–5	An alarm for retry can be selected.		✔	✔	✔	6-152
		67	Number of retries at alarm occurrence	1	0	0	No retry function		✔	✔	✔	
						1–10	Set the number of retries at alarm occurrence. An alarm output is not provided during retry operation.					
						101–110	Set the number of retries at alarm occurrence. (The setting value minus 100 is the number of retries.) An alarm output is provided during retry operation.					
		68	Retry waiting time	0.1s	1s	0–10s	Set the waiting time from when an inverter alarm occurs until a retry is made.		✔	✔	✔	
		69	Retry count display erase	1	0	0	Clear the number of restarts succeeded by retry.		✔	✔	✔	
—	66		Refer to Pr. 22 and Pr. 23									
	67–69		Refer to Pr. 65									
—	70		Refer to Pr. 30									
Applied motor	71		Applied motor	1	0	0	Thermal characteristics of a standard motor		✔	✔	✔	6-82
						1	Thermal characteristics of the Mitsubishi constant-torque motor					
						2	Thermal characteristic of standard motor Adjustable 5 points V/F					
						20	Mitsubishi standard motor (SF-JR 4P 1.5kW or less)					

Tab. 6-1: *Parameter overview (8)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Carrier frequency and Soft-PWM selection	72		PWM frequency selection	1	2	0–15/ 0–6/25 *	PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz, 15 indicates 14.5kHz and 25 indicates 2.5kHz. * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	6-167
		240	Soft-PWM operation selection	1	1	0	Soft-PWM invalid	✔	✔	✔	
						1	When Pr. 72 = "0 to 5" ("0 to 4" for the 01800 or more), Soft-PWM is valid.				
		260	PWM frequency automatic switch over	1	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.				
Analog input selection	73		Analog input selection	1	1	0–7/10–17	Input specification (0 to 5V, 0 to 10V) of terminal 2 and 1 can be selected. Override and reversible operation can be selected.	✔	—	✔	6-170
		242	Terminal 1 added compensation amount (terminal 2)	0.1%	100%	0–100%	Set the ratio of added compensation amount when terminal 2 is the main speed.	✔	✔	✔	
		243	Terminal 1 added compensation amount (terminal 4)	0.1%	75%	0–100%	Set the ratio of added compensation amount when terminal 4 is the main speed.	✔	✔	✔	
		252	Override bias	0.1%	50%	0–200%	Set the bias side compensation value of override function.	✔	✔	✔	
		253	Override gain	0.1%	150%	0–200%	Set the gain side compensation value of override function.	✔	✔	✔	
		267	Terminal 4 input selection	1	0	0	Terminal 4 input 0/4 to 20mA	✔	—	✔	
						1	Terminal 4 input 0 to 5V				
						2	Terminal 4 input 0 to 10V				
		573	4mA input check selection	1	9999	1	When the current input drops to or below 2mA, the LF signal is output and inverter continues operation at the frequency just before current reaches 2mA.	✔	✔	✔	
						9999	4mA input is not checked.				
Noise elimination at the analog input	74		Input filter time constant	1	1	0–8	The primary delay filter time constant for the analog input can be set. A larger setting results in a larger filter.	✔	✔	✔	6-180

Tab. 6-1: *Parameter overview (9)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Reset selection/ disconnected PU/PU stop	75		Reset selection/disconnected PU detection/ PU stop selection	1	14	0–3/14–17/ 100–103/ 114–117 *	You can select the reset input acceptance, disconnected PU (FR-PUO7) connector detection function and PU stop function, and reset restriction (01800 or more). For the initial value, reset always enabled, without disconnected PU detection, with PU stop function, and without reset restriction (01800 or more) are set. * 100 to 103 and 114 to 117 can be set only for 01800 or more.	✔	—	—	6-192
Output function of alarm code	76		Alarm code output selection	1	0	0	Without alarm code output	✔	✔	✔	6-155
						1	With alarm code output				
						2	Alarm code output at alarm occurrence only				
Prevention of parameter rewrite	77		Parameter write selection	1	0	0	Write is enabled only during a stop	✔	✔	✔	6-197
						1	Parameter write is disabled.				
						2	Parameter write is enabled in any operation mode regardless of operation status.				
Prevention of reverse rotation of the motor	78		Reverse rotation prevention selection	1	0	0	Both forward and reverse rotations allowed	✔	✔	✔	6-199
						1	Reverse rotation disallowed				
						2	Forward rotation disallowed				
Operation mode selection	79	◎	Operation mode selection	1	0	0	External/PU switch over mode	✔	✔	✔	6-203
						1	Fixed to PU operation mode				
						2	Fixed to External operation mode				
						3	External/PU combined operation mode 1				
						4	External/PU combined operation mode 2				
						6	Switch-over mode				
						7	External operation mode (PU operation interlock)				
		340	Communication start-up mode selection	1	0	0	As set in Pr. 79.	✔	✔	✔	6-215
						1/2	Started in the network operation mode. When the setting is "2", it will resume the preinstantaneous power failure operation mode after an instantaneous power failure occurs.				
						10/12	Started in the network operation mode. Operation mode can be changed between the PU operation mode and network operation mode from the operation panel. When the setting is "12", it will resume the preinstantaneous power failure operation mode after an instantaneous power failure occurs.				

Tab. 6-1: *Parameter overview (10)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Simple magnetic flux vector control	80		Motor capacity (simple magnetic flux vector control)	0.01/ 0.1kW *	9999	0.4–55kW/ 0–3600kW *	To select the simple magnetic flux vector control, set the capacity of the motor used. * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	6-33
						9999	V/f control is performed				
	90		Motor constant R1	0.001Ω/ 0.01mΩ*	9999	0–50Ω/ 0–400mΩ *	Used to set the motor primary resistance value. (Normally setting is not necessary.) * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	
						9999	Use the Mitsubishi motor (SF-JR, SF-HRCA) constants				
Adjustable 5 points V/f	100		V/f1(first frequency)	0.01Hz	9999	0–400Hz/ 9999	Set each points (frequency, voltage) of V/f pattern. 9999: No V/f setting	✔	✔	✔	6-52
	101		V/f1 (first frequency voltage)	0.1V	0V	0–1000V		✔	✔	✔	
	102		V/f2 (second frequency)	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	103		V/f2 (second frequency voltage)	0.1V	0V	0–1000V		✔	✔	✔	
	104		V/f3 (third frequency)	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	105		V/f3 (third frequency voltage)	0.1V	0V	0–1000V		✔	✔	✔	
	106		V/f4 (fourth frequency)	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	107		V/f4 (fourth frequency voltage)	0.1V	0V	0–1000V		✔	✔	✔	
	108		V/f5 (fifth frequency)	0.01Hz	9999	0–400Hz/ 9999		✔	✔	✔	
	109		V/f5 (fifth frequency voltage)	0.1V	0V	0–1000V		✔	✔	✔	
		71	Refer to page 6-8								

Tab. 6-1: *Parameter overview (11)*

<table>
<tr><th rowspan="2">Function</th><th>Parameter</th><th rowspan="2">Name</th><th rowspan="2">Increments</th><th rowspan="2">Initial Value</th><th rowspan="2">Setting Range</th><th rowspan="2">Description</th><th>Parameter copy</th><th>Parameter clear</th><th>All parameter clear</th><th rowspan="2">Refer to page</th></tr>
<tr><th>Related parameters</th><th colspan="3">✔: enabled
—: disabled</th></tr>
<tr><td rowspan="20">Communication initial setting</td><td>117</td><td>PU communication station</td><td>1</td><td>0</td><td>0–31</td><td>Specify the inverter station number. Set the inverter station numbers when two or more inverters are connected to one personal computer.</td><td>✔</td><td>✔</td><td>✔</td><td rowspan="20">6-233</td></tr>
<tr><td>118</td><td>PU communication speed</td><td>1</td><td>192</td><td>48/96/
192/384</td><td>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><td>✔</td><td>✔</td><td>✔</td></tr>
<tr><td rowspan="4">119</td><td rowspan="4">PU communication stop bit length.</td><td rowspan="4">1</td><td rowspan="4">1</td><td>0</td><td>Stop bit length: 1bit
data length: 8bit</td><td rowspan="4">✔</td><td rowspan="4">✔</td><td rowspan="4">✔</td></tr>
<tr><td>1</td><td>Stop bit length: 2bit
data length: 8bit</td></tr>
<tr><td>10</td><td>Stop bit length: 1bit
data length: 7bit</td></tr>
<tr><td>11</td><td>Stop bit length: 2bit
data length: 7bit</td></tr>
<tr><td rowspan="3">120</td><td rowspan="3">PU communication parity check</td><td rowspan="3">1</td><td rowspan="3">2</td><td>0</td><td>Without parity check</td><td rowspan="3">✔</td><td rowspan="3">✔</td><td rowspan="3">✔</td></tr>
<tr><td>1</td><td>With odd parity check</td></tr>
<tr><td>2</td><td>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 rowspan="2">1</td><td>0–10</td><td>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><td rowspan="2">✔</td><td rowspan="2">✔</td><td rowspan="2">✔</td></tr>
<tr><td>9999</td><td>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">0.1s</td><td rowspan="3">9999</td><td>0</td><td>No PU connector communication</td><td rowspan="3">✔</td><td rowspan="3">✔</td><td rowspan="3">✔</td></tr>
<tr><td>0.1–999.8s</td><td>Set the communication check time interval. 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>No communication check</td></tr>
<tr><td rowspan="2">123</td><td rowspan="2">PU communication waiting time setting</td><td rowspan="2">1</td><td rowspan="2">9999</td><td>0–150ms</td><td>Set the waiting time between data transmission to the inverter and response.</td><td rowspan="2">✔</td><td rowspan="2">✔</td><td rowspan="2">✔</td></tr>
<tr><td>9999</td><td>Set with communication data.</td></tr>
</table>

Tab. 6-1: *Parameter overview (12)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Communication initial setting	124		PU communication CR/LF presence/ absence selection	1	1	0	Without CR/LF	✔	✔	✔	6-233
						1	With CR				
						2	With CR/LF				
		331	RS-485 communication station	1	0	0–31 (0–247)	Set the inverter station number. (same specifications as Pr.117) When "1" (Modbus-RTU protocol) is set in Pr.551, the setting range within parenthesis is applied.	✔	✔	✔	
		332	RS-485 communication speed	1	96	3/6/12/24/ 48/96/192/ 384	Used to select the communication speed. (same specifications as Pr. 118)	✔	✔	✔	
		333	RS-485 communication stop bit length	1	1	0/1/10/11	Select stop bit length and data length. (same specifications as Pr. 119)	✔	✔	✔	
		334	RS-485 communication parity check selection	1	2	0/1/2	Select the parity check specifications. (same specifications as Pr. 120)	✔	✔	✔	
		335	RS-485 communication retry count	1	1	0–10/9999	Set the permissible number of retries at occurrence of a data receive error. (same specifications as Pr. 121)	✔	✔	✔	
		336	RS-485 communication check time interval	0.1s	0s	0	RS-485 communication can be made, but the inverter will come to an alarm stop in the NET operation mode.	✔	✔	✔	
						01–9998s	Set the communication check time interval. (same specifications as Pr. 122)				
						9999	No communication check				
		337	RS-485 communication waiting time setting	1	9999	0–150ms/ 9999	Set the waiting time between data transmission to the inverter and response. (same specifications as Pr. 123)	✔	✔	✔	
		341	RS-485 communication CR/LF selection	1	1	0/1/2	Select presence/absence of CR/LF. (same specifications as Pr. 124)	✔	✔	✔	
		342	Communication E^2PROM write selection	1	0	0	Parameter values written by communication are written to the E^2PROM and RAM.	✔	✔	✔	
						1	Parameter values written by communication are written to the RAM.				
		343	Communication error count	1	0	Read only	Display the number of communication errors during Modbus-RTU communication. Read only. Displayed only when Modbus-RTU protocol is selected.	—	—	—	
		549	Protocol selection	1	0	0	Mitsubishi inverter (computer link) protocol — After setting change, reset (switch power off, then on) the inverter. The setting change is reflected after a reset.	✔	✔	✔	
						1	Modbus-RTU protocol				

Tab. 6-1: *Parameter overview (13)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description		Parameter copy	Parameter clear	All parameter clear	Refer to page
									✔: enabled —: disabled			
Change of analog input frequency, adjustment of voltage, current input and frequency (calibration)	125	◎	Terminal 2 frequency setting gain frequency	0.01Hz	50Hz	0–400Hz	Set the frequency of terminal 2 input gain (maximum).		✔	—	✔	6-181
	126	◎	Terminal 4 frequency setting gain frequency	0.01Hz	50Hz	0–400Hz	Set the frequency of terminal 4 input gain (maximum).		✔	—	✔	
		241	Analog input display unit switch over	1	0	0	Displayed in %	Select the unit for analog input display.	✔	✔	✔	
						1	Displayed in V/mA					
		C2 (902)	Terminal 2 frequency setting bias frequency	0.01Hz	0Hz	0–400Hz	Set the frequency on the bias side of terminal 2 input.		✔	—	✔	
		C3 (902)	Terminal 2 frequency setting bias	0.1%	0%	0–300%	Set the converted % of the bias side voltage (current) of terminal 2 input.		✔	—	✔	
		C4 (903)	Terminal 2 frequency setting gain	0.1%	100%	0–300%	Set the converted % of the gain side voltage of terminal 2 input.		✔	—	✔	
		C5 (904)	Terminal 4 frequency setting bias frequency	0.01Hz	0Hz	0–400Hz	Set the frequency on the bias side of terminal 4 input.		✔	—	✔	
		C6 (904)	Terminal 4 frequency setting bias	0.1%	20%	0–300%	Set the converted % of the bias side current (voltage) of terminal 4 input.		✔	—	✔	
		C7 (905)	Terminal 4 frequency setting gain	0.1%	100%	0–300%	Set the converted % of the gain side current (voltage) of terminal 4 input.		✔	—	✔	
PID control	127		PID control automatic switchover frequency	0.01Hz	9999	0–400Hz	Set the frequency at which the control is automatically changed to PID control.		✔	✔	✔	6-271
						9999	Without PID automatic switchover function					
	128		PID action selection	1	10	10, 110	PID reverse action	Deviation value signal (terminal 1)	✔	✔	✔	
						11, 111	PID forward action					
						20, 120	PID reverse action	Measured value input (terminal 4) Set value (terminal 2 or Pr. 133)				
						21, 121	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 value input (LONWORKS, CC-Link communication)				
						61	PID forward action					
	129		PID proportional band	0.1%	100%	0.1–1000%	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the measured value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain K = 1/proportional band		✔	✔	✔	
						9999	No proportional control.					

Tab. 6-1: *Parameter overview (14)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
PID control	130		PID integral time	0.1s	1s	0.1–3600s	Time 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.	✔	✔	✔	6-271
						9999	No integral control.				
	131		PID upper limit	0.1%	9999	0–100%	Set the upper limit value. If the feedback value exceeds the setting, the FUP signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	✔	✔	✔	
						9999	No function				
	132		PID lower limit	0.1%	9999	0–100%	Set the lower limit value. If the process value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	✔	✔	✔	
						9999	No function				
	133		PID action set point	0.01%	9999	0–100%	Used to set the set point for PID control in the PU operation mode.	✔	✔	✔	
						9999	Terminal 2 input voltage is the set point.				
	134		PID differential time	0.01s	9999	0.01–10.00s	Time required for only the differential (D) action to provide the same manipulated variable as that for the proportional (P) action. As the differential time increases, greater response is made to a deviation change.	✔	✔	✔	
						9999	No differential control.				
		553	PID deviation limit	0.1%	9999	0–100.0%	Y48 signal is output when the absolute value of deviation amount exceeds the deviation limit value.	✔	✔	✔	
						9999	No function				
		554	PID signal operation selection	1	0	0–3, 10–13	Select the operation to be performed at the detection of upper, lower, and deviation limit for the measured value input. The operation for PID output suspension function can be selected.	✔	✔	✔	
		575	Output interruption detection time	0.1s	1s	0–3600s	If the output frequency after PID operation remains lower than the Pr. 576 setting for longer than the time set in Pr. 575, the inverter stops operation.	✔	✔	✔	
						9999	Without output interruption function				
		576	Output interruption detection level	0.01Hz	0Hz	0–400Hz	Set the frequency at which the output interruption processing is performed.	✔	✔	✔	
		577	Output interruption release level	0.1%	1000%	900–1100%	Set the level (Pr. 577 minus 1000%) to release the PID output interruption function.	✔	✔	✔	

Tab. 6-1: *Parameter overview (15)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
PID Control		C42 (934)	PID display bias coefficient	0.01	9999	0–500.00	Set the coefficient on bias (minimum) side of terminal 4 input.	✔	—	✔	6-271
						9999	Displayed in %.				
		C43 (934)	PID display bias value	0.1%	20%	0–300.0%	Set the converted % on bias (minimum) side current /voltage of terminal 4 input.	✔	—	✔	
		C44 (935)	PID display gain coefficient	0.01	9999	0–500.00	Set the coefficient on gain (maximum) side of the terminal 4 input.	✔	—	✔	
						9999	Displayed in %.				
		C45 (935)	PID display gain value	0.1%	100%	0–300.0%	Set the converted % on gain (maximum) side of current/voltage of terminal 4 input.	✔	—	✔	
Switch between the inverter operation and commercial power-supply operation	135		Commercial power supply switchover sequence output terminal selection	1	0	0	Without commercial power-supply switchover sequence	✔	✔	✔	6-290
						1	With commercial power-supply switchover sequence				
	136		MC switchover interlock time	0.1s	1s	0–100s	Set the operation interlock time of MC2 and MC3.	✔	✔	✔	
	137		Start waiting time	0.1s	0.5s	0–100s	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		Commercial power supply operation switchover selection at an alarm	1	0	0	Inverter output is stopped (motor coast) at inverter fault.	✔	✔	✔	
						1	Operation is automatically switched to the commercial power-supply operation at inverter fault. (Not switched when an external thermal error occurs.)				
	139		Automatic switchover frequency between inverter and commercial power-supply operation	0.01Hz	9999	0–60Hz	Set the frequency to switch the inverter operation to the commercial power-supply operation.	✔	✔	✔	
						9999	Without automatic switchover				
		159	Automatic switchover ON range between commercial power-supply and inverter operation	0.01Hz	9999	0–10Hz	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 commercial power-supply operation, the inverter automatically switches operation to the inverter operation and operates at the frequency of frequency command. When the inverter start command (STF/STR) is turned off, operation is switched to the 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 the inverter operation to commercial power-supply inverter operation, operation is switched to the inverter operation and the motor decelerates to stop.				

Tab. 6-1: *Parameter overview (16)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
—	140 – 143		Refer to Pr. 29								
	144		Refer to Pr. 37								
Parameter unit language switchover	145		PU display language selection	1	1	0	Japanese	✔	—	—	6-327
						1	English				
						2	German				
						3	French				
						4	Spanish				
						5	Italian				
						6	Swedish				
						7	Finnish				
—	148 149		Refer to Pr. 22 and Pr. 23								
Detection of output current (Y12 signal) and Detection of zero current (Y13 signal)	150		Output current detection level	0.1%	110%	0–120%	Set the output current detection level. 100% is the rated inverter current.	✔	✔	✔	6-115
	151		Output current detection signal delay time	0.1s	0s	0–10s	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	0.1%	5%	0–150%	Set the zero current detection level. Suppose that the rated inverter current at the specified overload capacity is 100%.	✔	✔	✔	
	153		Zero current detection time	0.01s	0.5s	0–10s	Set this parameter to define the period from when the output current drops below the Pr. 152 value until the zero current detection signal (Y13) is output.	✔	✔	✔	
		166	Output current detection signal retention time	0.1s	0.1s	0–10s	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	1	0		**Y12 Signal-ON** / **Y13 Signal-ON**	✔	✔	✔	
						0	Operation continued / Operation continued				
						1	Fault stop (E.CDO) / Operation continued				
						10	Operation continued / Fault stop (E.CDO)				
						11	Fault stop (E.CDO) / Fault stop (E.CDO)				
—	154		Refer to Pr. 22 and Pr. 23								
Selection of action conditions of the second function	155		RT signal reflection time selection	1	0	0	Second function is immediately made valid with on of the RT (X9) signal.	✔	✔	✔	6-101
						10	Second function is valid only during the RT signal is on and constant speed operation. (Invalid during acceleration/deceleration)				

Tab. 6-1: *Parameter overview (17)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description		Parameter copy	Parameter clear	All parameter clear	Refer to page
									✔: enabled —: disabled			
—	156 157		Refer to Pr. 22 and Pr. 23									
	158		Refer to Pr. 54 to Pr. 56									
	159		Refer to Pr. 135 and Pr. 139									
Display of applied parameters and user group function	160	◎	User group read selection	1	9999	9999	Only the simple mode parameters can be displayed.		✔	✔	✔	6-200
						1	Only parameters registered in the user group can be displayed.					
						0	Simple mode and extended mode parameters can be displayed.					
		172	User group registered display/batch clear	1	0	(0–16)	Displays the number of cases registered as a user group (reading only).		✔	—	—	
						9999	Batch clear the user group registration					
		173	User group registration	1	9999	0–999/9999	Set the parameter numbers to be registered to the user group. Read value is always "9999".		✔	—	—	
		174	User group clear	1	9999	0–999/9999	Set the parameter numbers to be cleared from the user group. Read value is always "9999".		✔	—	—	
Operation selection of the operation panel	161		Frequency setting/key lock operation selection	1	0	0	Setting dial frequency setting mode	Key lock mode invalid	✔	—	✔	6-328
						1	Setting dial potentiometer mode					
						10	Setting dial frequency setting mode	Key lock mode valid				
						11	Setting dial potentiometer mode					
—	162 – 165		Refer to Pr. 57 and Pr. 58									
	166 167		Refer to Pr. 150 to Pr. 153									
	168 169		Parameter for manufacturer setting. Do not set.									
	170 171		Refer to Pr. 52									
	172 – 174		Refer to Pr. 160									

Tab. 6-1: *Parameter overview (18)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
Function assignment of input terminal	178		STF terminal function selection	1	60	0–8/10–14/16/24/25/37/60/62/64–67/70–72/9999	0: Low-speed operation command 1: Middle-speed operation command 2: High-speed operation command 3: Second function selection 4: Terminal 4 input selection 5: Jog operation selection 6: Selection of automatic restart after instantaneous power failure 7: External thermal relay input 8: Fifteen speed selection 10: Inverter operation enable signal (FR-HC, MT-HC, FR-CV connection) 11: FR-HC, MT-HC connection, instantaneous power failure detection 12: PU operation external interlock 13: External DC injection brake start 14: PID control valid terminal 16: PU-external operation switchover 24: Output stop 25: Start self-holding selection 37: Traverse function selection 60: Forward rotation command (assigned to STF terminal (Pr.178) only) 61: Reverse rotation command (assigned to STR terminal (Pr.179) only) 62: Inverter reset 63: PTC thermistor input (assigned to AU terminal (Pr.184) only) 64: PID forward/reverse action switchover 65: NET/PU operation switchover 66: External/NET operation switchover 67: Command source switchover 70: DC feeding operation permission 71: DC feeding cancel 72: PID integral value reset 9999: No function	✔	—	✔	6-96
	179		STR terminal function selection	1	61	0–8/10–14/16/24/25/37/61/62/64–67/70–72/9999		✔	—	✔	
	180		RL terminal function selection	1	0	0–8/10–14/16/24/25/37/62/64–67/70–72/9999		✔	—	✔	
	181		RM terminal function selection	1	1			✔	—	✔	
	182		RH terminal function selection	1	2			✔	—	✔	
	183		RT terminal function selection	1	3			✔	—	✔	
	184		AU terminal function selection	1	4	0–8/10–14/16/24/25/37/64–67/70–72/9999		✔	—	✔	
	185		JOG terminal function selection	1	5	0–8/10–14/16/24/25/37/62/64–67/70–72/9999		✔	—	✔	
	186		CS terminal function selection	1	6			✔	—	✔	
	187		MRS terminal function selection	1	24			✔	—	✔	
	188		STOP terminal function selection	1	25			✔	—	✔	
	189		RES terminal function selection	1	62			✔	—	✔	

✔: enabled
—: disabled

Tab. 6-1: *Parameter overview (19)*

<table>
<tr><th rowspan="2">Function</th><th rowspan="2">Parameter</th><th rowspan="2">Related parameters</th><th rowspan="2">Name</th><th rowspan="2">Increments</th><th rowspan="2">Initial Value</th><th rowspan="2">Setting Range</th><th rowspan="2">Description</th><th>Parameter copy</th><th>Parameter clear</th><th>All parameter clear</th><th rowspan="2">Refer to page</th></tr>
<tr><th colspan="3">✔: enabled
—: disabled</th></tr>
<tr><td rowspan="7">Function assignment of output terminal</td><td>190</td><td></td><td>RUN terminal function selection</td><td>1</td><td>0</td><td rowspan="5">0–5/7/8/ 10–19/25/ 26/45–48/ 64/70–79/ 85/90–96/ 98/99/ 100–105/ 107/108/ 110–116/ 125/126/ 145–148/ 164/170/ 179/185 190–196/ 198/199/ 9999</td><td rowspan="7">0/100: Inverter running
1/101: Up to frequency
2/102: Instantaneous power failure/under voltage
3/103: Overload alarm
4/104: Output frequency detection
5/105: Second output frequency detection
7/107: Regenerative brake prealarm (≥ 01800)
8/108: Electronic thermal relay function prealarm
10/110: PU operation mode
11/111: Inverter operation ready
12/112: Output current detection
13/113: Zero current detection
14/114: PID lower limit
15/115: PID upper limit
16/116: PID forward/reverse rotation output
17/–: Commercial power-supply switchover MC1
18/–: Commercial power-supply switchover MC2
19/–: Commercial power-supply switchover MC3
25/125: Fan fault output
26/126: Heatsink overheat prealarm
45/145: Inverter running and start command is on
46/146: During deceleration at occurrence of power failure (retained until release)
47/147: PID control activated
48/148: PID deviation limit
64/164: During retry
70/170: PID output interruption
71: Commercial-power supply side motor 1 connection RO1
72: Commercial-power supply side motor 2 connection RO2
73: Commercial-power supply side motor 3 connection RO3
74: Commercial-power supply side motor 4 connection RO4
75: Inverter side motor 1 connection RIO1
76: Inverter side motor 2 connection RIO2
77: Inverter side motor 3 connection RIO3
78: Inverter side motor 4 connection RIO4
79/179: Pulse train output of output power
85/185: DC feeding
90/190: Life alarm
91/191: Alarm output 3 (power-off signal)
92/192: Energy saving average value updated timing
93/193: Current average monitor
94/194: Alarm output 2
95/195: Maintenance timer alarm
96/196: Remote output
98/198: Minor fault output
99/199: Alarm output
9999: No function
0–99: Source logic
100–199: Sink logic</td><td>✔</td><td>—</td><td>✔</td><td rowspan="7">6-107</td></tr>
<tr><td>191</td><td></td><td>SU terminal function selection</td><td>1</td><td>1</td><td>✔</td><td>—</td><td>✔</td></tr>
<tr><td>192</td><td></td><td>IPF terminal function selection</td><td>1</td><td>2</td><td>✔</td><td>—</td><td>✔</td></tr>
<tr><td>193</td><td></td><td>OL terminal function selection</td><td>1</td><td>3</td><td>✔</td><td>—</td><td>✔</td></tr>
<tr><td>194</td><td></td><td>FU terminal function selection</td><td>1</td><td>4</td><td>✔</td><td>—</td><td>✔</td></tr>
<tr><td>195</td><td></td><td>ABC1 terminal function selection</td><td>1</td><td>99</td><td rowspan="2">0–5/7/8/ 10–19/25/ 26/45–48/ 64/70–79/ 85/90/91/ 94–96/98/ 99/ 100–105/ 107/108/ 110–116/ 125/126/ 145–148/ 164/170/ 179/185 190/191/ 194–196/ 198/199/ 9999</td><td>✔</td><td>—</td><td>✔</td></tr>
<tr><td>196</td><td></td><td>ABC2 terminal function selection</td><td>1</td><td>9999</td><td>✔</td><td>—</td><td>✔</td></tr>
</table>

Tab. 6-1: *Parameter overview (20)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description		Parameter copy	Parameter clear	All parameter clear	Refer to page
									✔: enabled —: disabled			
—	232 – 239		Refer to Pr. 4 to Pr. 6									
	240		Refer to Pr. 72									
	241		Refer to Pr. 125 and Pr. 126									
	242 243		Refer to Pr. 73									
Increase cooling fan life	244		Cooling fan operation selection	1	1	0	Operates at power on Cooling fan on/off control invalid (The cooling fan is always on at power on.)		✔	✔	✔	6-316
						1	Cooling fan on/off control valid					
Slip compensation	245		Rated slip	0.01%	9999	0–50%	Used to set the rated motor slip.		✔	✔	✔	6-34
						9999	No slip compensation					
	246		Slip compensation time constant	0.01s	0.5 s	0.01–10s	Used to set the response time of slip compensation. When the value is made smaller, response will be faster. However, as load inertia is greater, a regenerative over voltage (E.OV☐) error is more liable to occur.		✔	✔	✔	
	247		Constant-output region slip compensation selection	1	9999	0	Slip compensation is not made in the constant output range (frequency range above the frequency set in Pr. 3)		✔	✔	✔	
						9999	Slip compensation is made in the constant output range.					
Selection of motor stopping method	250		Stop selection	0.1s	9999	0–100s	The motor is coasted to a stop when the preset time elapses after the start signal is turned off. When 1000s to 1100s is set (Pr. 250 setting – 1000)s later, the motor coasts to stop.	STF signal: Forward rotation start STR signal: Reverse rotation start	✔	✔	✔	6-88
						1000–1100s		STF signal: Start signal STR signal: Forward/reverse signal				
						8888	When the start signal is turned off, the motor decelerates to stop.	STF signal: Start signal STR signal: Forward/reverse signal				
						9999		STF signal: Forward rotation start STR signal: Reverse rotation start				
Input/output phase loss protection selection	251		Output phase loss protection selection	1	1	0	Without output phase loss protection		✔	✔	✔	6-157
						1	With output phase loss protection					
		872	Input phase loss protection selection	1	0	0	Without input phase loss protection		✔	✔	✔	
						1	With input phase loss protection					

Tab. 6-1: *Parameter overview (21)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
—	252 253		Refer to Pr. 73								
Display of the life of the inverter parts	255		Life alarm status display	1	0	(0–15)	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.	—	—	—	6-317
	256		Inrush current limit circuit life display	1%	100%	(0–100%)	Display the deterioration degree of the inrush current limit circuit. (Reading only)	—	—	—	
	257		Control circuit capacitor life display	1%	100%	(0–100%)	Display the deterioration degree of the control circuit capacitor. (Reading only)	—	—	—	
	258		Main circuit capacitor life display	1%	100%	(0–100%)	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	1	0	0/1	Start measuring the main circuit capacitor life. Switch the power supply on again and check the Pr. 259 setting. Measurement is complete if the setting is "3". Set the deterioration degree in Pr. 258.	✔	✔	✔	
—	260		Refer to Pr. 72								
Decelerate the motor to a stop at instantaneous power failure	261		Power failure stop selection	1	0		**Operation at undervoltage/ power failure** / **At power restoration during power failure deceleration**	✔	✔	✔	6-145
						0	Coasts to a stop				
						1	Decelerates to a stop				
						2	Decelerates to a stop / Accelerates again				
						21	Decelerates to a stop / Decelerates to a stop				
						22	Decelerates to a stop / Accelerates again				
	262		Subtracted frequency at deceleration start	0.01Hz	3Hz	0–20Hz	Normally operation can be performed with the initial value unchanged. But adjust the frequency according to the magnitude of the load specifications (moment of inertia, torque).	✔	✔	✔	
	263		Subtraction starting frequency	0.01Hz	50Hz	0–120Hz	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	0,1/ 0.01s	5s	0–3600/ 360s	Set a deceleration slope down to the frequency set in Pr. 266.	✔	✔	✔	
	265		Power-failure deceleration time 2	0.1/ 0.01s	9999	0–3600/ 360s	Set a deceleration slope below the frequency set in Pr. 266.	✔	✔	✔	
						9999	Same slope as in Pr. 264				
	266		Power failure deceleration time switchover frequency	0.01Hz	50Hz	0–400Hz	Set the frequency at which the deceleration slope is switched from the Pr. 264 setting to the Pr. 265 setting.	✔	✔	✔	

Tab. 6-1: *Parameter overview (22)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
—	267		Refer to Pr. 73								
—	268		Refer to Pr. 52								
—	269		Parameter for manufacturer setting: Do not set!								
—	299		Refer to Pr. 57 to Pr. 58								
—	331 – 337		Refer to Pr. 117 to Pr. 124								
Communication	338		Communication operation command source	1	0	0	Operation command source communication	✔	✔	✔	6-217
						1	Operation command source external (start/stop)				
	339		Communication speed command source	1	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	1	9999	0	Communication option valid	✔	✔	✔	
						1	Inverter RS-485 terminal valid				
						9999	Automatic recognition of the communication option Normally, the RS-485 terminals are valid. Communication option is valid when the communication option is mounted				
		551	PU mode operation command source selection	1	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.				
—	340		Refer to Pr. 79								
—	341 – 343		Refer to Pr. 117 to Pr. 124								
Remote output function (REM signal)	495 Ver.UP		Remote output selection	1	0	0	Remote output data clear at powering off	✔	✔	✔	6-118
						1	Remote output data retention even at powering off				
						10	Remote output data clear at powering off				
						11	Remote output data retention even at powering off				
	496		Remote output data 1	1	0	0–4095	Output terminal can be switched on and off.	—	—	—	
	497		Remote output data 2	1	0	0–4095		—	—	—	

Tab. 6-1: *Parameter overview (23)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
To determine the maintenance time of parts.	503		Maintenance timer	1	0	0 (1–9998)	Display the cumulative energizing time of the inverter in 100h increments. Reading only Writing the setting of "0" clears the cumulative energizing time.	—	—	—	6-321
	504		Maintenance timer alarm output set time	1	9999	0–9998	Set the time taken until when the maintenance timer alarm output signal (Y95) is output.	✔	—	✔	
						9999	No Function				
Output stop function	522		Output stop frequency	0.01Hz	9999	0–400Hz	Set the frequency to start coasting to a stop (output shutoff).	✔	✔	✔	6-94
						9999	No function				
Modbus-RTU communication	539		Modbus-RTU communication check time interval	0.1s	9999	0	Modbus-RTU communication can be made, but the inverter will come to trip in the NET operation mode.	✔	✔	✔	6-253
						0.1–999.8s	Set the interval of communication check time. (same specifications as Pr. 122)				
						9999	No communication check (signal loss detection)				
—	549		Refer to Pr. 117 to Pr. 124								
	550 551		Refer to Pr. 338 and Pr. 339								
—	553 554		Refer to Pr. 127 to Pr. 134								
Current average monitor signal	555		Current average time	0.1s	1s	0.1–1.0s	Set the time taken to average the current during start bit output (1s).	✔	✔	✔	6-322
	556		Data output mask time	0.1s	0s	0.0–20.0s	Set the time for not obtaining (mask) transient state data.	✔	✔	✔	
	557		Current average value monitor signal output reference current	0.01/ 0.1A *	Rated inverter current	0–500/ 0–3600A *	Set the reference (100%) for outputting the signal of the current average value * Setting increments and setting range differ according to the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	
—	563 564		Refer to Pr. 52								
Multiple rating selection	570		Multiple rating setting	1	0	0	SLD: Ambient temperature 40°C, overload 110% 60s, 120% 3s	✔	—	—	6-44
						1	LD: Ambient temperature 50°C, overload 120% 60s, 150% 3s				
—	571		Refer to Pr. 13								
	573		Refer to Pr. 73								
	575 – 577		Refer to Pr. 127 to Pr. 134								

✔: enabled
—: disabled

Tab. 6-1: *Parameter overview (24)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Advanced PID control	578		Auxiliary motor operation selection	1	0	0	No auxiliary motor operation	✔	✔	✔	6-296
						1–3	Set the number of auxiliary motors to be run				
	579		Motor connection function selection	1	0	0	Basic system	✔	✔	✔	
						1	Alternative system				
						2	Direct system				
						3	Alternative-direct system				
	580		MC switching interlock time	0.1s	1s	0–100s	You can set the MC switching interlock time when Pr. 579 = 2 or 3.	✔	✔	✔	
	581		Start waiting time	0.1s	1s	0–100s	You can set the time from MC switch-over to a start when Pr. 579 = 2 or 3. Set this time a little longer than the MC switching time.	✔	✔	✔	
	582		Auxiliary motor connection-time deceleration time	0.1s	1s	0–3600/ 360s	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	0.1s	1s	0–3600/ 360s	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	0.01Hz	50Hz	0–400Hz	Set the frequency to connect an auxiliary motor.	✔	✔	✔	
	585		Auxiliary motor 2 starting frequency	0.01Hz	50Hz	0–400Hz		✔	✔	✔	
	586		Auxiliary motor 3 starting frequency	0.01Hz	50Hz	0–400Hz		✔	✔	✔	
	587		Auxiliary motor 1 stopping frequency	0.01Hz	0Hz	0–400Hz	Set the frequency to open an auxiliary motor.	✔	✔	✔	
	588		Auxiliary motor 2 stopping frequency	0.01Hz	0Hz	0–400Hz		✔	✔	✔	
	589		Auxiliary motor 3 stopping frequency	0.01Hz	0Hz	0–400Hz		✔	✔	✔	
	590		Auxiliary motor start detection time	0.1s	5s	0–3600s	You can set the delay time until the auxiliary motor is started.	✔	✔	✔	
	591		Auxiliary motor stop detection time	0.1s	5s	0–3600s	You can set the delay time until the auxiliary motor is stopped.	✔	✔	✔	

Tab. 6-1: *Parameter overview (25)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Traverse function	592		Traverse function selection	1	0	0	Traverse function invalid	✔	✔	✔	6-310
						1	Traverse function is valid only in the external operation mode				
						2	Traverse function is valid independently of operation mode				
	593		Maximum amplitude amount	0.1%	10%	0–25%	Amplitude amount during traverse operation	✔	✔	✔	
	594		Amplitude compensation amount during deceleration	0.1%	10%	0–50%	Compensation amount at the time of amplitude inversion (acceleration → deceleration)	✔	✔	✔	
	595		Amplitude compensation amount during acceleration	0.1%	10%	0–50%	Compensation amount during amplitude inversion operation (deceleration → acceleration)	✔	✔	✔	
	596		Amplitude acceleration time	1s	5s	0.1–3600s	Acceleration time during traverse operation	✔	✔	✔	
	597		Amplitude deceleration time	1s	5s	0.1–3600s	Deceleration time during traverse operation	✔	✔	✔	
—	611		Refer to Pr. 57 and Pr. 58								
Speed smoothing control	653		Speed smoothing control	0.1%	0	0–200%	The torque fluctuation is reduced to reduce vibration due to mechanical resonance.	✔	✔	✔	6-169
	654		Speed smoothing cutoff frequency	0.01Hz	20Hz	0–120Hz	Set the minimum value for the torque variation cycle (frequency).	✔	✔	✔	
—	799		Pulse increment setting for output power	0.1	1kWh	0.1/1/10/ 100/ 1000kWh	Pulse train output of output power (Y79) is output in pulses at every output power (kWh) that is specified.	✔	✔	✔	6-120
—	867 869		Refer to Pr. 54 to Pr. 56								
—	872		Refer to Pr. 251								
Regeneration avoidance function	882		Regeneration avoidance operation selection	1	0	0	Regeneration avoidance function invalid	✔	✔	✔	6-313
						1	Regeneration avoidance function valid	✔	✔	✔	
	883		Regeneration avoidance operation level	0.1V	760V/ 785V DC	300–800V	Set the bus voltage level at which regeneration avoidance operates. When the bus voltage level is set to low, overvalued error will be less apt to occur. However, the actual deceleration time increases.	✔	✔	✔	
	884		Regeneration avoidance at deceleration detection sensitivity	1	0	0–5	Set sensitivity to detect the bus voltage change 1 (low) → 5 (high)	✔	✔	✔	
	885		Regeneration avoidance compensation frequency limit value	0.01Hz	6Hz	0–10Hz	Set the limit value of frequency which rises at activation of regeneration avoidance function.	✔	✔	✔	
						9999	Frequency limit invalid				
	886		Regeneration avoidance voltage gain	0.1%	100%	0–200%	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.	✔	✔	✔	

Tab. 6-1: *Parameter overview (26)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Free parameter	888		Free parameter 1	1	9999	0–9999	Parameters you can use for your own purposes Used for maintenance, management, etc. by setting a unique number to each inverter when multiple inverters are used.	✔	—	—	6-326
	889		Free parameter 2	1	9999	0–9999		✔	—	—	
Energy saving monitor	891		Refer to Pr. 52								
	892		Load factor	0.1%	100%	30–150%	Set the load factor for commercial power-supply operation. This value is used to calculate the power consumption estimated value during commercial power supply operation.	✔	✔	✔	6-160
	893		Energy saving monitor reference (motor capacity)	0.01/ 0.1kW *	LD/SLD value of Applied motor Capacity	0.1–55/ 0–3600kW *	Set the motor capacity (pump capacity). Set when calculating power savings rate and average power savings rate value. * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	✔	✔	
	894		Control selection during commercial power-supply operation	1	0	0	Discharge damper control (fan)	✔	✔	✔	
						1	Inlet damper control (fan)				
						2	Valve control (pump)				
						3	Commercial power-supply drive (fixed value)				
	895		Power saving rate reference value	1	9999	0	Consider the value during commercial power-supply operation as 100%.	✔	✔	✔	
						1	Consider the Pr. 893 setting as 100%.				
						9999	No function				
	896		Power unit cost	0.01	9999	0–500	Set the power unit cost. Display the power savings rate on the energy saving monitor	✔	✔	✔	
						9999	No function				
	897		Power saving monitor average time	1	9999	0	Average for 30 minutes	✔	✔	✔	
						1–1000h	Average for the set time				
						9999	No function				
	898		Power saving cumulative monitor clear	1	9999	0	Cumulative monitor value clear	✔	✔	✔	
						1	Cumulative monitor value hold				
						10	Cumulative monitor continue (communication data upper limit 9999)				
						9999	Cumulative monitor continue (communication data upper limit 65535)				
	899		Operation time rate (estimated value)	0.1%	9999	0–100%	Use for calculation of annual power saving amount. Set the annual operation ratio (consider 365 days × 24hr as 100%).	✔	✔	✔	
						9999	No function				

Tab. 6-1: *Parameter overview (27)*

Function	Parameter	Related parameters	Name	Increments	Initial Value	Setting Range	Description	Parameter copy	Parameter clear	All parameter clear	Refer to page
								✔: enabled —: disabled			
Adjustment of terminal CA and AM (calibration)	C0 (900)		CA terminal calibration	—	—	—	Calibrate the scale of the meter connected to terminal CA.	✔	—	✔	6-132
	C1 (901)		AM terminal calibration	—	—	—	Calibrate the scale of the analog meter connected to terminal AM.	✔	—	✔	
—	C2 (902)		Terminal 2 frequency setting bias frequency	Refer to Pr. 125 and Pr. 126							
	C3 (902)		Terminal 2 frequency setting bias								
	C4 (903)		Terminal 2 frequency setting gain								
	C5 (904)		Terminal 4 frequency setting bias frequency								
	C6 (904)		Terminal 4 frequency setting bias								
	C7 (905)		Terminal 4 frequency setting gain								
Analog output current calibration	C8 (930)		Current output bias signal	0.1%	0%	0–100%	Set the output signal value at the minimum analog current output.	✔	✔	✔	6-132
	C9 (930)		Current output bias current	0.1%	0%	0–100%	Set the minimum current value at the minimum analog current output.	✔	✔	✔	
	C10 (931)		Current output gain signal	0.1%	100%	0–100%	Set the output signal value at the maximum analog current output.	✔	✔	✔	
	C11 (931)		Current output gain current	0.1%	100%	0–100%	Set the maximum current value at the maximum analog current output.	✔	✔	✔	
—	C42 (934) – C45 (935)		Refer to Pr. 127 to Pr. 134								
—	989		Parameter copy alarm release	1	10/100 *	10/100	Parameters for alarm release at parameter copy * The setting depends on the inverter capacity: (01160 or less/01800 or more)	✔	—	✔	—
Buzzer control of the operation panel	990		PU buzzer control	1	1	0	Without buzzer	✔	✔	✔	6-328
						1	With buzzer				

Tab. 6-1: *Parameter overview (28)*

<table>
<tr><th rowspan="2">Function</th><th colspan="2">Parameter</th><th rowspan="2">Name</th><th rowspan="2">Increments</th><th rowspan="2">Initial Value</th><th rowspan="2">Setting Range</th><th rowspan="2">Description</th><th>Parameter copy</th><th>Parameter clear</th><th>All parameter clear</th><th rowspan="2">Refer to page</th></tr>
<tr><th></th><th>Related parameters</th><th colspan="3">✔: enabled
—: disabled</th></tr>
<tr><td>Contrast adjustment of the parameter unit</td><td>991</td><td>◎</td><td>PU contrast adjustment</td><td>1</td><td>58</td><td>0–63</td><td>Contrast adjustment of the LCD of the parameter unit (FR-PU04/ FR-PU07) can be performed.
0 (light) → 63 (dark)</td><td>✔</td><td>✔</td><td>✔</td><td>6-329</td></tr>
<tr><td rowspan="7">Parameter clear, parameter copy</td><td colspan="2">Pr.CL</td><td>Parameter clear</td><td>1</td><td>0</td><td>0/1</td><td colspan="4">Setting "1" returns all parameters except calibration parameters to the initial values.</td><td>5-13</td></tr>
<tr><td colspan="2">ALLC</td><td>All parameter clear</td><td>1</td><td>0</td><td>0/1</td><td colspan="4">Setting "1" returns all parameters to the initial values.</td><td>5-14</td></tr>
<tr><td colspan="2">Er.CL</td><td>Alarm history clear</td><td>1</td><td>0</td><td>0/1</td><td colspan="4">Setting "1" will clear eight past alarms.</td><td>7-21</td></tr>
<tr><td colspan="2" rowspan="4">PCPY</td><td rowspan="4">Parameter copy</td><td rowspan="4">1</td><td>0</td><td>0</td><td colspan="4">Cancel</td><td rowspan="4">5-15</td></tr>
<tr><td>0</td><td>1</td><td colspan="4">Read the source parameters to the operation panel.</td></tr>
<tr><td>0</td><td>2</td><td colspan="4">Write the parameters copied to the operation panel to the destination inverter.</td></tr>
<tr><td>0</td><td>3</td><td colspan="4">Verify parameters in the inverter and operation panel.</td></tr>
</table>

Tab. 6-1: *Parameter overview (29)*

NOTE

The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/ FR-PU07).

6.2 Motor torque

Purpose	Parameter that must be set		Refer to Section
Set starting torque manually	Manual torque boost	Pr. 0, Pr. 46,	6.2.1
Automatically control output current according to load	Simple magnetic flux vector control	Pr. 71, Pr. 80, Pr. 90	6.2.2
Compensate for motor slip to secure low-speed torque	Slip compensation	Pr. 245–Pr. 247	6.2.3
Limit output current to prevent inverter trip	Stall prevention operation	Pr. 22, Pr. 23, Pr. 66, Pr. 154, Pr. 156, Pr. 157	6.2.4
Change the overload current rating specifications	Multiple rating setting	Pr. 570	6.2.5

6.2.1 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 between terminals.

Pr. No.	Name	Initial Value		Setting Range	Description
0	Torque boost	00023	6%	0–30%	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	Second torque boost ①	9999		0–30 %	Set the torque boost value when the RT signal is on.
				9999	Without second torque boost

Parameters referred to		Refer to Section
3	Base frequency	6.4.1
19	Base frequency voltage	6.4.1
71	Applied motor	6.7.2
80	Motor capacity (simple magnetic flux vector control)	6.2.2
178–189	Input terminal function selection	6.9.1

① The above parameter can be set when Pr. 160 "User group read selection" = 0.

Starting torque adjustment

On the assumption that Pr. 19 "Base frequency voltage" is 100%, set the output voltage at 0Hz in % to Pr. 0 (Pr. 46).

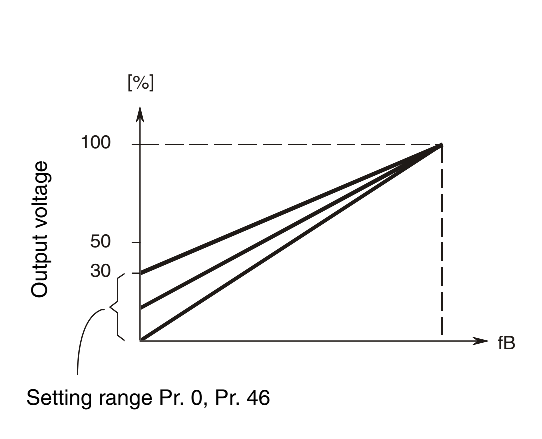


Fig. 6-1:
Relationship between output frequency and output voltage

I000001C

CAUTION:

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.

The requirements of the motor manufacturer must also be observed.

Set multiple base frequencies (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. The RT signal acts as the second function selection signal and makes the other second functions valid.

NOTES

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 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.

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.

When simple magnetic flux vector control is selected in Pr. 80, the settings of Pr. 0 and Pr. 46 are invalid.

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.

6.2.2 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)

Pr. No.	Name	Initial Value	Setting Range		Description
80	Motor capacity (simple magnetic flux vector control)	9999	01160 or more	0.4–55kW	Set the capacity of the motor used to select simple magnetic flux vector control.
			01800 or more	0–3600kW	
			9999		V/f control is performed
90	Motor constant (R1)	9999	01160 or less	0–50Ω	Used to set the motor primary resistance value. (Normally setting is not necessary.)
			01800 or more	0–400mΩ	
			9999		Use the Mitsubishi motor (SF-JR, SF-HRCA) constants

Parameters referred to		Refer to Section
3	Base frequency	6.4.1
19	Base frequency voltage	6.4.1
60	Energy saving control selection	6.13.1
71	Applied motor	6.7.2
77	Parameter write selection	6.16.2

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Following conditions must be satisfied to perform simple magnetic flux vector control:

- 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.

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).

NOTES

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

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 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.

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 star connection. When the setting value is "9999" (initial value), the motor constant is based on the Mitsubishi motor constant (SF-JR, SF-HRCA).

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

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

Pr. No.	Name	Initial Value	Setting Range	Description
245	Rated slip	9999	0.01–50%	Used to set the rated motor slip.
			0/9999	No slip compensation
246	Slip compensation time constant	0.5s	0.01–10s	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 over voltage (E.OV☐) error is more liable to occur.
247	Constant-output region slip compensation selection	9999	0	Slip compensation is not made in the constant output range (frequency range above the frequency set in Pr. 3)
			9999	Slip compensation is made in the constant output range.

Parameters referred to		Refer to Section
1	Maximum Frequency	6.3.1
3	Base frequency	6.4.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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.

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

NOTE

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.

6.2.4 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, over voltage, 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.

Pr. No.	Name	Initial Value	Setting Range	Description
22	Stall prevention operation level	110% ①	0	Stall prevention operation selection becomes invalid.
			0.1–120% ①	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	0–150% ①	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% ①	0	Second stall prevention operation invalid
			0.1–120% ①	The second stall prevention operation level can be set.
49	Second stall prevention operation frequency	0Hz	0	Second stall prevention operation invalid
			0.01–400Hz	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	0–400Hz	Set the frequency at which the stall operation level is started to reduce.
148	Stall prevention level at 0V input.	110% ①	0–120% ①	Stall prevention operation level can be changed by the analog signal input to terminal 1.
149	Stall prevention level at 10V input.	120% ①	0–120% ①	
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	0–31/ 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	0–25s	Set the output start time of the OL signal output when stall prevention is activated.
			9999	Without the OL signal output

Parameters referred to		Refer to Section
73	Analog input selection	6.15.1
178–189	Input terminal function selection	6.9.1
190–196	Output terminal function selection	6.9.5
570	Multiple rating setting	6.2.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① When Pr. 570 "Multiple rating setting" = 1, performing parameter clear changes the initial value and setting range.

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.

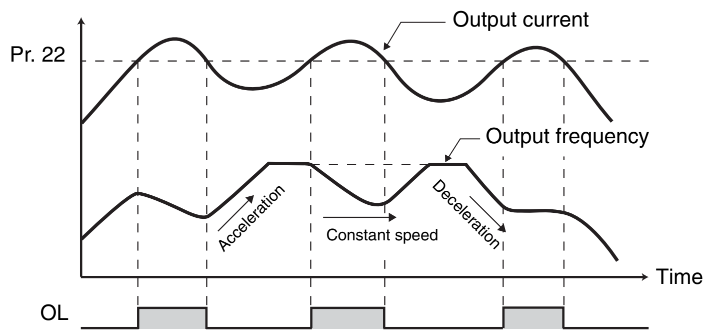


Fig. 6-2: *Stall prevention operation example*

NOTES

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).

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 (over voltage stall) is executed.

Pr. 157 Setting	Description
0 (Initial setting)	Output immediately.
0.1–25s	Output after the set time (s) has elapsed.
9999	Not output.

Tab. 6-2: *Setting of parameter 157*

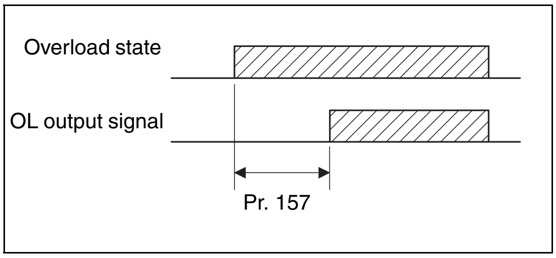


Fig. 6-3:
Output of the OL signal

I001330E

NOTES

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" (source logic) or "103" (sink logic) to any of Pr. 190 to Pr. 196 "Output terminal function selection".

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.

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.

Setting of stall prevention operation in high frequency region (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 region. This function is effective for performing operation up to the high-speed range on a centrifugal separator etc.

Pr. 23 sets the change in the current limiting in the frequency range starting at the frequency set by Pr. 66. For example, if Pr. 66 is set to 75Hz the motor stall prevention operation level at an output frequency of 150Hz will be reduced to 75% when Pr. 23 is set to 100%, and to 66% when Pr. 23 is set to 50% (see the formula below). Generally Pr. 66 is set to 50Hz and Pr. 23 to 100%.

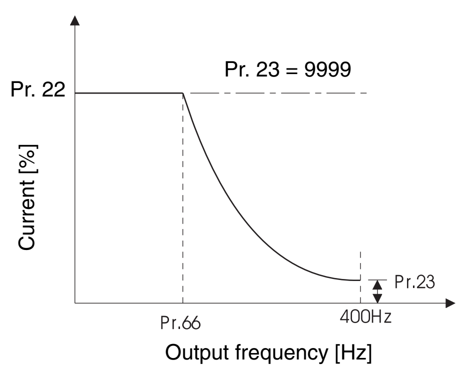


Fig. 6-4:
Stall prevention operation level

I001121C

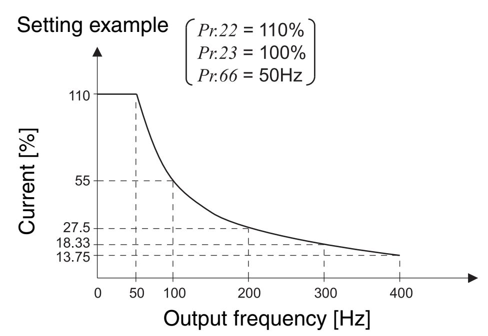


Fig. 6-5:
Stall prevention operation level when Pr. 22 = 110 %, Pr. 23 = 100 % and Pr. 66 = 50 Hz

I001122C

Formula for stall prevention operation level:

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

$$\text{where } A = \frac{\text{Pr. 66 [Hz]} \times \text{Pr. 22 [\%]}}{\text{Output frequency [Hz]}},\ B = \frac{\text{Pr. 66 [Hz]} \times \text{Pr. 22 [\%]}}{\text{400Hz}}$$

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.

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.

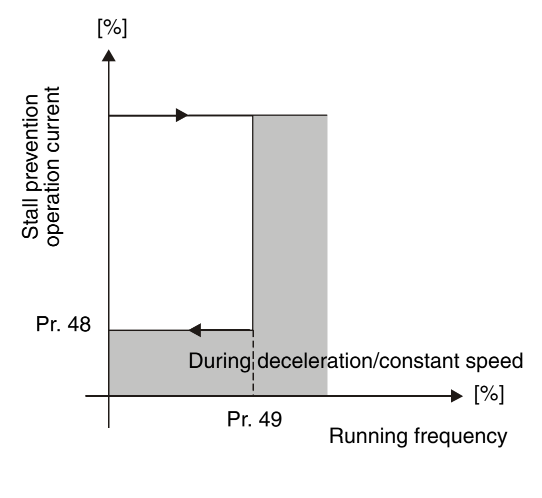


Fig. 6-6: *Second stall prevention operation current setting example*

I000022C

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 setting)	The second stall prevention operation is not performed.
0.01Hz–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

Tab. 6-3: *Settings of parameter 49*

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.)

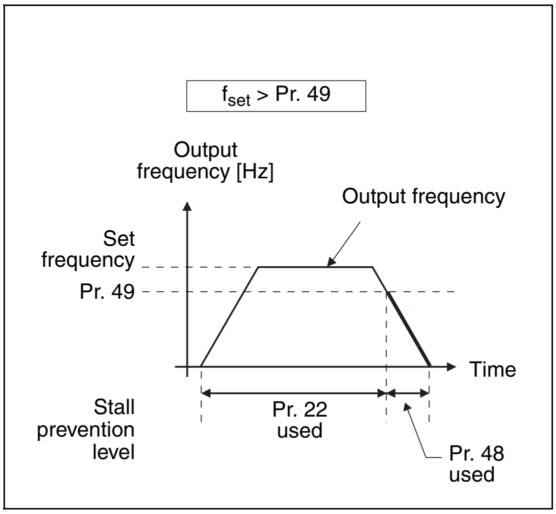


Fig. 6-7:
Stall prevention level, when the set frequency exceeds the value of Pr. 49

I001123E

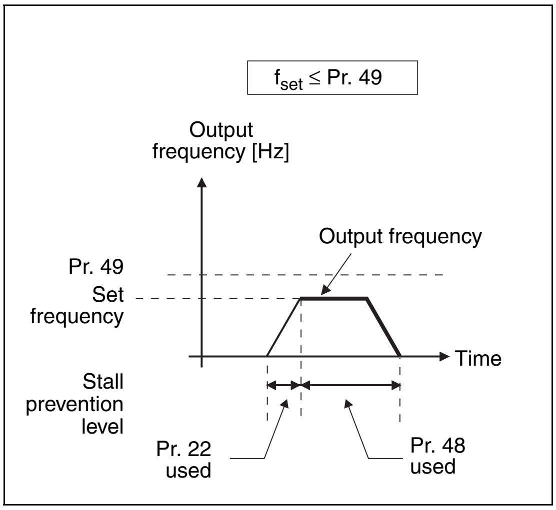


Fig. 6-8:
Stall prevention level, when the set frequency is equal to or less than the value of Pr. 49

I001124E

NOTES

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.

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.

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

① Set Pr. 22 to "9999".

② 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.

③ Set the current limit level at the input voltage of 0V (0mA) in Pr. 148 "Stall prevention level at 0V input".

④ Set the current limit level at the input voltage of 10V or 5V (20mA) in Pr. 149 "Stall prevention level at 10V input".

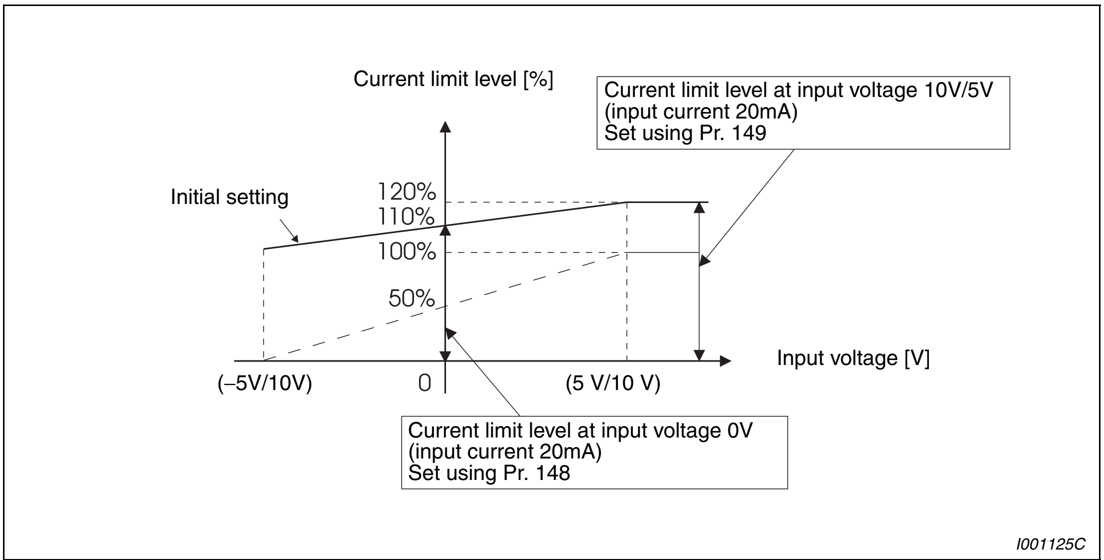


Fig. 6-9: *Analog setting of the stall prevention operation level by terminal 1*

NOTES

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.

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

Tab. 6-4: *Settings of parameter 154*

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	Stall Prevention Operation Level			OL Signal Output	
		Acceleration	Constant speed	Deceleration	Without alarm	Stop with alarm "E.OLT"
0	✔	✔	✔	✔	✔	—
1	—	✔	✔	✔	✔	—
2	✔	—	✔	✔	✔	—
3	—	—	✔	✔	✔	—
4	✔	✔	—	✔	✔	—
5	—	✔	—	✔	✔	—
6	✔	—	—	✔	✔	—
7	—	—	—	✔	✔	—
8	✔	✔	✔	—	✔	—
9	—	✔	✔	—	✔	—
10	✔	—	✔	—	✔	—
11	—	—	✔	—	✔	—
12	✔	✔	—	—	✔	—
13	—	✔	—	—	✔	—
14	✔	—	—	—	✔	—
15	—	—	—	—	①	①
16	✔	✔	✔	✔	—	✔
17	—	✔	✔	✔	—	✔
18	✔	—	✔	✔	—	✔
19	—	—	✔	✔	—	✔
20	✔	✔	—	✔	—	✔
21	—	✔	—	✔	—	✔
22	✔	—	—	✔	—	✔
23	—	—	—	✔	—	✔
24	✔	✔	✔	—	—	✔
25	—	✔	✔	—	—	✔
26	✔	—	✔	—	—	✔
27	—	—	✔	—	—	✔
28	✔	✔	—	—	—	✔
29	—	✔	—	—	—	✔
30	✔	—	—	—	—	✔
31	—	—	—	—	①	①
100 D ②	✔	✔	✔	✔	✔	—
100 R ②	—	—	—	—	①	①
101 D ②	—	✔	✔	✔	✔	—
101 R ②	—	—	—	—	①	①

Tab. 6-5: *Setting of parameter 156 (D = Driving, R = Regeneration)*

① Since both fast-response current limit and stall prevention are not activated, OL signal and E.OLT are not output.

② 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.

NOTES

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.

6.2.5 Multiple rating (LD = Light Duty, SLD = Super Light Duty) (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.

Pr. No.	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)

Parameters referred to	Refer to Section
—	

The above parameter can be set when Pr. 160 "User group read selection" = 0.

If the setting of Pr. 570 is changed the factory defaults and setting ranges of the following parameters will be changed when you clear the parameters or perform a reset.

Pr. No.	Name		Pr. 570 Setting 0	Pr. 570 Setting 1	Refer to Page
9	Electronic thermal O/L relay	Initial Value	SLD rated current ①	LD rated current ①	6-76
22	Stall prevention operation level	Setting Range	0/0.1–120%/9999	0/0.1–150%/9999	6-35
		Initial Value	110%	120%	
23	Stall prevention operation level compensation factor at double speed	Setting Range	0–150%/9999	0–200%/9999	6-35
		Initial Value	9999	9999	
48	Second stall prevention operation current	Setting Range	0/0.1–120%	0/0.1–150%	6-35
		Initial Value	110%	120%	
56	Current monitoring reference	Initial Value	SLD rated current ①	LD rated current ①	6-130
148	Stall prevention level at 0V input	Setting Range	0–120%	0–150%	6-35
		Initial Value	110%	120%	
149	Stall prevention level at 10V input	Setting Range	0–120%	0–150%	6-35
		Initial Value	120%	150%	
150	Output current detection level	Setting Range	0–120%	0–150%	6-115
		Initial Value	110%	120%	
165	Stall prevention operation level for restart	Setting Range	0–120%	0–150%	6-137
		Initial Value	110%	120%	
557	Current average value monitor signal output reference current	Initial Value	SLD rated current ①	LD rated current ①	6-322
893	Energy saving monitor reference (motor capacity)	Initial Value	SLD value of Applied motor Capacity ②	LD value of Applied motor Capacity ②	6-160

Tab. 6-6: *Influence of Pr. 570 on other parameters*

① The rated current differs according to the inverter capacity.

② For the 01160 or less, SLD/LD value of Applied motor Capacity is the same.

NOTE

When Pr. 570 = 0 (initial value), Pr. 260 "PWM frequency automatic switchover" becomes invalid. (Refer to section 6.14.1).

6.3 Limit the output frequency

Purpose	Parameters that must be set		Refer to Section
Set upper limit and lower limit of output frequency	Maximum/minimum frequency	Pr. 1, Pr. 2, Pr. 18	6.3.1
Perform operation by avoiding machine resonance points	Frequency jump	Pr. 31–Pr. 36	6.3.2

6.3.1 Maximum and minimum frequency (Pr. 1, Pr. 2, Pr. 18)

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

Pr. No.	Name	Initial Value		Setting Range	Description
1	Maximum frequency	01160 or less	120Hz	0–120Hz	Set the upper limit of the output frequency.
		01800 or more	60Hz		
2	Minimum frequency	0Hz		0–120Hz	Set the lower limit of the output frequency.
18	High speed maximum frequency ①	01160 or less	120Hz	120–400Hz	Set when performing the operation at 120Hz or more
		01800 or more	60Hz		

Parameters referred to		Refer to Section
13	Starting frequency	6.6.2
15	Jog frequency	6.5.2
125	Terminal 2 frequency setting gain frequency	6.15.4
126	Terminal 4 frequency setting gain frequency	6.15.4

① The above parameter can be set when Pr. 160 "User group read selection" = 0.

Set the 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.)

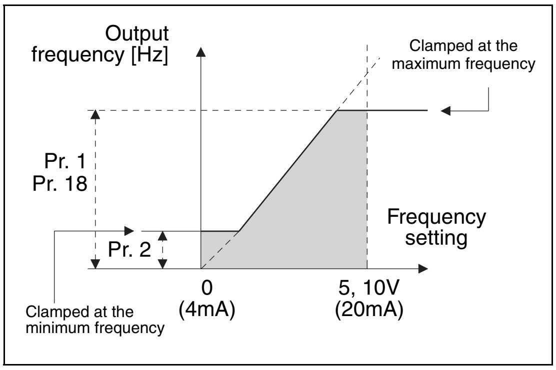


Fig. 6-10:
Maximum und minimum output frequency

I001100E

NOTE When performing operation above 60Hz using the frequency setting analog signal, change Pr. 125 (Pr. 126) "Frequency setting gain". (Refer to section 6.15.4.) If only Pr. 1 or Pr. 18 is changed, operation above 60Hz cannot be performed.

Set the minimum frequency

Use Pr. 2 "Minimum frequency" to set the lower limit of the output frequency.

NOTES

When Pr. 15 "Jog frequency" is equal to or less than Pr. 2, the Pr. 15 setting has precedence over the Pr. 2 setting.

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.)

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.

6.3.2 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.

Pr. No.	Name	Initial Value	Setting Range	Description
31	Frequency jump 1A	9999	0–400Hz/9999	1A to 1B, 2A to 2B, 3A to 3B is frequency jumps 9999: Function invalid
32	Frequency jump 1B	9999	0–400Hz/9999	
33	Frequency jump 2A	9999	0–400Hz/9999	
34	Frequency jump 2B	9999	0–400Hz/9999	
35	Frequency jump 3A	9999	0–400Hz/9999	
36	Frequency jump 3B	9999	0–400Hz/9999	

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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.

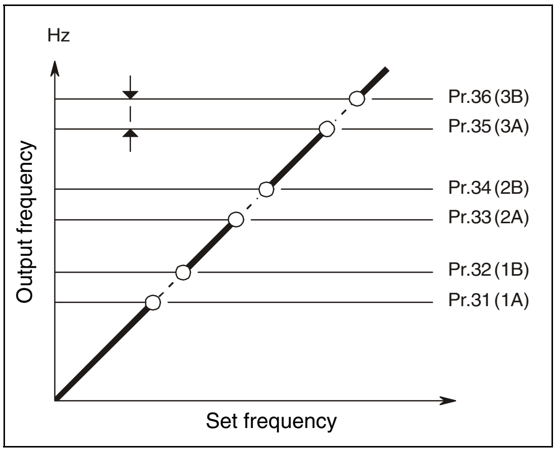


Fig. 6-11:
Definition of the jump areas

I000019C

The following diagrams show how the jump point is selected. The diagram on the left shows a sequence in which the jump takes place at the end of the area to be jumped, for which the lower frequency must be entered first. In the diagram on the right the jump takes place at the beginning of the frequency area to be jumped, for which the higher frequency must be entered first.

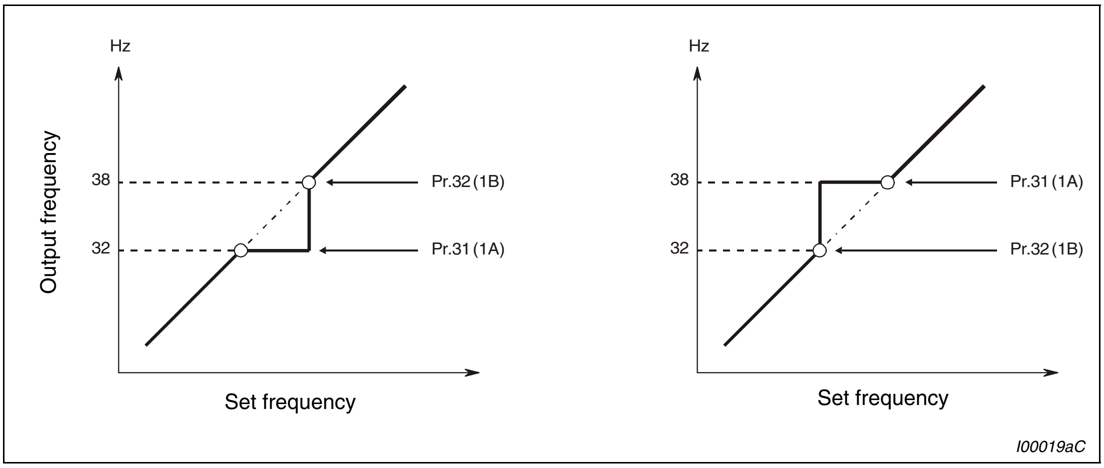


Fig. 6-12: *Selection of the jump point*

NOTE

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

6.4 Set V/f pattern

Purpose	Parameters that must be set		Refer to Section
Set motor ratings	Base frequency, Base frequency voltage	Pr. 3, Pr. 19, Pr. 47	6.4.1
Select a V/F pattern according to applications	Load pattern selection	Pr. 14	6.4.2
Use special motor	Adjustable 5 points V/f	Pr. 71, Pr. 100–Pr. 109	6.4.3

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

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

Pr. No.	Name	Initial Value	Setting Range	Description
3	Base frequency	50Hz	0–400Hz	Set the frequency when the motor rated torque is generated. (50Hz/ 60Hz)
19	Base frequency voltage	8888	0–1000V	Set the rated motor voltage.
			8888	95% of power supply voltage
			9999	Same as power supply voltage
47	Second V/f (base frequency) ①	9999	0–400Hz	Set the base frequency when the RT signal is on.
			9999	Second V/f invalid

Parameters referred to		Refer to Section
14	Load pattern selection	6.4.2
29	Acceleration/deceleration pattern selection	6.6.3
71	Applied motor	6.7.2
80	Motor capacity (simple magnetic flux vector control)	6.2.2
178–189	Input terminal function selection	6.9.1

① The above parameter can be set when Pr. 160 "User group read selection" = 0.

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 commercial power supply-inverter switch-over operation, set Pr. 3 to the same value as the power supply frequency.
If the frequency given on the motor rating plate is "60Hz" only, always set to "60Hz". It may result in an inverter trip due to overload. Caution must be taken especially when Pr. 14 "Loadpattern selection" = "1" (variable torque load).

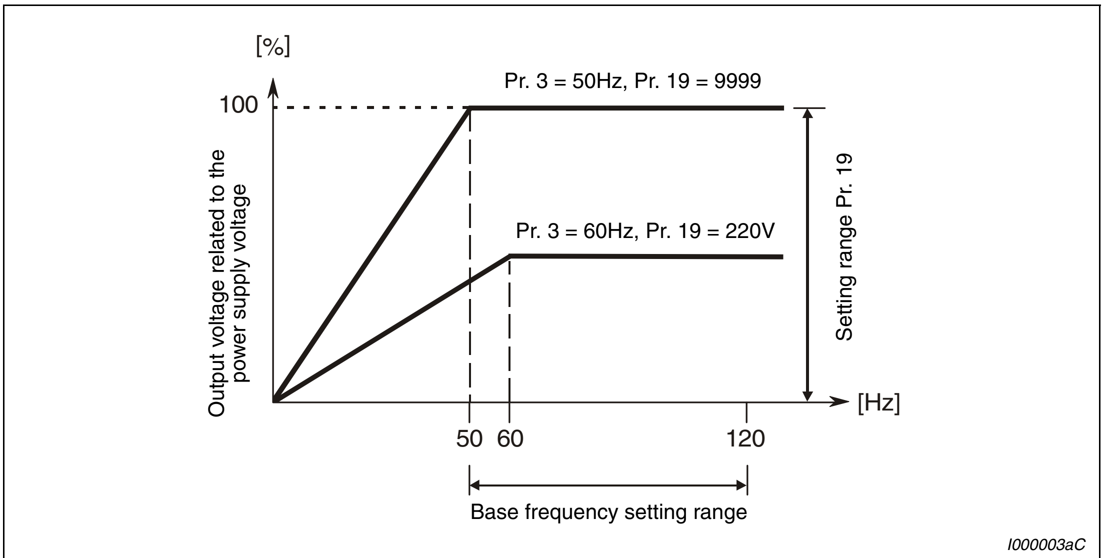


Fig. 6-13: *Output voltage related to the output frequency*

Set multiple base frequencies (Pr. 47)

Use the second base frequency when you want to change the base frequency, e.g. when using multiple motors by switching between them by one inverter.

Pr. 47 "Second V/f (base frequency)" is valid when the RT signal is on.

NOTES

The RT signal acts as the second function selection signal and makes the other second functions valid.

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.

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:

- 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.
- 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.
- For special settings (87Hz function, special motors, field weakening range).
  Pr. 19 can also be set to a value above the power supply voltage when operating motors with special windings, in 87Hz mode or for field weakening operation with a specific output voltage. The inverter will then use a V/f pattern the rise of which is defined by Pr. 3 and Pr. 19. However, the actual effective output voltage cannot be higher than the power supply voltage and is thus limited to this maximum value.

NOTES

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.

Note that the output voltage of the inverter cannot exceed the power supply voltage.

6.4.2 Load pattern selection (Pr. 14)

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

Pr. No.	Name	Initial Value	Setting Range	Description
14	Load pattern selection	1	0	For constant torque load
			1	For variable-torque load

Parameters referred to		Refer to Section
3	Base frequency	6.4.1
178–189	Input terminal function selection	6.9.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

For constant-torque load (Pr. 14 = 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.

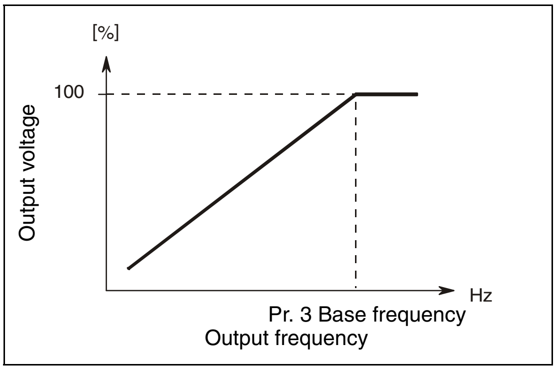


Fig. 6-14:
Constant-torque load

I001322C

For variable-torque load (Pr. 14 = 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.

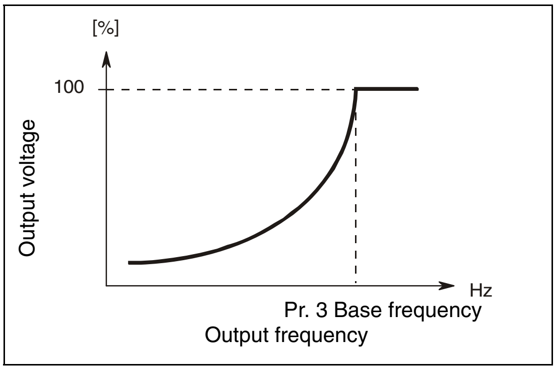


Fig. 6-15:
Variable-torque load

I001323C

6.4.3 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 start-up 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.

Pr. No.	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	0–400Hz/9999	Set each points (frequency, voltage) of V/f pattern. 9999: No V/f setting
101	V/f1 (first frequency voltage)	0V	0–1000V/9999	
102	V/f2 (second frequency)	9999	0–400Hz/9999	
103	V/f2 (second frequency voltage)	0V	0–1000V/9999	
104	V/f3 (third frequency)	9999	0–400Hz/9999	
105	V/f3 (third frequency voltage)	0V	0–1000V/9999	
106	V/f4 (fourth frequency)	9999	0–400Hz/9999	
107	V/f4 (fourth frequency voltage)	0V	0–1000V/9999	
108	V/f5 (fifth frequency)	9999	0–400Hz/9999	
109	V/f5 (fifth frequency voltage)	0V	0–1000V/9999	

Parameters referred to		Refer to Section
3	Base frequency	6.4.1
12	DC injection brake operation voltage	6.8.1
19	Base frequency voltage	6.4.1
47	Second V/f (base frequency)	6.4.1
60	Energy saving control selection	6.13.1
71	Applied motor	6.7.2
80	Motor capacity (simple magnetic flux vector control)	6.2.2
90	Motor constant (R1)	6.2.2

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Any V/f characteristic can be provided by presetting the parameters of V/f1 (first frequency voltage/first frequency) to V/f5.

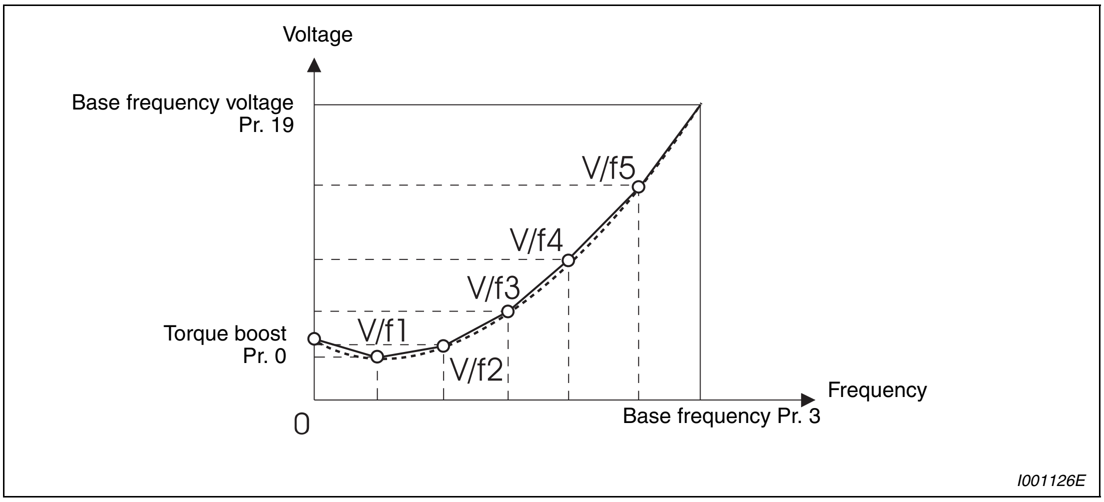


Fig. 6-16: *V/f characteristic*

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.

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

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

NOTES

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.

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 and Pr. 12 settings are automatically changed according to the Pr. 71 setting:

Parameter 71 = 0, 2, 20
The setting of Parameter 0 changes to 3% and the setting of Parameter 12 to 4%.

Parameter 71 = 1
The settings of Parameter 0 and 12 change to 2%.

6.5 Frequency setting by external terminals

Purpose	Parameters that must be set		Refer to Section
Make frequency setting by combination of terminals	Multi-speed operation	Pr. 4–Pr. 6, Pr. 24–Pr. 27 Pr. 232–Pr. 239	6.5.1
Perform jog operation	Jog operation	Pr. 15, Pr. 16	6.5.2
Added compensation for multi-speed setting and remote setting	Multi-speed input compensation selection	Pr. 28	6.5.3
Infinitely variable speed setting by terminals	Remote setting function	Pr. 59	6.5.4

6.5.1 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 signals.

Any speed can be selected by merely turning on-off the contact signals (RH, RM, RL, REX signals).

Pr. No.	Name	Initial Value	Setting Range	Description
4	Multi-speed setting (high speed)	50Hz	0–400Hz	Set the frequency when RH turns on.
5	Multi-speed setting (middle speed)	30Hz	0–400Hz	Set the frequency when RM turns on.
6	Multi-speed setting (low speed)	10Hz	0–400Hz	Set the frequency when RL turns on.
24	Multi-speed setting (speed 4) ①	9999	0–400Hz/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) ①	9999	0–400Hz/9999	
26	Multi-speed setting (speed 6) ①	9999	0–400Hz/9999	
27	Multi-speed setting (speed 7) ①	9999	0–400Hz/9999	
232	Multi-speed setting (speed 8) ①	9999	0–400Hz/9999	
233	Multi-speed setting (speed 9) ①	9999	0–400Hz/9999	
234	Multi-speed setting (speed 10) ①	9999	0–400Hz/9999	
235	Multi-speed setting (speed 11) ①	9999	0–400Hz/9999	
236	Multi-speed setting (speed 12) ①	9999	0–400Hz/9999	
237	Multi-speed setting (speed 13) ①	9999	0–400Hz/9999	
238	Multi-speed setting (speed 14) ①	9999	0–400Hz/9999	
239	Multi-speed setting (speed 15) ①	9999	0–400Hz/9999	

Parameters referred to		Refer to Section
1	Maximum frequency	6.3.1
2	Minimum frequency	6.3.1
15	JOG frequency	6.5.2
28	Multi-speed input compensation selection	6.5.3
59	Remote function selection	6.5.4
178–189	Input terminal function selection	6.9.1

① The above parameter can be set when Pr. 160 "User group read selection" = 0.

NOTE

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".

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.

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.)

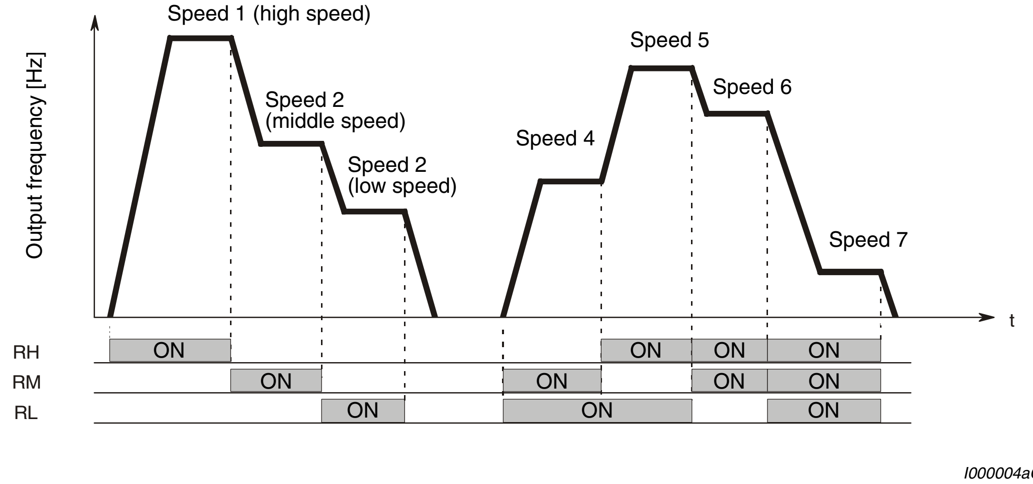


Fig. 6-17: *Multi-speed selection by external terminals*

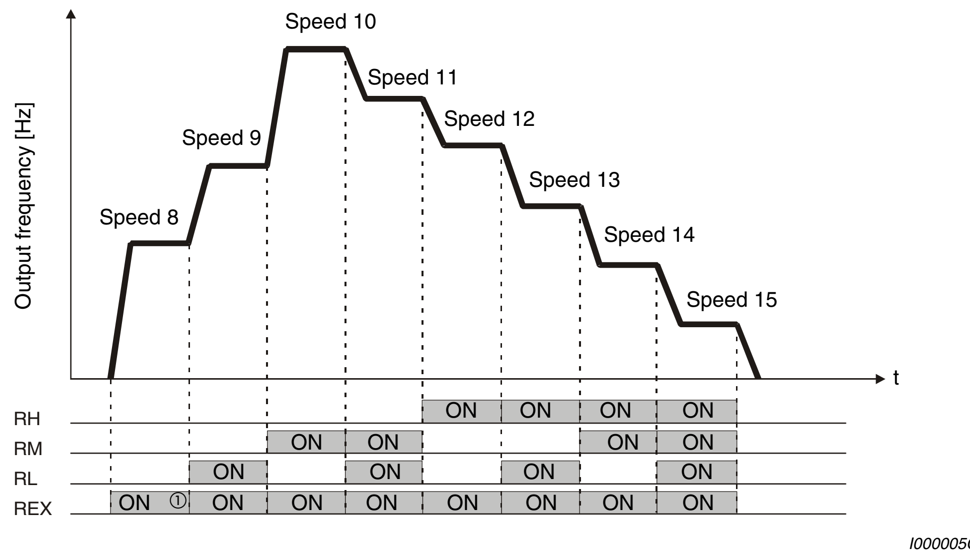


Fig. 6-18: *Multi-speed selection by external terminals*

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.

NOTES

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.

For the terminal used for REX signal input, set "8" in any of Pr. 178 to Pr. 186 to assign the function.

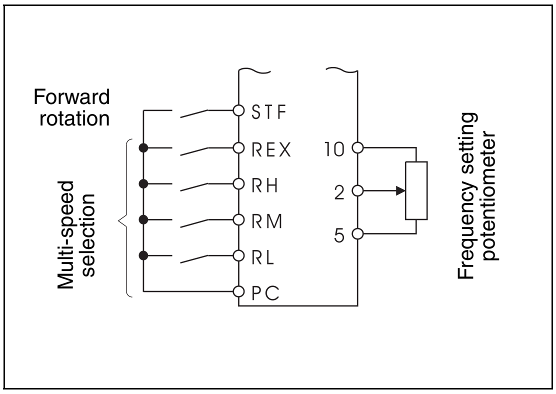


Fig. 6-19:
Connection example

I001127E

NOTES

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 section 6.15 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".

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.

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

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

Pr. No.	Name	Initial Value	Setting Range	Description
15	Jog frequency	5Hz	0–400Hz	Set the frequency for jog operation.
16	Jog acceleration/ deceleration time	0.5s	0–3600/360s ①	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.

Parameters referred to		Refer to Section
13	Starting frequency	6.6.2
29	Acceleration/deceleration pattern selection	6.6.3
20	Acceleration/deceleration reference frequency	6.6.1
21	Acceleration/ deceleration time increments	6.6.1
79	Operation mode selection	6.17.1
178–189	Input terminal function selection	6.9.1

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

NOTE

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.

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.)

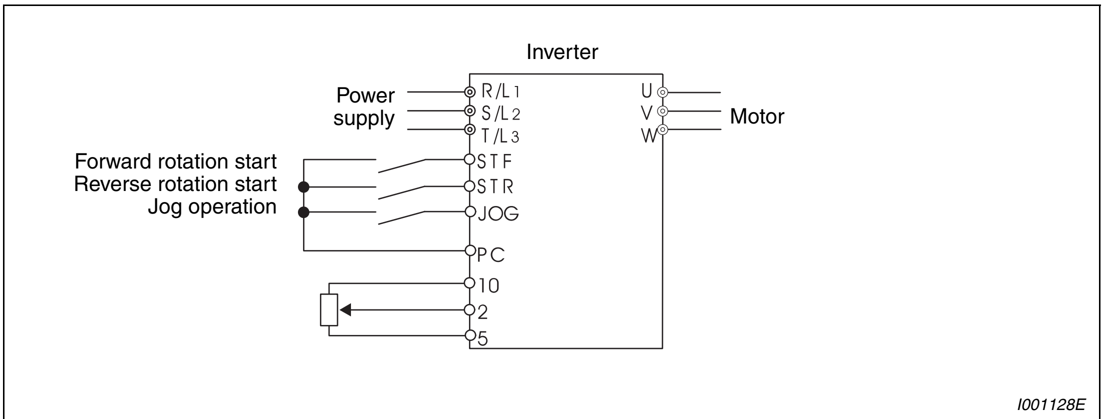


Fig. 6-20: *Connection diagram for external jog operation*

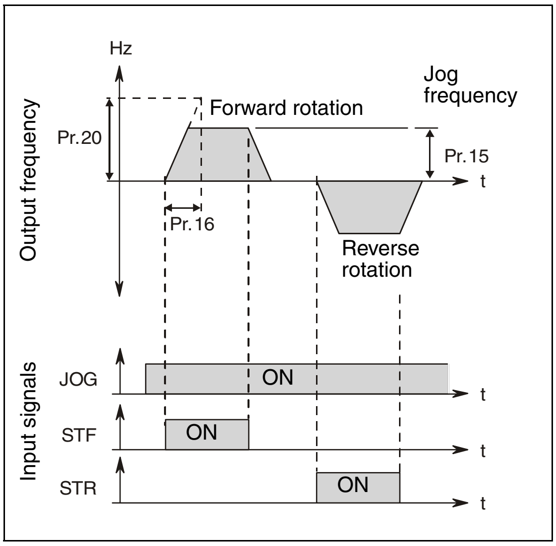


Fig. 6-21:
Jog operation signal timing chart

I001324C

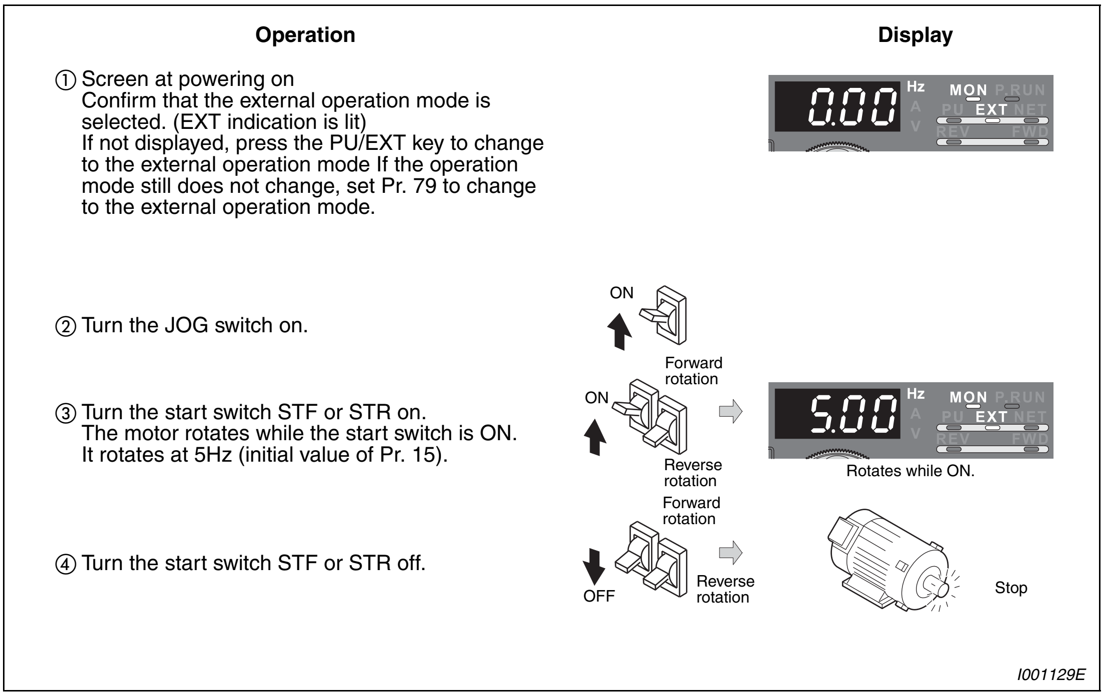


Fig. 6-22: *Jog operation in the external operation mode*

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.

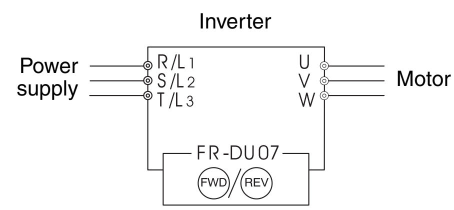
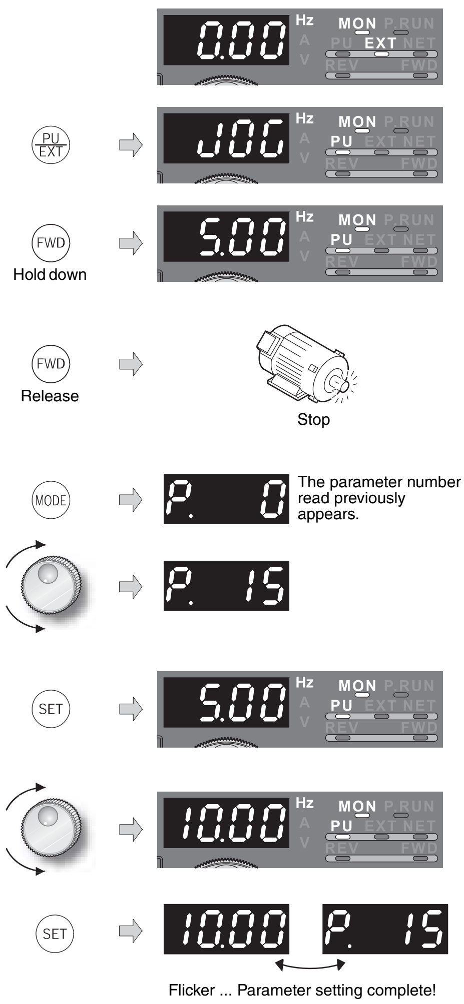


Fig. 6-23: *Connection example for jog operation performed from PU*

I001130E

Operation	Display
① Confirmation of the RUN indication and operation mode indication. The monitor mode must have been selected. The inverter must be at a stop.	
② Press the PU/EXT key to choose the PU JOG operation mode.	
③ Press the FWD or REV key. The motor rotates while the key is pressed. It rotates at 5Hz (initial value of Pr. 15).	
④ Release the FWD or REV key to stop the motor.	
When changing the frequency of PU JOG operation:	
⑤ Press the MODE key to choose the parameter setting mode.	
⑥ Turn the digital dial until Pr. 15 "JOG frequency" appears.	
⑦ Press the SET key to show the currently set value (5Hz).	
⑧ Turn the digital dial to set the value to "10.00" (10.00Hz).	
⑨ Press the SET key to set. ⑩ Perform the operations in steps ① to ④ The motor rotates at 10Hz.	



I001131E

Fig. 6-24: *JOG operation performed from PU*

NOTES

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 section 6.9.3)).

When Pr. 79 "Operation mode selection" = 4, push the FWD/REV key of the PU (FR-DU07/FR-PU04/FR-PU07) to make a start or push the STOP/RESET key to make a stop.

This function is invalid when Pr. 79 = 3.

6.5.3 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.

Pr. No.	Name	Initial Value	Setting Range	Description
28	Multi-speed input compensation selection	0	0	Without compensation
			1	Without compensation

Parameters referred to		Refer to Section
4–6 24–47 232–239	Multi-speed operation	6.5.1
73	Analog input selection	6.15.1
59	Remote function selection	6.5.4

The above parameter can be set when Pr. 160 "User group read selection" = 0.

NOTE

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

6.5.4 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.

Pr. No.	Name	Initial Value	Setting Range	Description: RH, RM, RL signal function	Description: Frequency setting storage function	Description: Deceleration to the frequency lower than set frequency
59	Remote function selection	0	0	Multi-speed setting	—	—
			1	Remote setting	✔	Disabled
			2	Remote setting	Not used	Disabled
			3	Remote setting	Not used (Turning STF/ STR off clears remotely set frequency.)	Disabled
			11	Remote setting	✔	Enabled
			12	Remote setting	Not used	Enabled
			13	Remote setting	Not used (Turning STF/ STR off clears remotely set frequency.)	Enabled

Parameters referred to		Refer to Section
1	Maximum frequency	6.3.1
18	High speed maximum frequency	6.3.1
7	Acceleration time	6.6.1
8	Deceleration time	6.6.1
44	Second acceleration/deceleration time	6.6.1
45	Second deceleration time	6.6.1
28	Multi-speed input compensation selection	6.5.3
178–189	Input terminal function selection	6.9.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

Pr. 59 can be used to select a digital motor potentiometer. Setting Pr. 59 to a value of "1, 11" activates the frequency setting storage function, so that the stored value is also stored when the power is switched off. The last frequency value is stored in the E²PROM. The delete instruction only applies to the data stored in RAM.

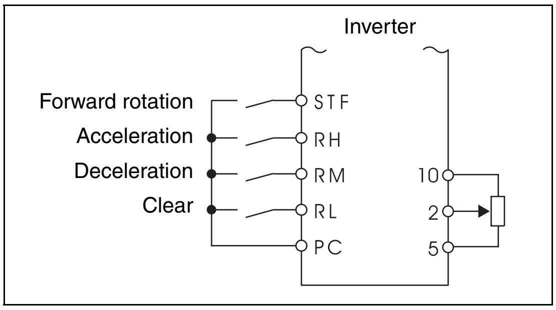


Fig. 6-25:
Connection diagram for remote setting

I001132E

When Pr. 59 is set to any of "1 to 3, 11 to 13" (remote setting function valid), the functions of the RH, RM and RL signals are changed: RH ⇒ acceleration, RM ⇒ deceleration and RL ⇒ clear.

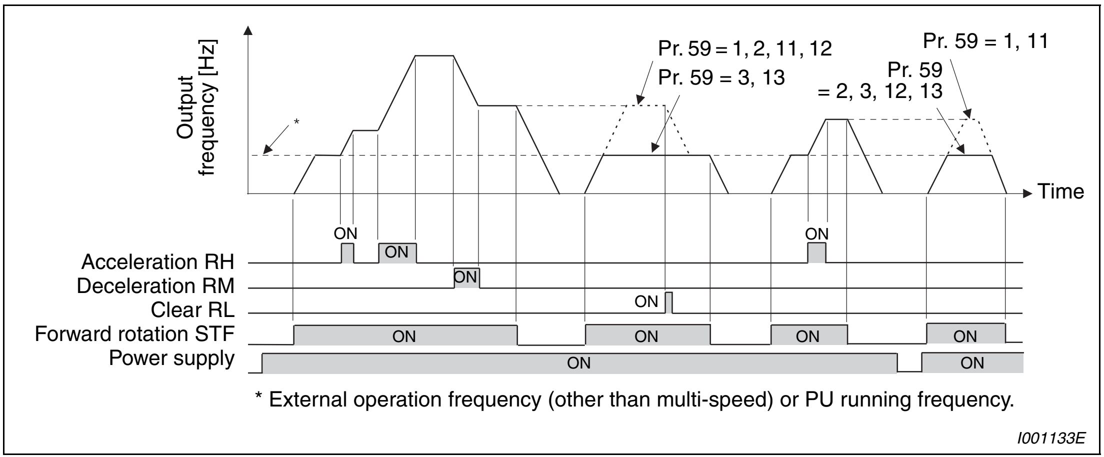


Fig. 6-26: *Example of the remote setting function (1)*

Remote setting function

External operation: Frequency set by RH/RM operation + external running frequency or PU running frequency (other than multi-speed). (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

By setting Pr. 59 = "11 to 13", the speed can be decelerated to the frequency lower than the main speed (set by the external operation frequency (except multi-speed setting) or PU operation frequency).

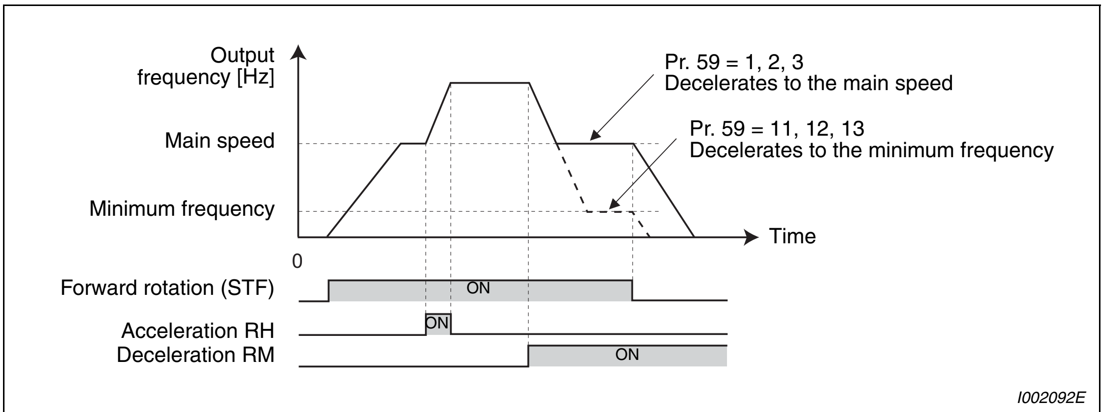


Fig. 6-27: *Example of the remote setting function (2)*

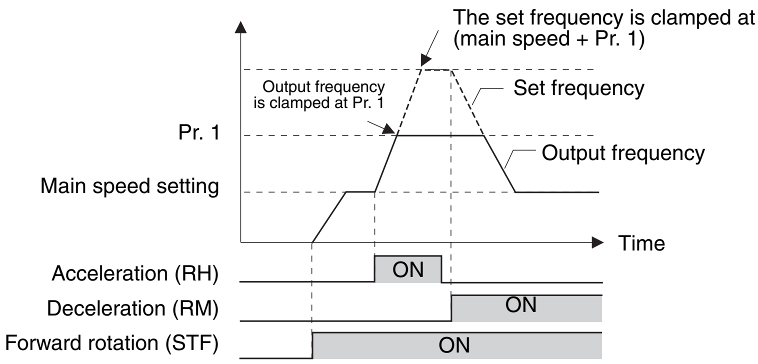
Frequency setting storage

The frequency setting storage function stores the remote setting frequency (frequency set by RH/RM operation) into the memory (E^2PROM). When power is switched off once, then on, operation is resumed with that output frequency value. (Pr. 59 = 1, 11)

The frequency is stored at the point when the start signal (STF or STR) turns off or 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.)

NOTES

The range where the frequency can be varied by RH (acceleration) or RM (deceleration) is 0 to the maximum frequency (Pr. 1 or Pr. 18 setting). Note that the maximum value of set frequency is (main speed plus maximum frequency).



When the acceleration or deceleration signal switches on, acceleration/deceleration time is as set in Pr. 44 and Pr. 45. Note that when long time has been set in Pr. 7 or Pr. 8, the acceleration/deceleration time is as set in Pr. 7 or Pr. 8 (when RT signal is off).
When the RT signal is on, acceleration/deceleration is made in the time set to Pr. 44 and Pr. 45, regardless of the Pr. 7 or Pr. 8 setting.

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 E^2PROM) invalid (Pr. 59 = 2, 3, 12, 13). If set valid (Pr. 59 = 1, 11), frequency is written to E^2PROM frequently, this will shorten the life of the E^2PROM.

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.

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

Set frequency = 0 Hz

- 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.

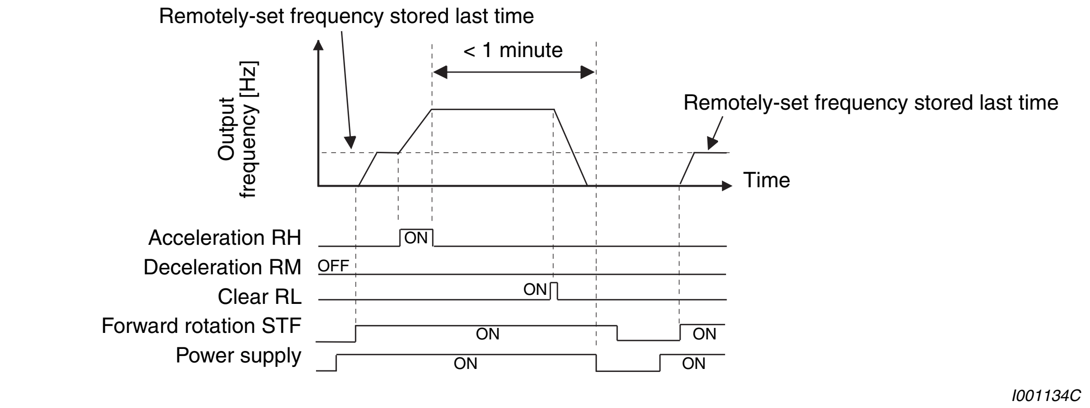


Fig. 6-28: *Outputting the remotely-set frequency stored last time*

- 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.

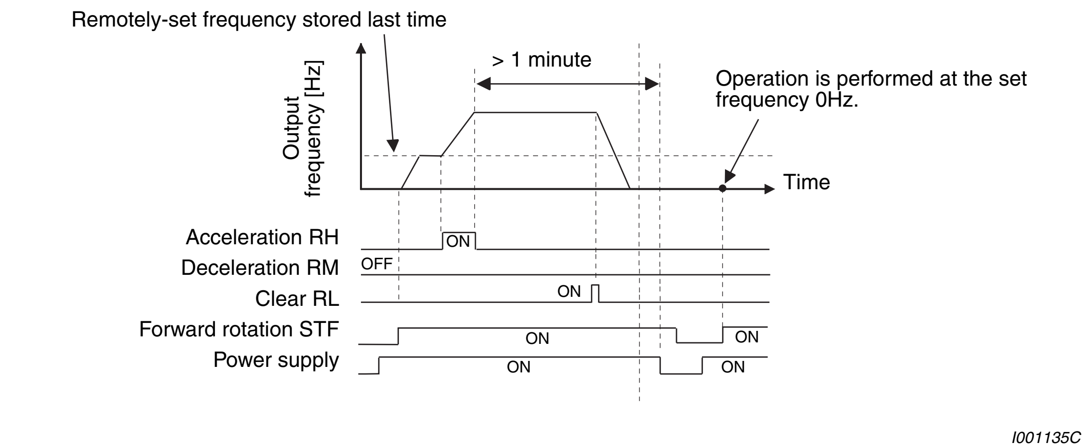


Fig. 6-29: *Outputting the current set frequency*

CAUTION:
When Pr. 59 is set to "1, 11" the motor will restart automatically after a power failure if there is an active rotation direction signal.

6.6 Acceleration and deceleration

Purpose	Parameters that must be set		Refer to Section
Motor acceleration/deceleration time setting	Acceleration/deceleration times	Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45	6.6.1
Starting frequency	Starting frequency and start-time hold	Pr. 13, Pr. 571	6.6.2
Set acceleration/deceleration pattern suitable for application	Acceleration/deceleration pattern and back lash measures	Pr. 29, Pr. 140–Pr. 143	6.6.3

6.6.1 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.

Pr. No.	Name	Initial Value		Setting Range	Description	
7	Acceleration time	00170 or less	5s	0–3600s/ 0–360s ②	Set the motor acceleration time.	
		00250 or more	15s			
8	Deceleration time	00170 or less	10s	0–3600s/ 0–360s ②	Set the motor deceleration time.	
		00250 or more	30s			
20	Acceleration/ deceleration reference frequency ①	50Hz		1–400Hz	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	Acceleration/ deceleration time increments ①	0		0	Increments: 0.1s Range: 0–3600s	Increments and setting range of acceleration/ deceleration time setting can be changed.
				1	Increments: 0,01 s Range: 0–360 s	
44	Second acceleration/ deceleration time ①	5s		0–3600s/ 0–360s ②	Set the acceleration/deceleration time when the RT signal is on.	
45	Second deceleration time ①	9999		0–3600s/ 0–360s ②	Set the deceleration time when the RT signal is on.	
				9999	Acceleration time = deceleration time	

Parameters referred to		Refer to Section
3	Base frequency	6.4.1
29	Acceleration/ deceleration pattern selection	6.6.3
125	Frequency setting gain frequency	6.15.4
126	Frequency setting gain frequency	6.15.4
178–189	Input terminal function selection	6.9.1

① The above parameters can be set when Pr. 160 "User group read selection" = 0.

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".

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.

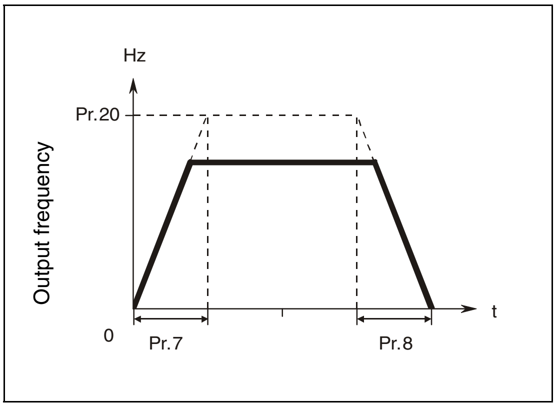


Fig. 6-30:
Acceleration/deceleration time

I000006C

Set the acceleration time according to the following formula:

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

Example ▽

When Pr. 20 = 50Hz (initial value), Pr. 13 = 0.5Hz

The acceleration can be made up to the maximum operating frequency of 40Hz in 10s.

$$\text{Pr. 7} = \frac{50\text{Hz}}{40\text{Hz} - 0{,}5\text{Hz}} \times 10\text{s} = 12.7\text{s}$$

△

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:

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

Example ▽

When Pr. 20 = 120Hz, Pr. 10 = 3Hz

The deceleration can be made up from the maximum operating frequency of 40Hz to a stop in 10s.

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

△

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 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.

Set multiple acceleration/deceleration time (RT signal, Pr. 44, Pr. 45)

The settings of Prs. 44 and 45 are activated by switching the RT signal. Switching the parameter sets allows you to operate motors with different specifications and capabilities with the frequency inverter. If the RT signal is on then all other second functions are active, for example the second torque boost setting.

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

S-shaped acceleration/deceleration pattern

If a S-shaped acceleration/deceleration pattern A is selected in pr. 29, the set time is the period required to reach the base frequency set in Pr. 3 "Base frequency".

Acceleration/deceleration time formula when the set frequency is the base frequency or higher.

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

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).

Acceleration/deceleration time [s]	Frequency Setting [Hz]			
	50	120	200	400
5	5	16	38	145
15	15	47	115	435

Tab. 6-7: *Acceleration/deceleration time at a base frequency of 50Hz*

NOTES

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.

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.

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 (inertia moment) and motor torque.

6.6.2 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.

Pr. No.	Name	Initial Value	Setting Range	Description
13	Starting frequency	0.5Hz	0–60Hz	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 start	9999	0.0–10.0s	Set the holding time of Pr. 13 "Starting frequency".
			9999	Holding function at a start is invalid

Parameters referred to	Refer to Section
2 Minimum frequency	6.3.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Starting frequency setting (Pr. 13)

The motor is started with the specified start frequency as soon as the frequency inverter receives a start signal and a frequency setting that is greater than or equal to the preset starting frequency.

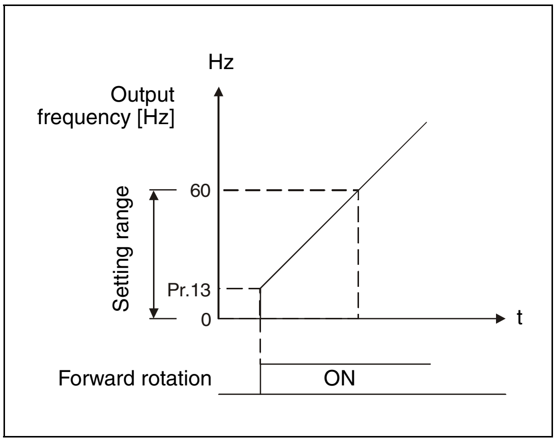


Fig. 6-31:
Starting frequency parameter

I000008C

NOTE The inverter will not start if the frequency setting signal is less than the value set in Pr. 13.

Example ▽ When 5Hz is set in Pr. 13, the motor will not start running until the frequency setting signal reaches 5Hz.

△

WARNING:
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.

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.

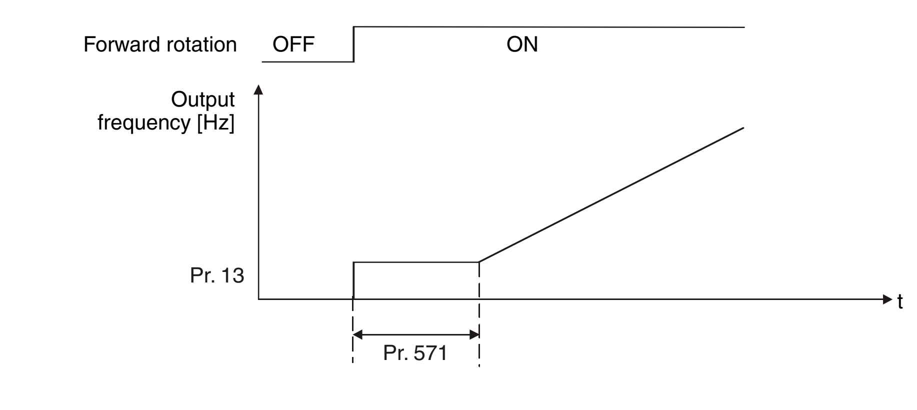


Fig. 6-32: *Holding time at start*

NOTES

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.

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

6.6.3 Acceleration and 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.

Pr. No.	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
			6	Variable-torque acceleration/deceleration
140	Backlash acceleration stopping frequency	1Hz	0–400Hz	Set the stopping frequency and time for backlash measures. Valid when Pr. 29 = 3
141	Backlash acceleration stopping time	0.5s	0–360s	
142	Backlash deceleration stopping frequency	1Hz	0–400Hz	
143	Backlash deceleration stopping time	0.5 s	0–360s	

Parameters referred to		Refer to Section
3	Base frequency	6.4.1
7	Acceleration time	6.6.1
8	Deceleration time	6.6.1
20	Acceleration/deceleration reference frequency	6.6.1
14	Load pattern selection	6.4.2
592	Traverse function sleection	6.19.4

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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 (refer to Fig. 6-33).

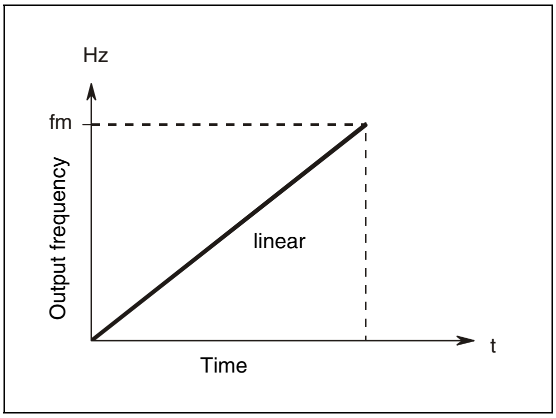


Fig. 6-33:
Characteristic for parameter 29 = 0

I000015C

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 base frequency. In this acceleration/deceleration pattern, Pr. 3 "Base frequency" (fb) is the inflection point of the S-pattern (refer to Fig. 6-34) and you can set the acceleration/deceleration time appropriate for motor torque reduction in a constant-output operation region of base frequency or higher.

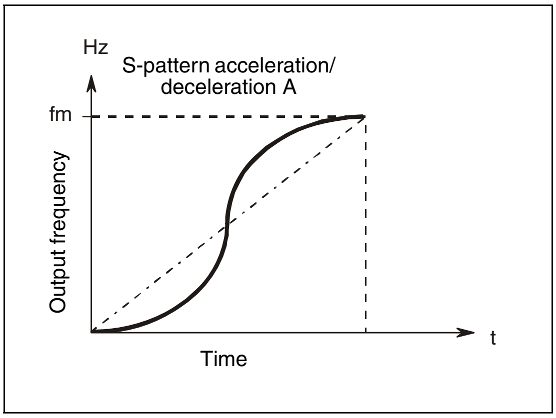


Fig. 6-34:
Characteristic for parameter 29 = 1

I000016C

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

When a setting of "2" is entered frequency changes are executed with an S-pattern. For example, if a drive is accelerated from 0 to 30Hz and then re-accelerated to 50Hz then each acceleration sequence (i.e. the first sequence from 0 to 30Hz and the second from 30Hz to 50Hz) will be executed with an S-pattern. The time for the S-pattern is not longer than that for linear acceleration (refer to Fig. 6-35). This prevents jolts in drive operation, for example for conveyor belt and positioning drive systems.

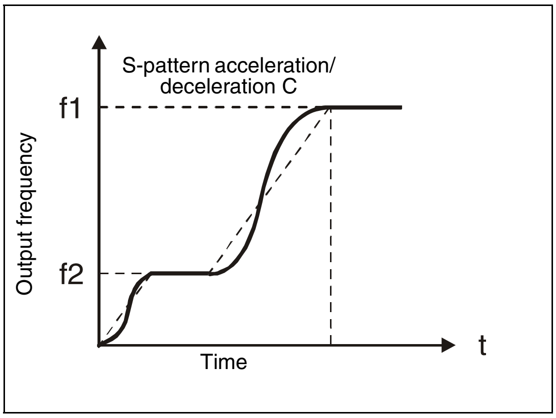


Fig. 6-35:
Characteristic for parameter 29 = 2

I000017C

NOTE

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

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.

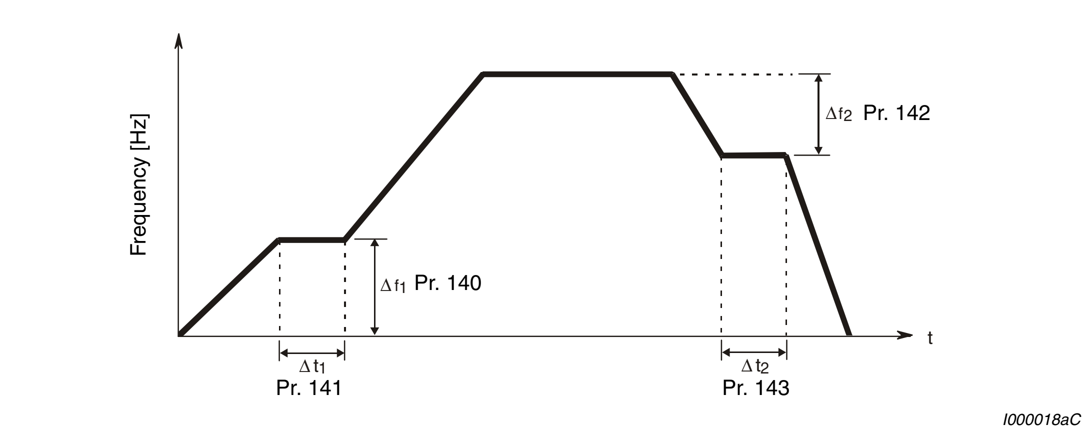


Fig. 6-36: *Anti-backlash measure function*

NOTE

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

Variable-torque acceleration/deceleration (Pr. 29 = 6)

This function is useful for variable-torque load such as a fan and blower to accelerate/decelerate in short time.

In areas where output frequency > base frequency, the speed accelerates/decelerates linearly.

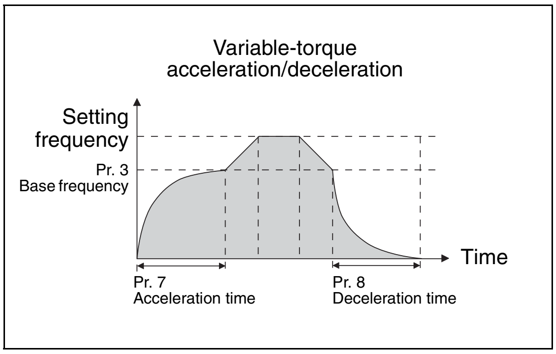


Fig. 6-37:
Characteristic for parameter 29 = 6

I002093E

NOTES

As the acceleration/deceleration time of variable-torque acceleration/deceleration, set the time taken to reach Pr. 3 Base frequency, not Pr. 20 Acceleration/deceleration reference frequency.

When the base frequency is not 45 to 65Hz, the speed accelerates/decelerates linearly even though Pr. 29 = "6".

Variable-torque acceleration/deceleration is disabled when traverse function is enabled (Pr.592 = "2" or Pr.592 = "1" at External operation mode).

Variable-torque acceleration/deceleration overrides Pr. 14 = "1" setting (for variable torque load). Thus, when Pr. 14 = "1" while variable-torque acceleration/deceleration is valid, inverter operates as Pr. 14 = "0" (for constant-torque load).

6.7 Selection and protection of a motor

Purpose	Parameters that must be set		Refer to Section
Motor protection from overheat	Electronic thermal O/L relay	Pr. 9, Pr. 51	6.7.1
Use the constant torque motor	Applied motor	Pr. 71	6.7.2

6.7.1 Motor protection from overheat (Electronic thermal relay function) (Pr. 9, Pr. 51)

The FR-F700 EC frequency inverters have an internal electronic motor protection function that monitors the motor frequency and motor current. Overload conditions are identified and the motor protection function is triggered on the basis of these two factors, in combination with the rated motor current. The electronic motor protection function is primarily for protection against overheating at intermediate speeds and high motor torques. The reduced cooling performance of the motor fan under these conditions is also taken into account.

Pr. No.	Name	Initial Value	Setting Range		Description
9	Electronic thermal O/L relay	Rated inverter output current	01160 or less	0–500A	Set the rated motor current.
			01800 or more	0–3600A	
51	Second electronic thermal O/L relay ①	9999	01160 or less	0–500A	Made valid when the RT signal is on. Set the rated motor current.
			01800 or more	0–3600A	
			9999		Second electronic thermal O/L relay invalid

Parameters referred to		Refer to Section
71	Applied motor	6.7.2
72	PWM frequency selection	6.14.1
178–189	Input terminal function selection	6.9.1
190–196	Output terminal function selection	6.9.5
	AU terminal	3.3

① The above parameter can be set when Pr. 160 "User group read selection" = 0. When parameter is read using the FR-PU04, a parameter name different from an actual parameter is displayed.

Electronic thermal O/L relay (Pr. 9)

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" to 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 set "1" to Pr. 71. (This provides a 100% continuous torque characteristic in the low-speed range.) After this set the rated current of the motor to Pr. 9.

The figure below shows the electronic thermal relay function operation characteristic. The region on the right of the characteristic curve is the operation region. The region on the left of the characteristic curve is the non-operation region.

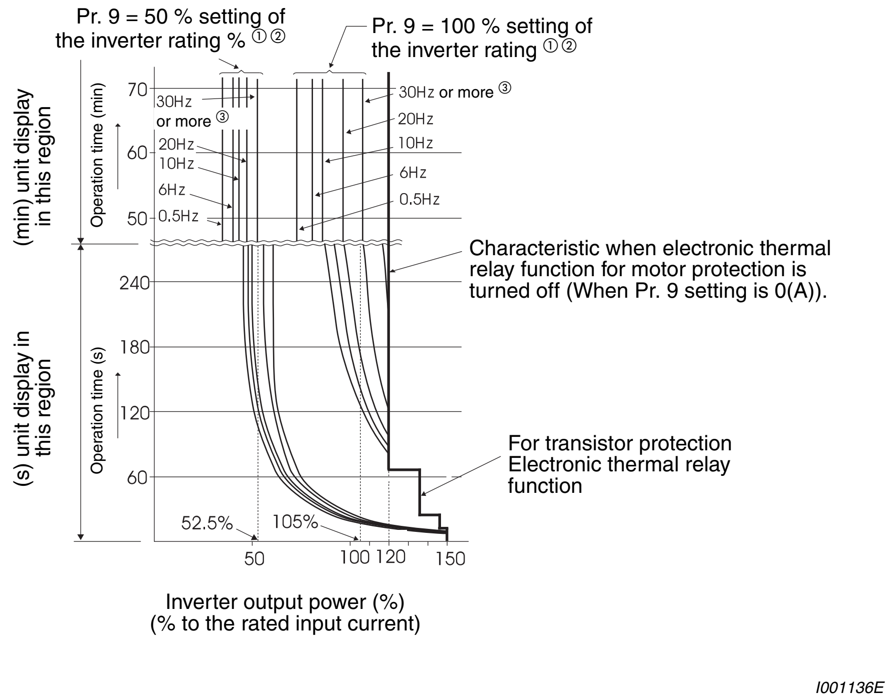


Fig. 6-38: Electronic thermal relay function operation characteristic

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

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

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

NOTES

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.

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.

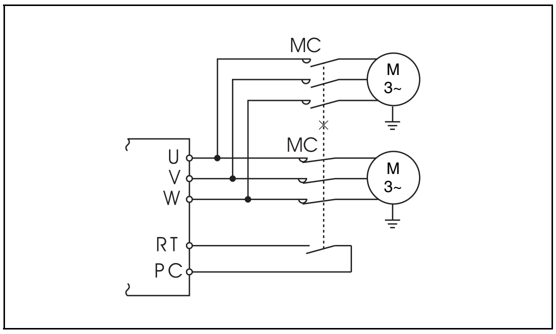


Fig. 6-39:
Operating two motors by a single inverter

NOTES

The RT signal acts as the second function selection signal and makes the other second functions valid.

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.

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

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" (source logic) or "108" (sink logic) in any of Pr. 190 to Pr. 196 "Output terminal function selection".

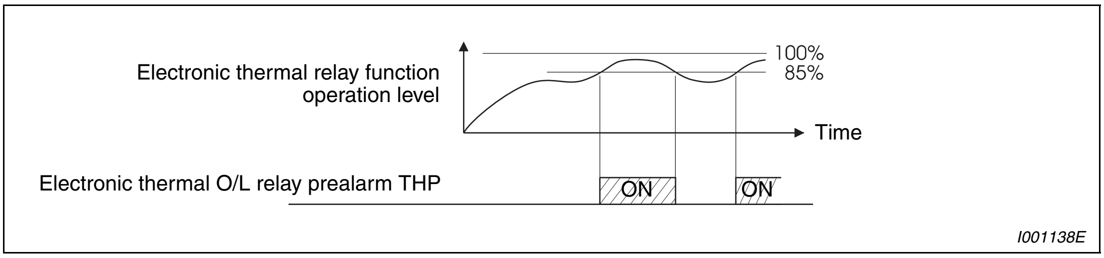


Fig. 6-40: *Prealarm signal output*

NOTE

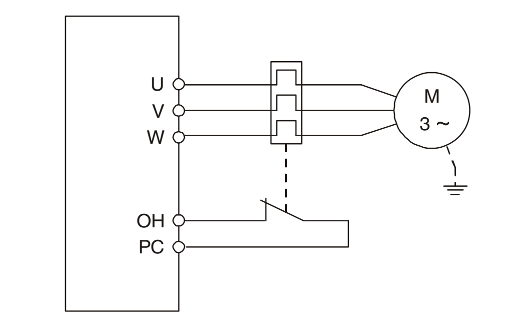
The signal can be assigned to the input terminal using any of Pr. 190 to Pr. 196 "Output terminal function selection". When terminal assignment is changed, the other functions may be affected. Please make setting after confirming the function of each terminal.

External thermal relay input (OH signal)

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".



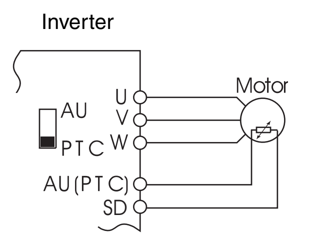
I000553C

Fig. 6-41:
Connection of an external thermal relay

NOTE 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.

PTC thermistor input (PTC signal)

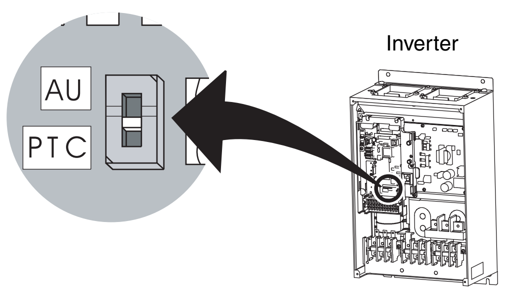
PTC thermistor output built-in the motor can be input to the PTC signal (AU terminal).



I001140E

Fig. 6-42:
Connection of a PTC thermistor

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.)



I001141E

Fig. 6-43:
AU/PTC switchover switch

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 table below shows the correspondence between the motor temperature and the PTC thermistor resistance values:

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

Tab. 6-8: *Working area of the PTC function*

NOTES

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.

6.7.2 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.

Pr. No.	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.

Parameters referred to		Refer to Section
0	Torque boost	6.2.1
12	DC injection brake operation voltage	6.8.1
100–109	Adjustable 5 points V/f	6.4.3

The above parameter can be set when Pr. 160 "User group read selection" = 0.

Pr. 71 Setting	Thermal Characteristic of the Electronic Thermal Relay Function
0	Thermal characteristics of a standard motor
1	Thermal characteristics of the Mitsubishi constant-torque motor
2	Thermal characteristics of a standard motor with adjustable 5 points V/Ff
20	Mitsubishi standard motor SF-JR 4P (1.5kW or less)

Tab. 6-9: *Setting of parameter 71*

NOTE

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	0, 2, 20	1
Pr. 0	3%	2%
Pr. 12	4%	2%

Tab. 6-10: *Changes of parameter 0 and 12 related to parameter 71*

CAUTION:

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

6.8 Motor brake and stop operation

Purpose	Parameters that must be set		Refer to Section
Motor braking torque adjustment	DC injection brake	Pr. 10–Pr. 12	6.8.1
Improve the motor braking torque with an option	Selection of a regenerative brake	Pr. 30, Pr. 70	6.8.2
Performing operation by DC current input	DC current feeding mode	Pr. 30	6.8.2
Coast the motor to a stop	Selection of motor stopping method	Pr. 250	6.8.3
	Output stop function	Pr. 522	6.8.4

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

The FR-F700 EC frequency inverter has an adjustable DC brake function.

This function uses the eddy current brake principle, stopping the motor by applying a pulsed DC voltage to the motor stator.

The pulsed DC voltage applied to the motor stator can achieve stopping torques of around 25 to 30% of the motor's rated torque.

Pr. No.	Name	Initial Value		Setting Range	Description
10	DC injection brake operation frequency	3Hz		0–120Hz	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
				0.1–10s	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%	0–30%	Set the DC injection brake voltage (torque). When "0" is set, DC injection brake is disabled.
		00250 to 01160	2%		
		01800 or more	1%		

Parameters referred to		Refer to Section
13	Starting frequency	6.6.2
71	Applied motor	6.7.2

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Operation frequency setting (Pr. 10)

When the frequency at which the DC injection brake operates is set to 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".

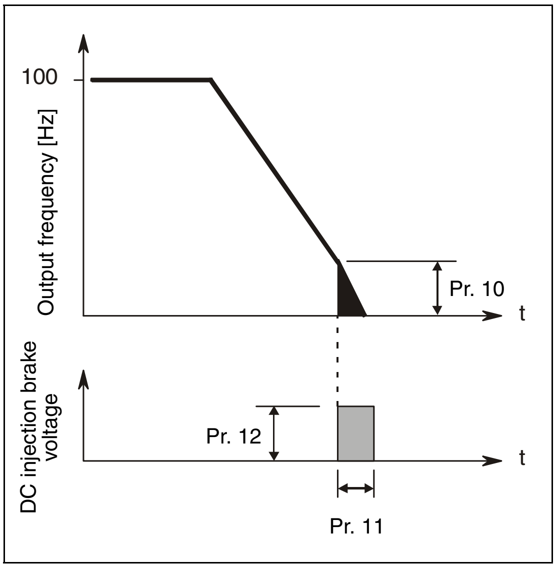


Fig. 6-44:
When Pr. 11 is set to a value between 0,1 and 10s

I000007C

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.

When the motor does not stop due to large load moment (J), increasing the setting produces an effect.

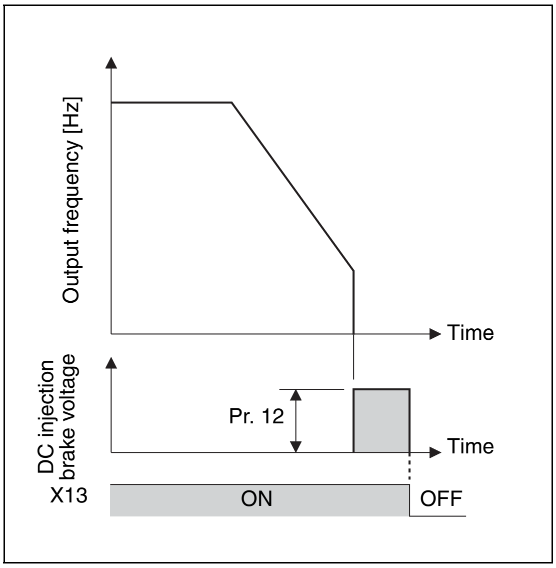


Fig. 6-45:
When Pr. 11 is set to "8888"

I001142E

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-HR-CA), change the Pr.12 setting as follows:

SF-JRCA: 00083 or less ... 4%, 00126 or more ... 2%
SF-HR, SF-HRCA: 00083 or less ... 4%, 00126, 00170 ... 3%, 00250 ... 2% (00620 ... 1.5%)

NOTES

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:

Parameter 12 = 4% (initial value)
The Pr. 12 setting is automatically changed to 2% if the Pr. 71 value is changed to from the value selecting the standard motor (0, 2) to the value selecting the constant motor (1).

Parameter 12 = 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).

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

6.8.2 Selection of a regenerative brake and DC feeding (Pr. 30, Pr. 70)

- When making frequent starts/stops, use the optional brake unit (BU, FR-BU, MT-BU5) to increase the regenerative brake duty.
- Use a power regeneration common converter (FR-CV) or power regeneration converter (MT-RC) for continuous operation in regenerative status.
  Use the high power factor converter (FR-HC, MT-HC) to reduce harmonics, improve the power factor, or continuously use the regenerative mode.
- You can select DC feeding mode 1, which operates with DC power supply (terminal P/+, N/–), or DC feeding mode 2, which normally operates with AC power supply (terminal R/L1, S/L2, T/L3) and with DC power supply such as battery at power failure occurrence.

Pr. No.	Name	Initial Value	Setting Range	Description	
				Regeneration unit	Terminal for power supply to the inverter
30	Regenerative function selection	0	0	Brake unit (FR-BU, BU type)	R/L1, S/L2, T/L3
			10		P/+, N/– (DC feeding mode 1)
			20		R/L1, S/L2, T/L3 - P/+, N/– (DC feeding mode 2)
			1	Brake unit (MT-BU5), power regeneration converter (MT-RC)	R/L1, S/L2, T/L3
			11		P/+, N/– (DC feeding mode 1)
			21		R/L1, S/L2, T/L3 - P/+, N/– (DC feeding mode 2)
			2	High power factor converter (FR-HC, MT-HC), power regeneration common converter (FR-CV)	P/+, N/–
70	Special regenerative brake duty	0%	0–10%	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)	

Parameters referred to		Refer to Section
57	Restart coasting time	6-137
178–189	Input terminal function selection	6.9.1
190–196	Output terminal function selection	6.9.5
261	Power failure stop selection	6.11.2

The above parameters can be set when Pr. 160 "User group read selection" = 0.

01160 or less

Regeneration Unit	Power supply to the inverter	Pr. 30 setting
Brake unit (FR-BU, BU)	R/L1, S/L2, T/L3	0 (initial value)
	P/+, N/–	10
	R/L1, S/L2, T/L3 - P/+, N/–	20
High power factor converter (FR-HC, MT-HC), power regeneration common converter (FR-CV)	P/+, N/–	2

Tab. 6-11: *Regeneration unit and DC injection (01160 or less)*

01800 or more

Regeneration unit	Power supply to the inverter	Pr. 30 setting	Pr. 70 setting
Not used	R/L1, S/L2, T/L3	0 (initial value)	—
	P/+, N/–	10	
	R/L1, S/L2, T/L3 - P/+, N/–	20	
Power regeneration converter (MT-RC)	R/L1, S/L2, T/L3	1	0% (initial value)
Brake unit (MT-BU5)	R/L1, S/L2, T/L3	1	10%
	P/+, N/–	11	
	R/L1, S/L2, T/L3 - P/+, N/–	21	
High power factor converter (FR-HC)	P/+, N/–	2	—

Tab. 6-12: *Regeneration unit and DC injection (01800 or more)*

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

Set "0" (initial value), "10" or "20" in Pr. 30. The Pr. 70 setting is made invalid.

When using a brake unit (MT-BU5) and power regeneration converter (MT-RC) (01800 or more)

Set "1, 11 or 21" 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).

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.

- 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).
- 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.

NOTES

The MRS signal can also be used instead of the X10 signal.

Refer to section 3.7 for the connection of the brake unit, high power factor converter (FR-HC, MT-HC) and power regeneration common converter (FR-CV)

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

When Pr. 30 = "2", "Err" is displayed on the operation panel as the inverter is reset by the setting.

DC feeding mode (Pr. 30 = "10, 11")

Setting "10, 11" in Pr. 30 enables DC power supply operation.

Leave the AC power supply connection terminal R/L1, S/L2, and T/L3 open and connect the DC power supply to terminal P/+ and N/–. Also, remove jumpers across terminal R/L1 and R1/L11 as well as S/L2 and S1/L21, and connect terminals R1/L11 and S1/L21 to terminal P/+ and N/–.

The diagram below is a connection example.

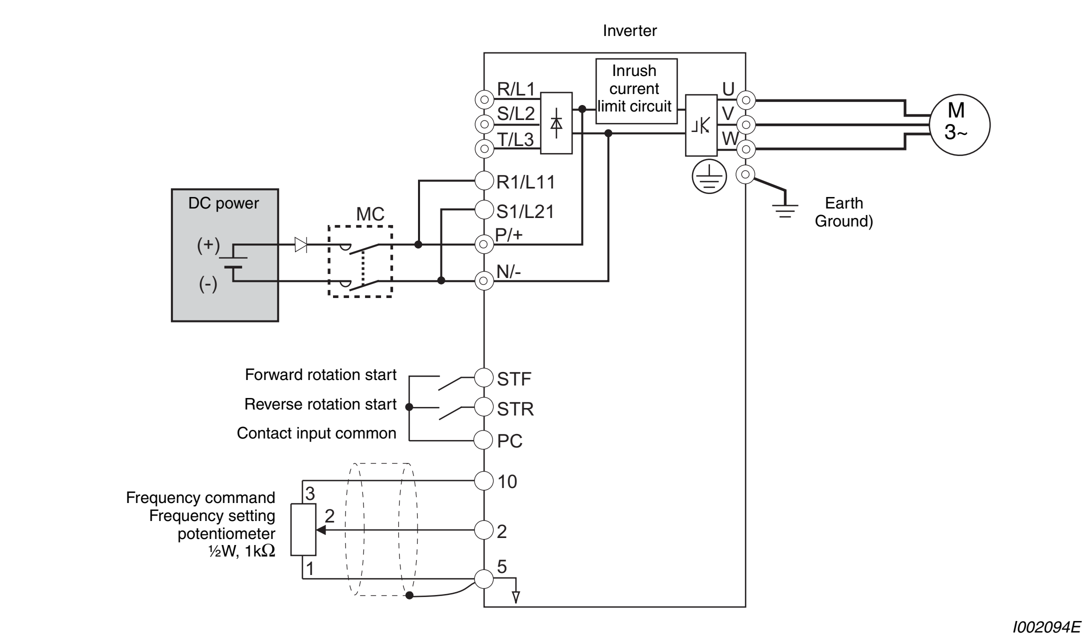


Fig. 6-46: *Connection example for DC feeding mode 1*

DC feeding mode (Pr. 30 = "20, 21")

When "20 or 21" is set in Pr. 30, operation is performed with AC power supply normally and with DC power supply such as battery at power failure.

Connect the AC power supply to terminal R/L1, S/L2, and T/L3 and connect the DC power supply to terminal P/+ and N/–. Also, remove jumpers across terminal R/L1 and R1/L11 as well as S/L2 and S1/L21, and connect terminals R1/L11 and S1/L21 to terminal P/+ and N/–.

Turning ON the DC feeding operation permission signal (X70) enables DC power supply operation. Refer to the table below for I/O signals.

Signal		Name	Description	Parameter Setting
Input	X70	DC feeding operation permission signal	When performing operation with DC feeding, turn ON the X70 signal. When the inverter output is shut off because of power failure, the inverter can be started in about 150ms after switching OFF the X70 signal then ON again. (When automatic restart operation is valid, the inverter starts after additional Pr. 57 set time has elapsed.) When the X70 signal turns OFF during inverter operation, output is shutoff (Pr. 261 = 0) or the inverter is decelerated to a stop (Pr. 261 ≠ 0).	Set 70 in any of Pr. 178 to Pr. 189.
Input	X71	DC feeding cancel signal	Turn this signal ON to stop DC feeding. When the X71 signal is turned ON during inverter operation with turning ON the X70 signal, output is shutoff (Pr. 261 = 0) or the inverter is decelerated to a stop (Pr. 261 ≠ 0), then the X85 signal turns OFF after the inverter stop. After turning ON the X71 signal, operation cannot be performed even if the X70 signal is turned ON.	Set 71 in any of Pr. 178 to Pr. 189.
Output	Y85	DC feeding signal	This signal turns ON during power failure or undervoltage of AC power. The signal turns OFF when the X71 signal turns ON or power is restored. The Y85 signal does not turn OFF during inverter operation even if the power is restored and turns OFF after an inverter stop. When the Y85 signal turns ON because of undervoltage, the Y85 signal does not turn OFF even if undervoltage is eliminated. ON/OFF status is retained at an inverter reset.	Set "85 (positive logic) or 185 (negative logic)" in any of Pr. 190 to Pr. 196.

Tab. 6-13: *I/O signals for DC feeding mode 2*

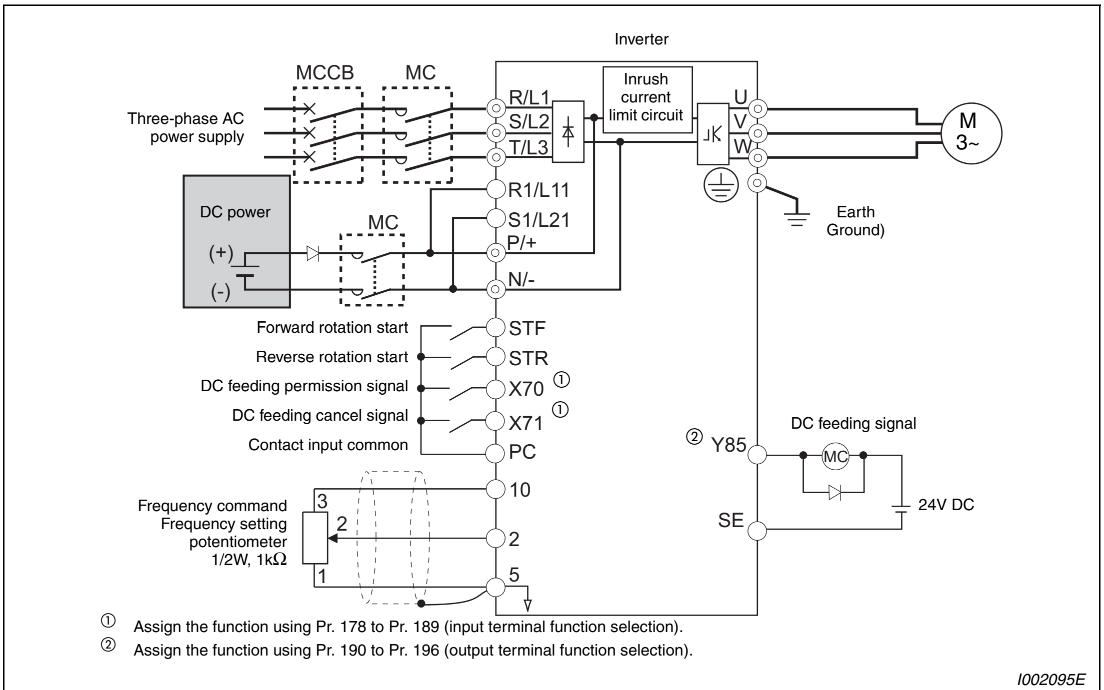


Fig. 6-47: *Connection example for DC feeding mode 2*

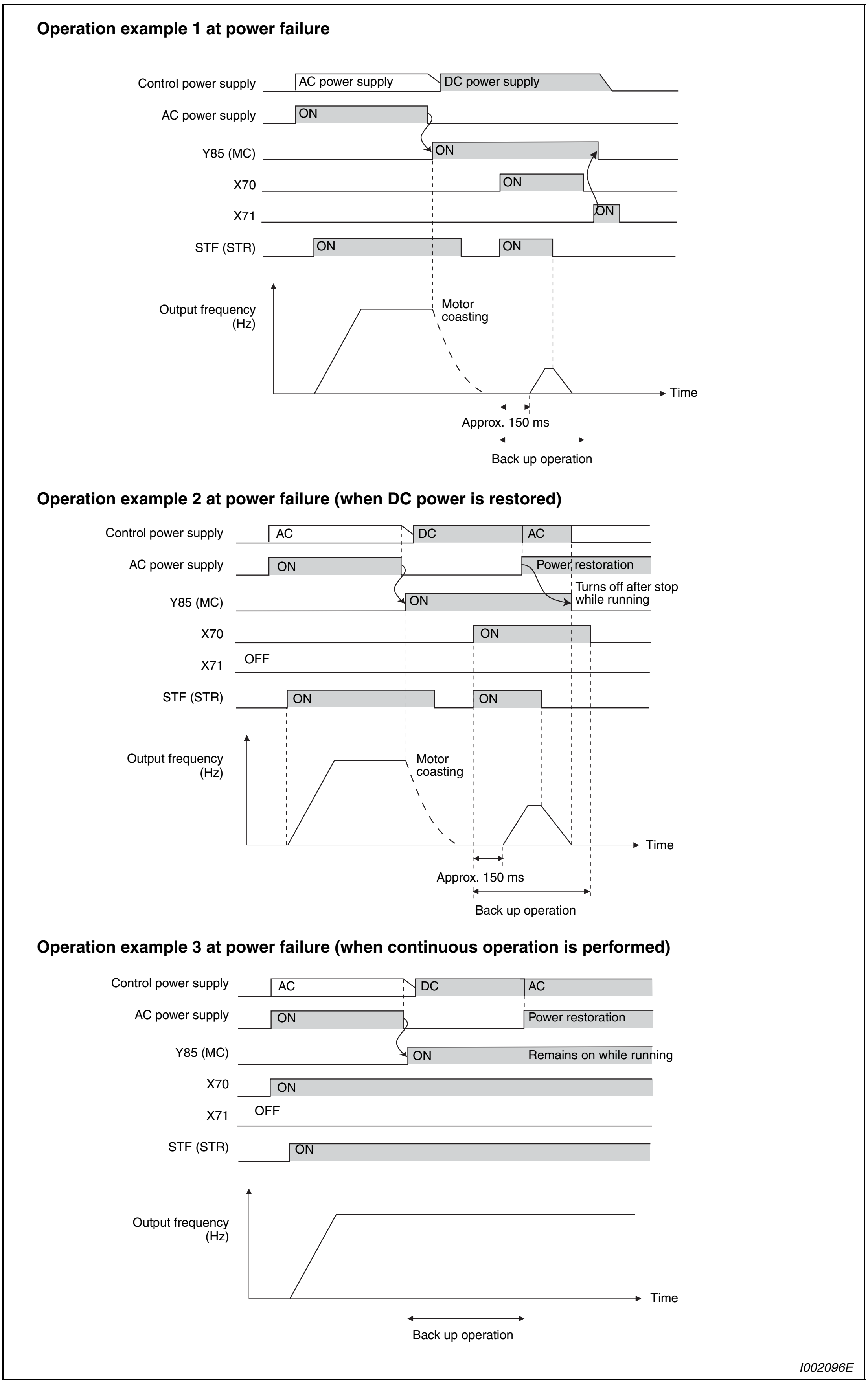


Fig. 6-48: *Operation examples at power failure*

Power supply specification at DC feeding

400V class	Rated input DC voltage	537V DC to 679V DC
	Permissible fluctuation	457V DC to 740V DC

CAUTION:
As voltage between P/+, N/– becomes 830V or more temporarily at regeneration, make selection of DC power supply carefully.

Regenerative brake duty alarm output and alarm signal (RBP signal) (01800 or more)

- [RB] appears on the operation panel and an alarm signal (RBP) is output when 85% of the regenerative brake duty set in Pr. 70 is reached. If the regenerative brake duty reaches 100% of the Pr. 70 setting, a regenerative overvoltage (E.OV1 to E.OV3) occurs.
- The inverter does not trip even when the alarm (RBP) signal is output.
- For the terminal used for the RBP signal output, assign the function by setting "7" (positive logic) or "107" (negative logic) in any of Pr. 190, Pr. 192 or Pr. 196 "Output terminal function selection".

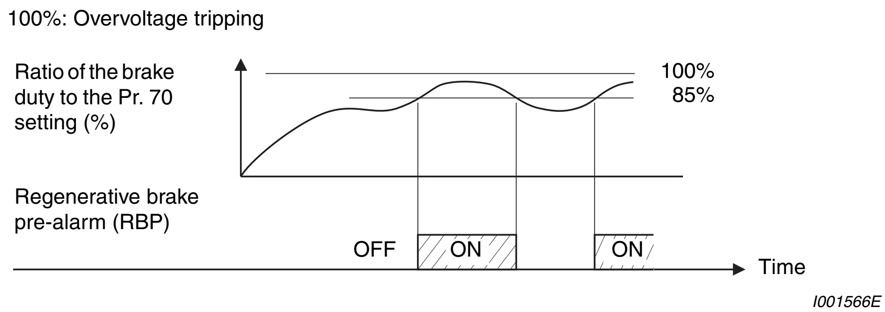


Fig. 6-49: *Regenerative overload*

NOTES

The MRS signal can also be used instead of the X10 signal.

Refer to section 3.7 for the connection of the brake unit, high power factor converter (FR-HC, MT-HC) and power regeneration common converter (FR-CV)

When AC power is connected to terminal R/L1, S/L2, T/L3 during DC feeding with "2, 10 or 11" (DC feeding) set in Pr. 30, an option alarm (E.OPT) occurs.

When DC feeding operation is performed with "2, 10, 11, 20, or 21" (DC feeding) set in Pr. 30, undervoltage protection (E.UVT) and instantaneous power failure (E.IPF) are not detected.

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.

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

6.8.3 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 section 6.9.4 for start signal selection.)

Pr. No.	Name	Initial Value	Setting Range	Description: Start Signal (STF/STR)	Description: Stop Operation
250	Stop selection	9999	0–100s	STF: Forward rotation start STR: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after the start signal is turned off.
			1000s–1100s	STF: Start signal STR: Forward/reverse signal	The motor is coasted to a stop (Pr. 250 – 1000)s after the start signal is turned off.
			9999	STF: Forward rotation start STR: Reverse rotation start	When the start signal is turned off, the motor decelerates to stop.
			8888	STF: Start signal STR: Forward/reverse signal	

Parameters referred to	Refer to Section
7 Acceleration time	6.6.1
8 Deceleration time	6.6.1
13 Starting frequency	6.6.2

The above parameter can be set when Pr. 160 "User group read selection" = 0.

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

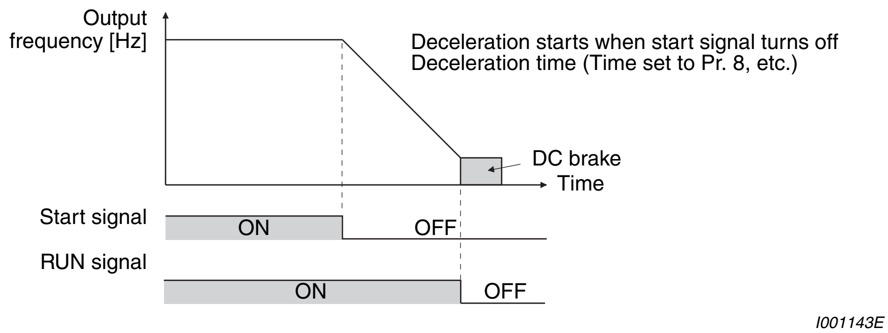


Fig. 6-50: *Stop operation when parameter 250 = 9999*

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.

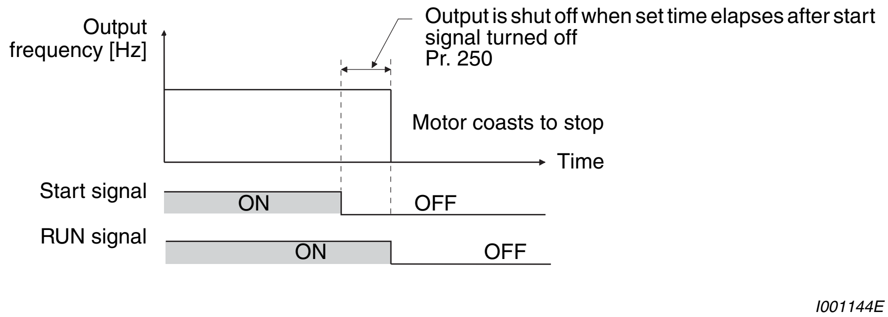


Fig. 6-51: *Stop operation when parameter 250 ≠ 8888 or 9999*

NOTES

The RUN signal turns off when the output stops.

Stop selection is invalid when the following functions are activated.
- Power failure stop function (Pr. 261)
- PU stop (Pr. 75)
- Deceleration stop because of communication error (Pr. 502)
- Emergency stop by LONWORKS communication

When setting of Pr. 250 is not 9999 nor 8888, acceleration/deceleration is performed according to the frequency command, until start signal is OFF and output is shutoff.

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

6.8.4 Output stop function (Pr. 522)

The motor coasts to a stop (inverter output shutoff) when inverter output frequency falls to Pr. 522 setting or lower.

Pr. No.	Name	Initial Value	Setting Range	Description
522	Output stop frequency	9999	0–400Hz	Set the frequency to start coasting to a stop (output shutoff).
			999	No function

Parameters referred to		Refer to Section
10	DC injection brake operation frequency	6.8.1
11	DC injection brake operation time	6.8.1
12	DC injection brake operation voltage	6.8.1
13	Starting frequency	6.6.2

The above parameter can be set when Pr. 160 "User group read selection" = 0.

When both of the frequency setting signal and output frequency falls to the frequency set in Pr. 522 or lower, the inverter stops the output and the motor coasts to a stop.

After a stop, the inverter output re-starts when the frequency signal is set higher than Pr. 522 + 2Hz. The motor reaccelerates at the Pr.13 Starting frequency.

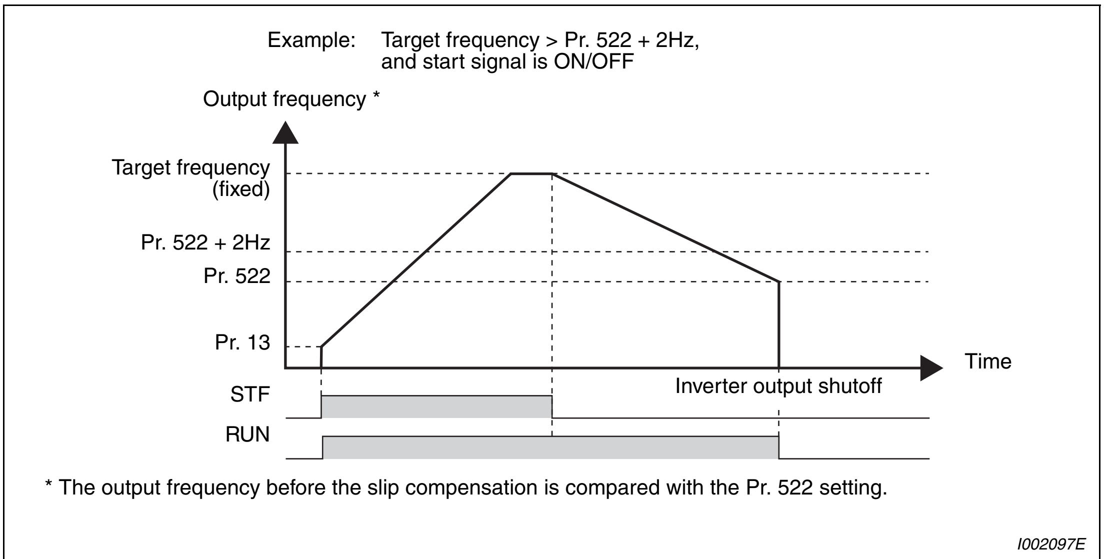


Fig. 6-52: *Example 1: Target frequency > Pr. 522 + 2Hz, start signal = ON/OFF*

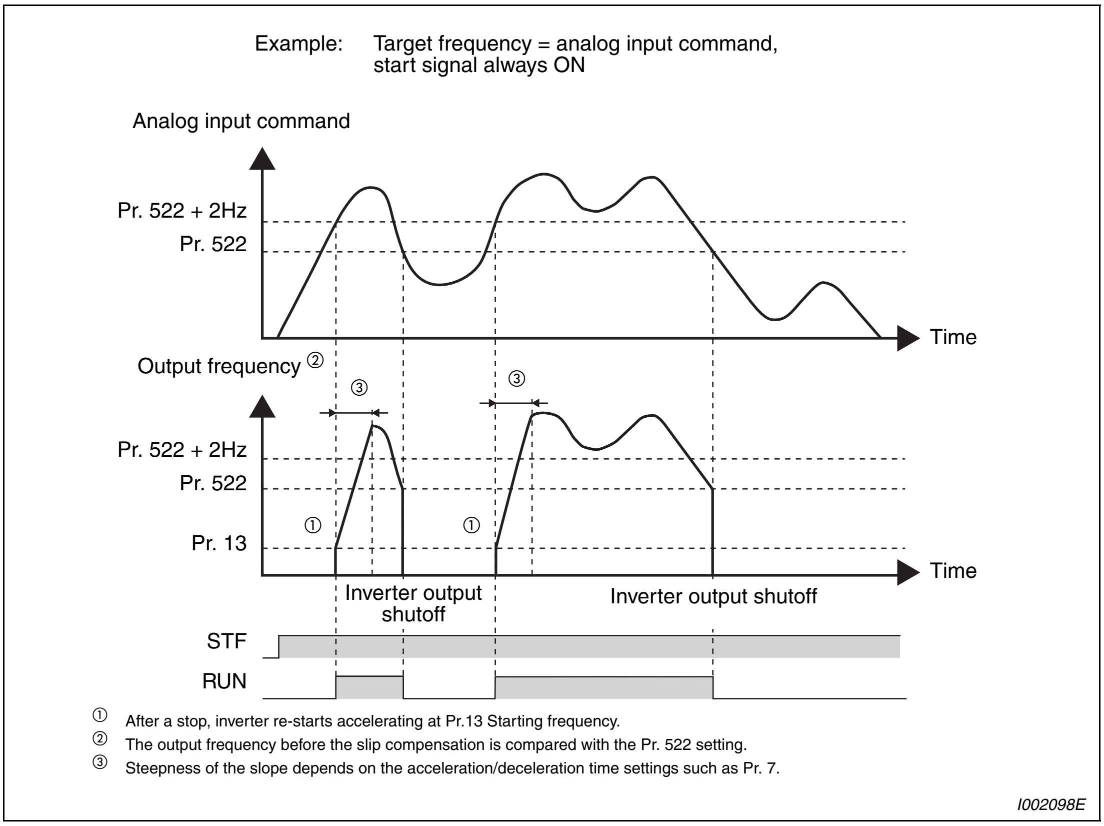


Fig. 6-53: *Example 2: Target frequency = analog input command, start signal always ON*

NOTES

When Pr. 522 ≠ "9999", output stop function disables DC injection brake operation, so the motor coasts to a stop when the output frequency falls to Pr. 522 or lower.

Output stop function is disabled during PID control, JOG control, power failure stop, and traverse function.

Output stop function does not operate during reverse rotation deceleration. However, when the frequency setting signal and output frequency falls to Pr.522 or lower, the inverter coasts to a stop.

During the output stop due to the output stop function (when forward/reverse command is given, but frequency command is not given), FWD/REV LED indication on the operation panel flickers fast.

6.9 Function assignment of external terminals

Purpose	Parameters that must be set		Refer to Section
Assign function to input terminal	Input terminal function selection	Pr. 178–Pr. 189	6.9.1
Set MRS signal (output shutoff) to normally closed contact specification	MRS input selection	Pr. 17	6.9.2
Make the second function valid only during constant speed operation	RT reflection time selection	Pr. 155	6.9.3
Assign start signal and forward/ reverse command to other signals	Start signal (STF/STF) operation selection	Pr. 250	6.9.4
Assign function to output terminal	Output terminal function selection	Pr. 190–Pr. 196	6.9.5
Detect output frequency	Up-to-frequency sensitivity Output frequency detection	Pr. 41–Pr. 43, Pr. 50	6.9.6
Detect output current	Output current detection Zero current detection	Pr. 150–Pr. 153, Pr. 166, Pr. 167	6.9.7
Remote output function	Remote output	Pr. 495–Pr. 497	6.9.8
Detect specified output power	Pulse train output of output power	Pr. 799	6.9.9

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

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

Pr. No.	Name	Initial Value	Initial Signal	Setting Range
178	STF terminal function selection	60	STF (forward rotation command)	0–8/10–14/16/24/25/ 37/60/62/64–67/ 70–72/9999
179	STR terminal function selection	61	STR (reverse rotation command)	0–8/10–14/16/24/25/ 37/61/62/64–67/ 70–72/9999
180	RL terminal function selection	0	RL (low-speed operation command)	0–8/10–14/16/24/25/ 37/62/64–67/ 70–72/9999
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)	0–8/10–14/16/24/25/ 37/62–67/ 70–72/9999
185	JOG terminal function selection	5	JOG (Jog operation selection)	0–8/10–14/16/24/25/ 37/62/64–67/ 70–72/9999
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)	

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Input terminal function assignment

Setting	Terminal	Function		Related Parameters	Refer to Page
0	RL	Pr. 59 = 0 (Initial value)	Low-speed operation command	Pr. 4–Pr. 6, Pr. 24–Pr. 27, Pr. 232–Pr. 239	6-54
		Pr. 59 = 1, 2 ①	Remote setting (setting clear)	Pr. 59	6-62
1	RM	Pr. 59 = 0 (Initial value)	Middle-speed operation command	Pr. 4–Pr. 6, Pr. 24–Pr. 27, Pr. 232–Pr. 239	6-54
		Pr. 59 = 1, 2 ①	Remote setting (deceleration)	Pr. 59	6-62
2	RH	Pr. 59 = 0 (Initial value)	High-speed operation command	Pr. 4–Pr. 6, Pr. 24–Pr. 27, Pr. 232–Pr. 239	6-54
		Pr. 59 = 1, 2 ①	Remote setting (acceleration)	Pr. 59	6-62
3	RT	Second function selection		Pr. 44–Pr. 51	6-30, 6-35, 6-49, 6-66, 6-76, 6-113
4	AU	Terminal 4 input selection		Pr. 267	6-170
5	JOG	Jog operation selection		Pr. 15, Pr. 16	6-57
6	CS	Selection of automatic restart after instantaneous power failure, flying start		Pr. 57, Pr. 58, Pr. 162–Pr. 165, Pr. 299, Pr. 611	6-137
7	OH	External thermal relay input ②		Pr. 9	6-76
8	REX	15 speed selection (combination with three speeds RL, RM, RH)		Pr. 4–Pr. 6, Pr. 24–Pr. 27, Pr. 232–Pr. 239	6-54
10	X10	Inverter operation enable signal (FR-HC, MT-HC, FR-CV connection)		Pr. 30	6-86
11	X11	FR-HC or MT-HC connection, instantaneous power failure detection		Pr. 30	6-86
12	X12	PU operation external interlock		Pr. 79	6-203
13	X13	External DC injection brake operation start		Pr. 11, Pr. 12	6-83
14	X14	PID control valid terminal		Pr. 127–Pr. 134, Pr. 575–Pr. 577	6-271
16	X16	PU-external operation switchover		Pr. 79, Pr. 340	6-212
24	MRS	Output stop		Pr. 17	6-99
25	STOP	Start self-holding selection		—	6-103
37	X37	Traverse function selection		Pr. 592–Pr. 597	6-310
60	STF	Forward rotation command (assigned to STF terminal (Pr. 178) only)		—	6-103
61	STR	Reverse rotation command (assigned to STR terminal (Pr. 179) only)		—	6-103
62	RES	Inverter reset		—	—
63	PTC	PTC thermistor input (assigned to AU terminal (Pr. 184) only)		Pr. 9	6-80
64	X64	PID forward/reverse action switchover		Pr. 127–Pr. 134, Pr. 5	6-271
65	X65	PU-NET operation switching		Pr. 79, Pr. 340	6-215
66	X66	External/NET operation switchover		Pr. 79, Pr. 340	6-215
67	X67	Command source switchover		Pr. 338, Pr. 339	6-217
70	X70	DC feeding operation permission		Pr. 30, Pr. 70	6-86
71	X71	DC feeding cancel		Pr. 30, Pr. 70	6-86
72	X72	PID integral value reset		Pr. 127–Pr. 134, Pr. 241, Pr. 553, Pr. 554, Pr. 575– Pr. 577, C42–C45	6-271
9999	—	No function		—	—

Tab. 6-14: *Input terminal function assignment*

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".

NOTES

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, the MRS signal shares this function.

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.)

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	✔	—	≤ 2ms	—	Invalid
	—	✔	—	≤ 2ms	—
	✔	✔	≤ 20ms	≤ 2ms	Valid
Other than 2	✔	—	≤ 20ms	—	Valid
	—	✔	—	—	—
	✔	✔	≤ 20ms	—	Valid

Tab. 6-15: *Response time of the signals MRS and X10*

6.9.2 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.

Pr. No.	Name	Initial Value	Setting Range	Description
17	MRS input selection	0	0	Open input always
			2	Close input always (NC contact input specifications)

Parameters referred to		Refer to Section
178–189	Input terminal function selection	6.9.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

Output shutoff signal (MRS signal)

Turning on the output shutoff signal (MRS) during inverter running shuts off the output immediately.

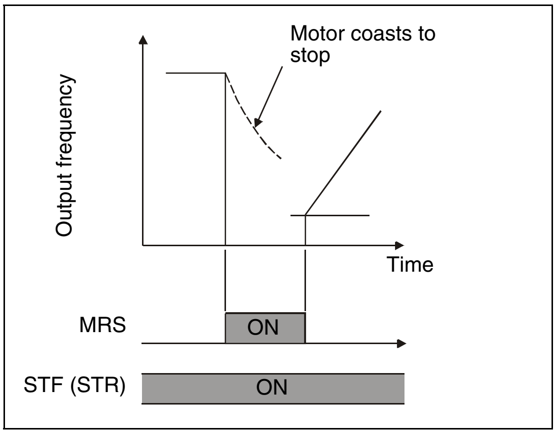


Fig. 6-54:
Output shutoff signal

I001325C

Terminal MRS may be used as described below:

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

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.

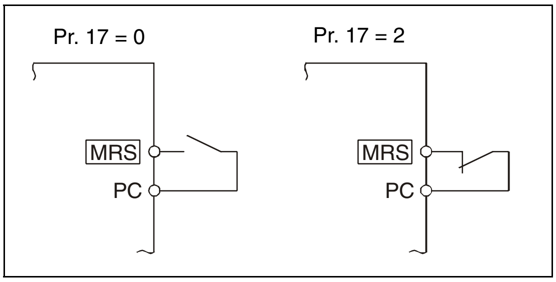


Fig. 6-55:
Connection of the MRS terminal in source logic

NOTES

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.

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.

6.9.3 Operation condition selection of second function selection signal (Terminal RT, Pr. 155)

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

Pr. No.	Name	Initial Value	Setting Range	Description
155	RT signal reflection time selection	0	0	Second function is immediately made valid with on of the RT signal.
			10	These functions are valid only during the RT siganl is on and constant speed operation. (invalid during acceleration/deceleration)

Parameters referred to		Refer to Section
178–189	Input terminal function selection	6.9.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

When the RT signal turns on, the second functions becomes valid.
The second function has the following applications:

- Switching between normal use and emergency use.
- Switching between heavy load and light load.
- Changing of acceleration/deceleration time by broken line acceleration/deceleration.
- Switching of characteristic between main motor and sub motor.

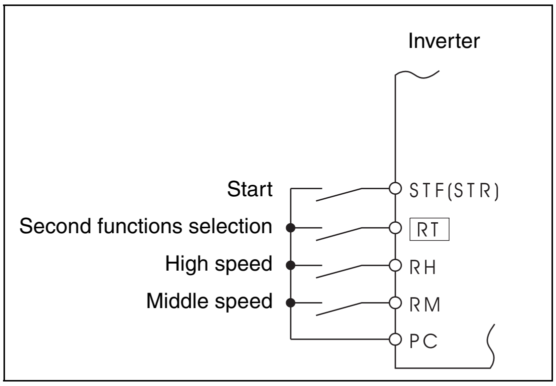


Fig. 6-56:
Second functions connection diagram

I001145C

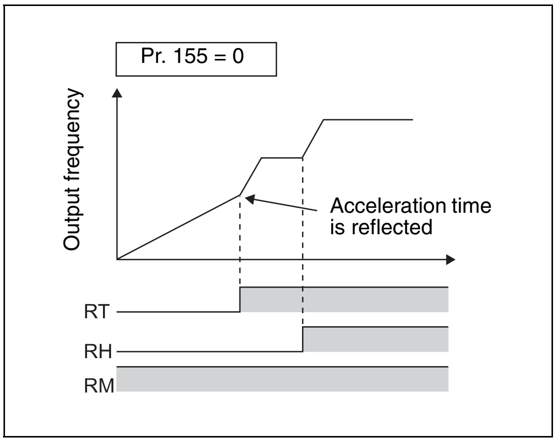


Fig. 6-57:
Second acceleration/deceleration time example

I001146E

Following functions that can be set as second functions:

Function	Parameter Number as		Refer to Page
	1. function	2. function	
Torque boost	Pr. 0	Pr. 46	6-30
Base frequency	Pr. 3	Pr. 47	6-49
Acceleration time	Pr. 7	Pr. 44	6-66
Deceleration time	Pr. 8	Pr. 44, Pr. 45	6-66
Electronic thermal relay function	Pr. 9	Pr. 51	6-76
Stall prevention	Pr. 22	Pr. 48, Pr. 49	6-35

Tab. 6-16: *Functions that can be set as second functions*

NOTES

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.

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.

6.9.4 Start signal selection (Terminal STF, STR, STOP, 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 section 6.8.3 for stop selection.)

Pr. No.	Name	Initial Value	Setting Range	Description	
				Start Signal (STF/STR)	Stop Operation
250	Stop selection	9999	0–100s	STF: Forward rotation start STR: Reverse rotation start	The motor is coasted to a stop when the preset time elapses after the start signal is turned off.
			1000s–1100s	STF: Start signal STR: Forward/reverse signal	The motor is coasted to a stop (Pr. 250 – 1000)s after the start signal is turned off.
			9999	STF: Forward rotation start STR: Reverse rotation start	When the start signal is turned off, the motor decelerates to stop.
			8888	STF: Start signal STR: Forward/reverse signal	

Parameters referred to		Refer to Section
4–6	Multi-speed setting	6.5.1
178–189	Input terminal function selection	6.9.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

2-wire type (terminals STF and STR)

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 10V DC 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 section 6.5.1.)

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.

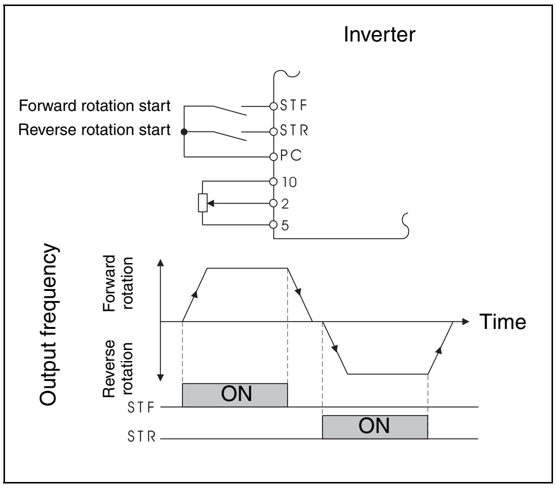


Fig. 6-58:
2-wire type connection (Pr. 250 = 9999)

I001148E

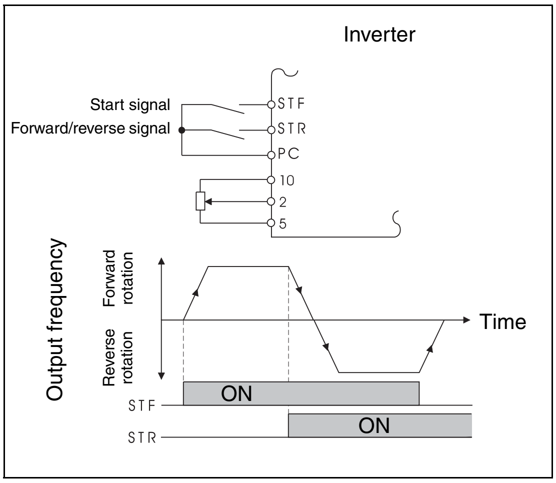


Fig. 6-59:
2-wire type connection (Pr. 250 = 8888)

I001149E

NOTES

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 section .)

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.

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.

3-wire type (terminals STF, STR and STOP)

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.

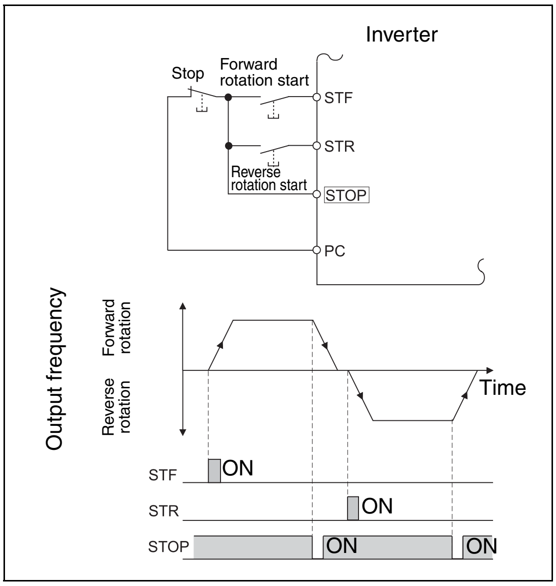


Fig. 6-60:
3-wire type connection (Pr. 250 = 9999)

I001150E

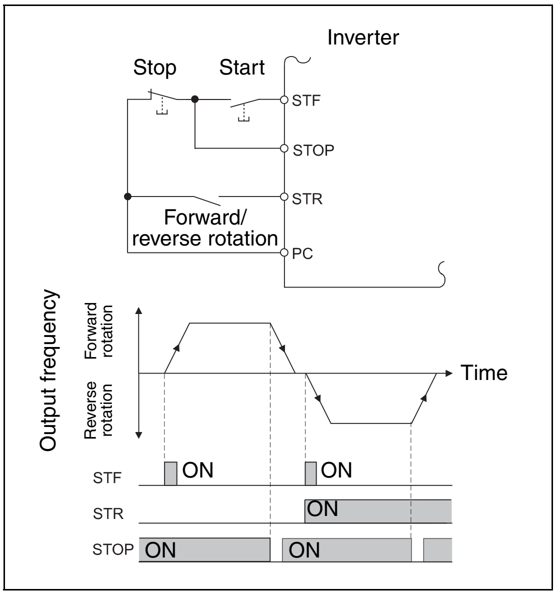


Fig. 6-61:
3-wire type connection (Pr. 250 = 8888)

I001151E

NOTES

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 cancelled.

Start signal selection

STF	STR	Setting Inverter Status	
		Pr. 250 = 0–100s/9999	**Pr. 250 = 1000–1100s/8888**
OFF	OFF	Stop	Stop
OFF	ON	Reverse rotation	
ON	OFF	Forward rotation	Forward rotation
ON	ON	Stop	Reverse rotation

Tab. 6-17: *Start signal selection*

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

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

Pr. No.	Name		Initial Value	Initial Signal	Setting Range
190	RUN terminal function selection	Open collector output terminal	0	RUN (inverter running)	0–5/7/8/10–19/25/ 26/45–48/64/70–79/ 85/90–96/98/99/ 100–105/107/108/ 110–116/ 125/126/ 145–148/164/170/ 179/185/190–196/ 198/199/9999
191	SU terminal function selection		1	SU (up to frequency)	
192	IPF terminal function selection		2	IPF (instantaneous power failure, under voltage)	
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)	0–5/7/8/10–19/25/ 26/45–48/64/70–79/ 85/90/91/94–96/98/ 99/100–105/107/ 108/110–116/125/ 126/145–148/164/ 170/179/185/190/ 191/194–196/198/ 199/9999
196	ABC2 terminal function selection		9999	No function	

Parameters referred to		Refer to Section
13	Starting frequency	6.6.2
76	Alarm code output selection	6.12.2

The above parameter can be set when Pr. 160 "User group read selection" = 0.

You can set the functions of the output terminals.
Refer to the following table and set the parameters:
0–99: Source logic
100–199: Sink logic

Setting		Terminal	Function	Operation	Related Parameters	Refer to Page
Source Logic	Sink Logic					
0	100	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above Pr. 13 "Starting frequency".	—	6-111
1	101	SU	Up to frequency ① ②	Output when the output frequency is reached to the set frequency.	Pr. 41	6-113
2	102	IPF	Instantaneous power failure/ under voltage	Output at occurrence of an instantaneous power failure or when undervoltage protection is activated.	Pr. 57	6-137
3	103	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66, Pr. 148, Pr. 149, Pr. 154	6-35
4	104	FU	Output frequency detection ②	Output when the output frequency reaches the frequency setting in Pr. 42 (Pr. 43 for reverse rotation).	Pr. 42, Pr. 43	6-113
5	105	FU2	Second output frequency detection ②	Output when the output frequency reaches the frequency setting in Pr. 50.	Pr. 50	6-113

Tab. 6-18: *Output terminal function assignment (1)*

Setting		Terminal	Function	Operation	Related Parameters	Refer to Page
Source Logic	Sink Logic					
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	6-86
8	108	THP	Electronic thermal relay function prealarm	Output when the electronic thermal relay function cumulative value reaches 85%. (Electronic thermal relay function protection (E.THT/ E.THM) activates, when the value reached 100%.)	Pr. 9	6-79
10	110	PU	PU operation mode	Output when the PU operation mode is selected.	Pr. 79	6-203
11	111	RY	Inverter operation ready	Output when the inverter can be started by switching the start signal on or while it is running.	—	6-111
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	6-115
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	6-115
14	114	FDN	PID lower limit	Output when the feedback value falls below the lower limit of PID control.	Pr. 127–Pr. 134, Pr. 575–Pr. 577	6-271
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–Pr. 139, Pr. 159	6-290
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	6-316
26	126	FIN	Heatsink overheat prealarm	Output when the heatsink temperature reaches about 85% of the heatsink overheat protection providing temperature.	—	7-12
45	145	RUN3	During inverter running and start command is on	Output when the inverter running and start commands are on.	—	6-111
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–Pr. 266	6-145
47	147	PID	During PID control activated	Output during PID control.	Pr. 127–Pr. 134, Pr. 575–Pr. 577	6-271
48	148	Y48	PID deviation limit	Output when the absolute value of deviation exceeds the limit value.	Pr. 127–Pr. 134, Pr. 241, Pr. 553, Pr. 554, Pr. 575–Pr. 577, C42–C45	6-271
64	164	Y64	During retry	Output during retry processing.	Pr. 65–Pr. 69	6-152

Tab. 6-18: *Output terminal function assignment (2)*

Setting		Terminal	Function	Operation	Related Parame-ters	Refer to Page
Source Logic	Sink Logic					
70	170	SLEEP	PID output interruption	Output when the PID output interruption function is executed.	Pr. 127–Pr. 134, Pr. 575–Pr. 577	6-271
71	—	R01	Commercial-power supply side motor 1 connection RO1	Used when using advanced PID control (pump function).	Pr. 575–Pr. 591	6-296
72	—	R02	Commercial-power supply side motor 2 connection RO2			
73	—	R03	Commercial-power supply side motor 3 connection RO3			
74	—	R04	Commercial-power supply side motor 4 connection RO4			
75	—	RI01	Inverter side motor 1 connection RIO1			
76	—	RI02	Inverter side motor 2 connection RIO2			
77	—	RI03	Inverter side motor 3 connection RIO3			
78	—	RI04	Inverter side motor 4 connection RIO4			
79	179	Y79	Pulse train output of output power	Output in pulses every time the accumulated output power of the inverter reaches the Pr. 799 setting.	Pr. 799	6-120
85	185	Y85	DC feeding	Output during power failure or under voltage of AC power.	Pr. 30, Pr. 70	6-86
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–Pr. 259	6-317
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.	—	6-112
92	192	Y92	Energy saving average value updated timing	Turned on and off alternately every time the power saving average value is updated when the power saving monitor is used.	Pr. 52, Pr. 54, Pr. 158, Pr. 891–Pr. 899	6-160
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–Pr. 557	6-322
94	194	ALM2 ③	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	—	6-112
95	195	Y95	Maintenance timer signal	Output when Pr. 503 rises to or above the Pr. 504 setting.	Pr. 503, Pr. 504	6-321

Tab. 6-18: *Output terminal function assignment (3)*

Setting		Terminal	Function	Operation	Related Parameters	Refer to Page
Source Logic	Sink Logic					
96	196	REM	Remote output	Output to the terminal when a value is set to the parameter.	Pr. 495–Pr. 497	6-118
98	198	LF	Minor fault output	Output when a minor fault (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244	6-233, 6-316
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.	—	6-112
9999		—	No function	—	—	—

Tab. 6-18: *Output terminal function assignment (4)*

① Note that when the frequency setting is varied using an analog signal or the digital 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.

③ The alarm output 2 signal "ALM2" can not be assigned to the extended assignment terminal of the option unit (FR-A7AY, FR-A7AR).

NOTES

The same function mag 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.

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.

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

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 or RUN3 signal, set "11 (source logic)" or "111 (sink logic)" (RY) or "45 (source logic)" or "145 (sink logic)" (RUN3) to any of Pr. 190 to Pr. 196 "Output terminal function selection" to assign the function to the output terminal. Set "0" (source logic) or "100" (sink logic) to any of Pr. 190 to Pr. 196 "Output terminal function selection" to assign the RUN function to the output terminal.

The RUN signal is assigned to the terminal RUN in the default setting.

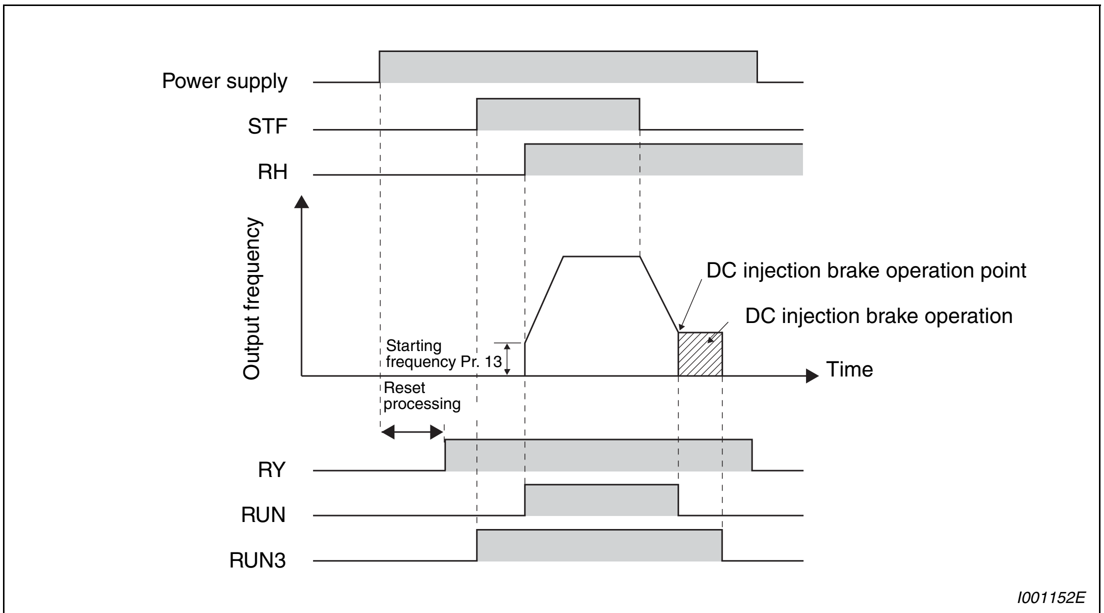


Fig. 6-62: *Ready and motor running signals*

NOTE The same function may be set to more than one terminal.

Alarm output signal (ALM, ALM2)

If the inverter comes to an alarm stop, the ALM and ALM2 signals are output. (Refer to section 7.1 for the alarm description.)

The ALM2 signal remains on during a reset period after alarm occurrence. When using the ALM2 signal, set "94" (source logic) or "194" (sink 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 A1, B1 and C1 contacts in the initial setting.

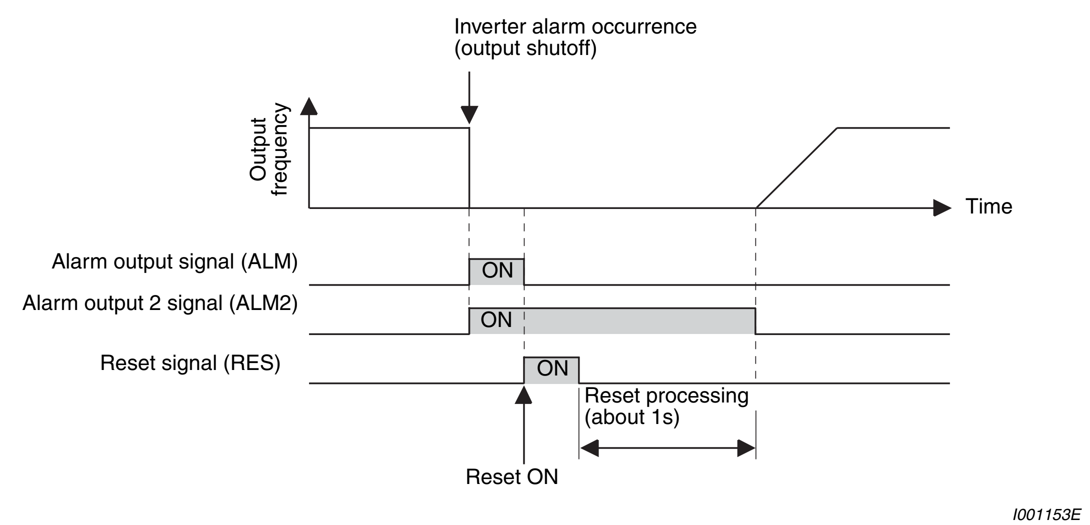


Fig. 6-63: *Alarm signals*

Input MC shutoff signal (Y91)

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 (source logic)" or "191 (sink 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.

No.	Alarm Definition
1	Inrush current limit circuit alarm (E.IOH)
2	CPU error (E.CPU)
3	CPU error (E.E6)
4	CPU error (E.E7)
5	Parameter storage device alarm (E.PE)
6	Parameter storage device alarm (E.PE2)
7	24V DC internal power output short circuit (E.P24)
8	Operation panel power supply short circuit RS-485 terminal power supply short circuit (E.CTE)
9	Output side earth (ground) fault overcurrent protection (E.GF)
10	Output phase loss (E.LF)
11	Brake transistor alarm detection/internal circuit error (E.BE)

Tab. 6-19: *Faults that lead to Y91 signal output*

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

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

Pr. No.	Name	Initial Value	Setting Range	Description
41	Up-to-frequency sensitivity	10%	0–100%	Set the level where the SU signal turns on.
42	Output frequency detection	6Hz	0–400Hz	Set the frequency where the FU signal turns on.
43	Output frequency detection for reverse rotation	9999	0–400Hz	Set the frequency where the FU signal turns on in reverse rotation.
			9999	Same as Pr. 42 setting
50	Second output frequency detection	30Hz	0–400Hz	Set the frequency where the FU2 signal turns on.

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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

When the output frequency reaches the running frequency, the up-to-frequency signal (SU) is output. The Pr. 41 value can be adjusted within the range ±1% to ±100% on the assumption that the set frequency is 100%.

This parameter can be used to ensure that the running frequency has been reached to provide the operation start signal etc. for related equipment.

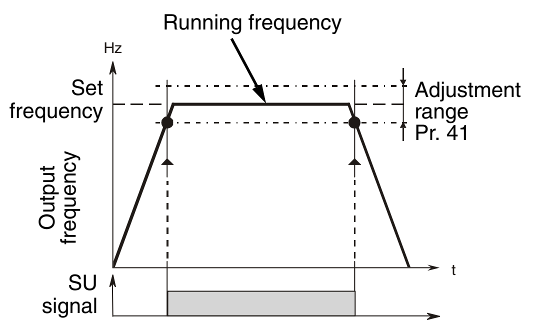


Fig. 6-64:
Output of the SU signal

I000020C

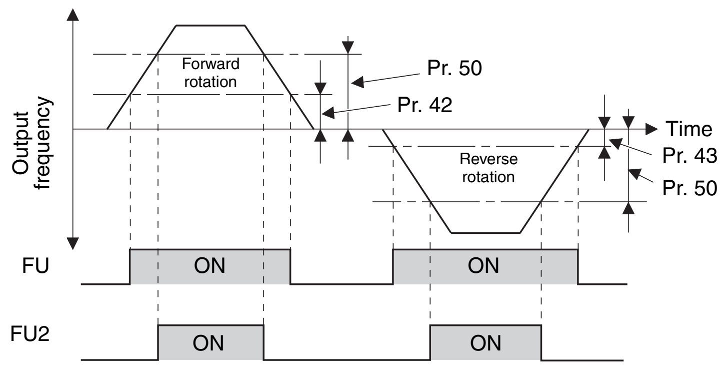
NOTE The output frequency compared with the set frequency changes depending on the control system. During V/f control the output frequency and during simple flux magnetic vector control the output frequency before slip compensation is compared with the set frequency.

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

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 for reverse operation use only 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 "Output frequency detection for reverse rotation" ≠ 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 to Pr. 50. The FU2 signal is output when the output frequency reaches or exceeds the Pr. 50 setting. For each signal, assign functions to Pr. 190 to Pr. 196 "Output terminal function selection" referring to the table below.



Pr. No.	Output Signals	Pr. 190–196 Setting	
		Source logic	Sink logic
42, 43	FU	4	104
50	FU2	5	105

I001154E

Fig. 6-65: *Frequency detection for forward and reverse rotation*

NOTE

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.

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

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

<table>
<tr><th>Pr. No.</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="2">Description</th></tr>
<tr><td>150</td><td>Output current detection level</td><td>110% ①</td><td>0–120% ①</td><td colspan="2">Set the output current detection level. 100% is the rated inverter current.</td></tr>
<tr><td>151</td><td>Output current detection signal delay time</td><td>0s</td><td>0–10s</td><td colspan="2">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.</td></tr>
<tr><td>152</td><td>Zero current detection level</td><td>5%</td><td>0–150%</td><td colspan="2">Set the zero current detection level. The rated inverter current is assumed to be 100%.</td></tr>
<tr><td>153</td><td>Zero current detection time</td><td>0.5s</td><td>0–10s</td><td colspan="2">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.</td></tr>
<tr><td rowspan="2">166</td><td rowspan="2">Output current detection signal retention time</td><td rowspan="2">0.1s</td><td>0–10s</td><td colspan="2">Set the retention time when the Y12 signal is on.</td></tr>
<tr><td>9999</td><td colspan="2">The Y12 signal on status is retained. The signal is turned off at the next start.</td></tr>
<tr><td rowspan="5">167</td><td rowspan="5">Output current detection operation selection</td><td rowspan="5">0</td><td></td><td>Y12 Signal - ON</td><td>Y13 Signal - ON</td></tr>
<tr><td>0</td><td>Operation continued</td><td>Operation continued</td></tr>
<tr><td>1</td><td>Fault stop (E.CDO)</td><td>Operation continued</td></tr>
<tr><td>10</td><td>Operation continued</td><td>Fault stop (E.CDO)</td></tr>
<tr><td>11</td><td>Fault stop (E.CDO)</td><td>Fault stop (E.CDO)</td></tr>
</table>

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① When Pr. 570 "Multiple rating setting" = 1, performing parameter clear changes the initial value and setting range. (Refer to section 6.2.5.)

Output current detection (Y12, 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" or "11", 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". Setting Pr. 167 = "1" or "11" at Y12 signal ON does not cause E.CDO. Setting to Pr. 167 becomes effective after Y12 is turned OFF.

Set "12 (source logic)" or "112 (sink logic)" to any of Pr.190 to Pr. 196 "Output terminal function selection" to assign the function of the Y12 signal to the output terminal.

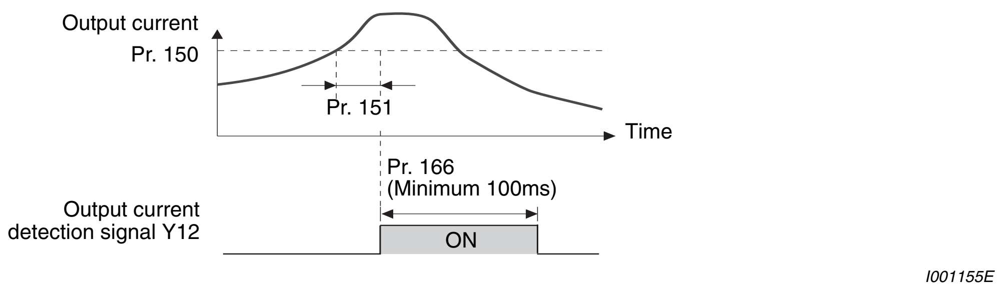


Fig. 6-66: *Output current detection (Pr. 166 ≠ 9999, Pr. 167 = 0)*

Zero current detection (Y13, Pr. 152, Pr. 153, Pr. 167)

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. As soon as the signal is output to terminal Y13, it remains turned on for 100ms.

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".

When Pr.167 = "10" or "11", turning Y13 signal ON stops the inverter output and causes output current detection fault (E.CDO) to be displayed. ON status of Y13 signal is held for 0.1s at the fault. Setting Pr. 167 = "10" or "11" while Y13 signal is ON does not cause E.CDO. Setting to Pr. 167 becomes effective after Y13 is turned OFF.

Set "13" (source logic) or "113" (sink logic) to any of Pr. 190 to Pr. 196 "Output terminal function selection" to assign the function of the output power detection signal (Y13) to the output terminal.

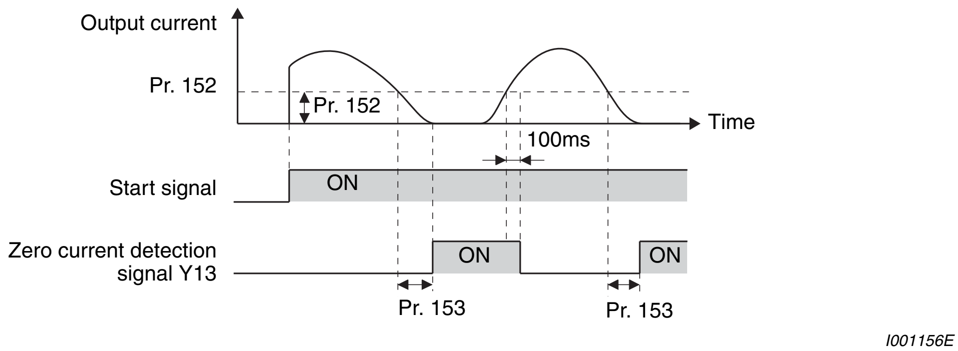


Fig. 6-67: *Zero current detection*

NOTE

The response time of Y12 and Y13 signals is approximately 0.1s. Note that the response time changes according to the load condition.
When Pr. 152 = "0", detection is disabled.

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.

6.9.8 Remote output function (REM, 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.

Pr. No.	Name	Initial Value	Setting Range	Description	
495	Remote output selection Ver.UP	0	0	Remote output data clear at powering off	Remote output data clear at inverter reset
			1	Remote output data retention even at powering off	Remote output data clear at inverter reset
			10	Remote output data clear at powering off	Remote output data retention at inverter reset
			11	Remote output data retention even at powering off	Remote output data retention at inverter reset
496	Remote output data 1 ①	0	0–4095	Refer to Fig. 6-68	
497	Remote output data 2 ①	0	0–4095	Refer to Fig. 6-68	

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Ver.UP .... Specifications differ according to the date assembled (refer to Appendix A.7)

① The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in Pr. 77 "Parameter write selection".

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" (source logic) or "196" (sink 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 Fig. 6-68 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 sink logic). By setting "0", the output terminal turns off (on for sink logic).

Example ▽ When "96" (source logic) is set to Pr. 190 "RUN terminal function selection" and "1" (H01) is set to Pr. 496, the terminal RUN turns on.

△

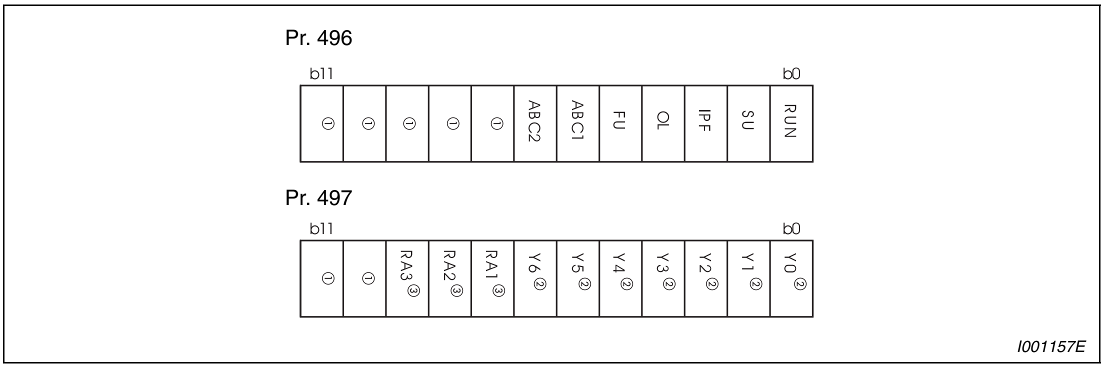


Fig. 6-68: *Remote output data*

① As desired (always "0" when read).

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.

When Pr. 495 = "0 (initial value) or 10", 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 or 11", the remote output data before power supply-off is stored into the E²PROM, 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 below.)

When Pr. 495 = "10 or 11", the signal before reset is held even an inverter reset is made.

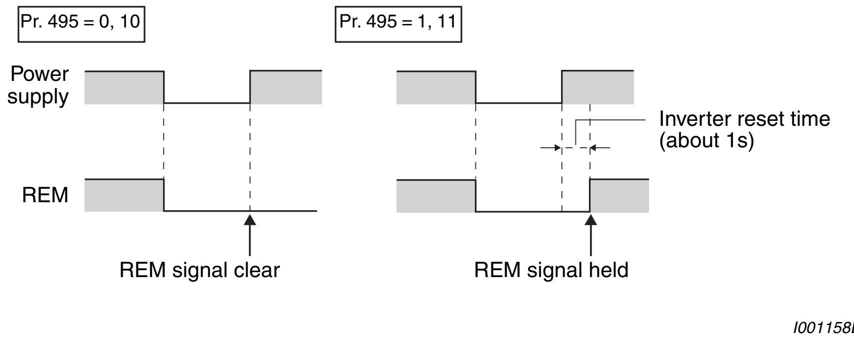


Fig. 6-69: *ON/OFF example for source logic*

NOTES

The output terminal where the REM signal is not assigned using any of Pr. 190 to Pr. 196 does not turn on/off if "0/1" is set to the terminal bit of Pr. 496 or Pr. 497. (It turns on/off with the assigned function.)

When the inverter is reset (terminal reset, reset request through communication), Pr. 496 and Pr. 497 values turn to "0". When Pr. 495 = 1, 11, however, they are the settings at power supply-off. (The settings are stored at power supply-off.) When Pr. 495 = "10, 11", they are the same as before an inverter reset is made.

When Pr. 495 ="1, 11"(remote output data retention at power OFF), connect R1/11 with P/+, and S1/L21 with N/– so that the control power is retained. If you do not take such a step, the output signals provided after power-on are not guaranteed.

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

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

Pr. No.	Name	Initial Value	Setting Range	Description
799	Pulse increment setting for output power	1kWh	0.1/ 1/10/ 100/ 1000kWh	Pulse train output of output power (Y79) is output in pulses at every output power (kWh) that is specified.

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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

After power ON or inverter reset, output signal (Y79 signal) is output in pulses every time accumulated output power of the inverter exceeds Pr. 799 Pulse increment setting for output power.

The inverter continues to count the output power at retry function or when automatic restart after instantaneous power failure function works without power OFF of output power (not power failure of inverter control circuit power), and it does not reset the count.

If power failure occurs, output power is counted from 0kWh again.

Assign pulse output of output power (Y79: setting value 79 (positive logic), 179 (negative logic)) to any of Pr.190 to Pr.196 (Output terminal function selection).

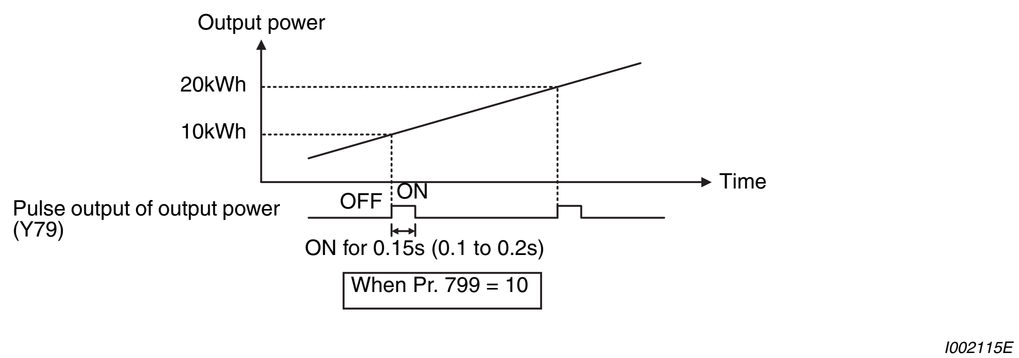


Fig. 6-70: *Pulse increment setting for output power (Y79 signal, Pr. 799)*

NOTES

Because the accumulated data in the inverter is cleared when control power is lost by power failure or at an inverter reset, the value on the monitor cannot be used to charge electricity bill.

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.

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

6.10 Monitor display and monitor output signals

Purpose	Parameters that must be set		Refer to Section
Display motor speed Set speed	Speed display and speed setting	Pr. 37, Pr. 144	6.10.1
Change PU monitor display data	DU/PU main display data selection Cumulative monitor clear	Pr. 52, Pr. 170, Pr. 171, Pr. 268, Pr. 891	6.10.2
Change of the monitor output from terminal CA and AM	Terminal CA, AM function selection	Pr. 54, Pr. 158, Pr. 867, Pr. 869	6.10.3
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	6.10.3
Adjust terminal CA, AM outputs	Terminal CA, AM calibration	Pr. 900, Pr. 901, Pr. 930, Pr. 931	6.10.4

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

You can output RPM rates, speeds and throughput volumes based on the output frequency to the displays of the FR-DU07 and FR-PU04/FR-PU07 operation panels or to the CA and AM outputs.

Pr. No.	Name	Initial Setting	Setting Range	Description
37	Speed display	0	0	Frequency display, setting
			1–9998	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.

Parameters referred to	Refer to Section
52 DU/PU main display data selection	6.10.2

The above parameters can be set when Pr. 160 "User group read selection" = 0.

To display the machine speed set Pr. 37 to the reference value for the speed to be shown at 60Hz. For example, if the speed is 55m/min at 60Hz set Pr. 37 to "55". The display will then show "55" when the motor frequency is 60Hz.

To display the motor speed set Pr. 144 to the number of motor poles (2, 4, 6, 8, 10) or the number of motor poles plus 100 (102, 104, 106, 108, 110). For example, to display the motor speed for a 4-pole motor set Pr. 144 to "4". This will generate a display of "1800" at 60Hz.

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 in the shaded fields shown in Tab. 6-20 are the initial values.)

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

Tab. 6-20: *Setting range of parameter 37 and 144*

① 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.

② Hz is in 0.01Hz increments, machine speed is in 1m/min increments, and r/min is in 1r/min increments.

NOTES

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.

6.10.2 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.

<table>
<tr><th>Pr. No.</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th>Description</th></tr>
<tr><td>52</td><td>DU/PU main display data selection</td><td>0 (output frequency)</td><td>0/5/6/ 8–14/17/ 20/23–25/ 50–57/100</td><td>Select the monitor to be displayed on the operation panel and parameter unit. Refer to Tab. 6-21 for monitor description.</td></tr>
<tr><td>54</td><td>CA terminal function selection</td><td rowspan="2">1 (output frequency)</td><td rowspan="2">1 to 3, 5, 6, 8 to 14, 17, 21, 24, 50, 52, 53</td><td>Select the monitor output to terminal CA.</td></tr>
<tr><td>158</td><td>AM terminal function selection</td><td>Select the monitor output to terminal AM.</td></tr>
<tr><td rowspan="3">170</td><td rowspan="3">Watt-hour meter clear</td><td rowspan="3">9999</td><td>0</td><td>Set "0" to clear the watt-hour meter monitor.</td></tr>
<tr><td>10</td><td>Set the maximum value when monitoring from communication to 0 to 9999kWh.</td></tr>
<tr><td>9999</td><td>Set the maximum value when monitoring from communication to 0 to 65535kWh.</td></tr>
<tr><td>171</td><td>Operation hour meter clear</td><td>9999</td><td>0/9999</td><td>Set "0" in the parameter to clear the watt-hour monitor.
Setting "9999" has no effect.</td></tr>
<tr><td rowspan="3">268</td><td rowspan="3">Monitor decimal digits selection ①</td><td rowspan="3">9999</td><td>0</td><td>Displays as integral value.</td></tr>
<tr><td>1</td><td>Displayed in 0.1 increments.</td></tr>
<tr><td>9999</td><td>No function</td></tr>
<tr><td>563</td><td>Energizing time carrying-over times</td><td>0</td><td>0–65535 (reading only)</td><td>The numbers of cumulative energizing time monitor exceeded 65535h is displayed.
Reading only</td></tr>
<tr><td>564</td><td>Operating time carrying-over times</td><td>0</td><td>0–65535 (reading only)</td><td>The numbers of operation time monitor exceeded 65535h is displayed. Reading only</td></tr>
<tr><td rowspan="2">891</td><td rowspan="2">Cumulative power monitor digit shifted times</td><td rowspan="2">9999</td><td>0–4</td><td>Set the number of times to shift the cumulative power monitor digit.
Clamp the monitoring value at maximum.</td></tr>
<tr><td>9999</td><td>No shift
Clear the monitor value when it exceeds the maximum value.</td></tr>
</table>

<table>
<tr><th colspan="2">Parameters referred to</th><th>Refer to Section</th></tr>
<tr><td>37</td><td>Speed display</td><td>6.10.1</td></tr>
<tr><td>144</td><td>Speed setting switchover</td><td>6.10.1</td></tr>
<tr><td>55</td><td>Frequency monitoring reference</td><td>6.10.3</td></tr>
<tr><td>56</td><td>Current monitoring reference</td><td>6.10.3</td></tr>
</table>

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in Pr. 77 "Parameter write selection".

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/PUmain 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".

Types of Monitor	Increments	Pr. 52 DU LED	Pr. 52 PU Main Monitor	Pr. 54 (CA) Pr. 158 (AM) Parameter Setting Value	Full-scale value of the terminal CA and AM	Description
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 class: 800V	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	1r/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)
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 (cleared 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 (cleared at every start).
Input power	0.01kW/0.1kW ⑤	13	①	13	Rated inverter power × 2	Display power of the inverter input side
Output power	0.01kW/0.1kW ⑤	14	①	14	Rated inverter power × 2	Display 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 energizing 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 ②③	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 6-128.)
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 = loutput current monitor value/rated inverter current × 100 [%]

Tab. 6-21: *Monitor description list (1)*

Types of Monitor	Increments	Pr. 52 DU LED	Pr. 52 PU Main Monitor	Pr. 54 (CA) Pr. 158 (AM) Parameter Setting Value	Full-scale value of the terminal CA and AM	Description
Cumulative power	0.01kWh/ 0.1kWh ④⑤	25		—	—	Cumulative power amount is displayed according to the output power monitor Use Pr. 170 to clear the value. (Refer to page 6-128.)
Power saving effect	Variable according to parameters	50		50	Inverter capacity	Display energy saving effect monitor You can change the monitor to power saving, power saving average value, charge display and % display using parameters. (Refer to page 6-161 for details.)
Cumulative saving power		51		—	—	
PID set point	0.1%	52		52	100%/ C42 or C44	Display the set point, measured value and deviation during PID control. (Refer to page 6-271 for details.)
PID measured value	0.1%	53		53	100%/ C42 or C44	
PID deviation value	0.1%	54		—	—	
Input terminal status	—	55	①	—	—	ON/OFF status of the input terminal is displayed on the PU (Refer to page 6-127 for DU display)
Output terminal status	—		①	—	—	ON/OFF status of the output terminal is displayed on the PU (Refer to page 6-127 for DU display)
Option input terminal states	—	56	—			ON/OFF status of the input terminal of the digital input option (FR-A7AX) is displayed on the DU (Refer to page 6-127 for DU display)
Option output terminal states	—	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 6-127 for DU display)

Tab. 6-21: *Monitor description list (2)*

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 energizing 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)

NOTES

By setting "0" in Pr. 52, the monitoring of output speed to alarm display can be selected in sequence by the SET key.

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.)

The monitor displayed at powering on is the first monitor. Display the monitor to be displayed on the first monitor and press the SET key for 1s. (To return to the output frequency monitor, hold down the SET key for 1s after displaying the output frequency monitor.)

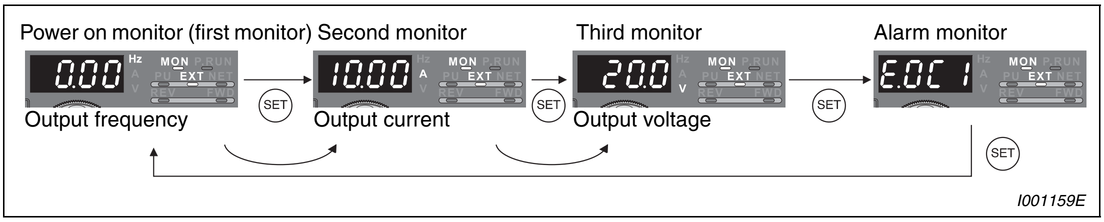


Fig. 6-71: *Displaying various types of monitor*

Example ▽

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

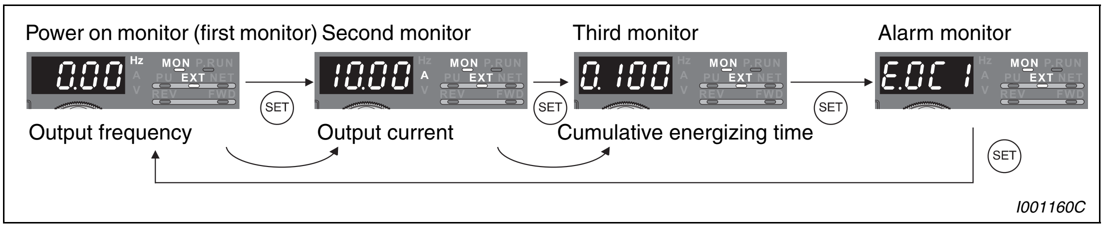


Fig. 6-72: *Selection of the third monitor*

△

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. (Hz indication flickers during stop and is lit during running.)

	Parameter 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		

Tab. 6-22: *Display during running and stop*

NOTES

During an error, the output frequency at error occurrence appears.

During MRS, the values displayed are the same as during a stop.

Operation panel (FR-DU07) I/O terminal monitor

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 centre line of LED is always on.

Pr. 52	Monitor Description
55	Displays the I/O and output terminal ON/OFF states of the inverter unit.
56 ①	Displays the input terminal ON/OFF states of the digital input option (FR-A7AX).
57 ①	Displays the output terminal ON/OFF states of the digital output option (FR-A7AY) or relay output option (FR-A7AR).

Tab. 6-23: *I/O terminal monitor*

① 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.

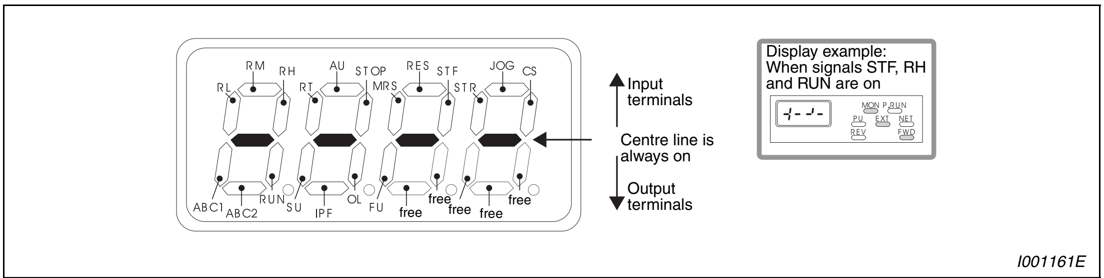


Fig. 6-73: *Displaying the signal states of the I/O terminals*

On the option FR-A7AX monitor (Pr. 52 = 56), the decimal point LED of the first digit LED is on.

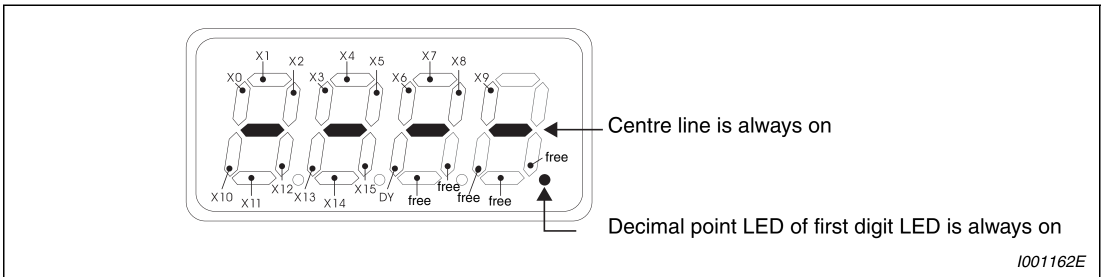


Fig. 6-74: *Displaying the signal states when the option FR-A7AX is mounted*

On the option FR-A7AY or FR-A7AR monitor (Pr. 52 = 57), the decimal point LED of the second digit LED is on.

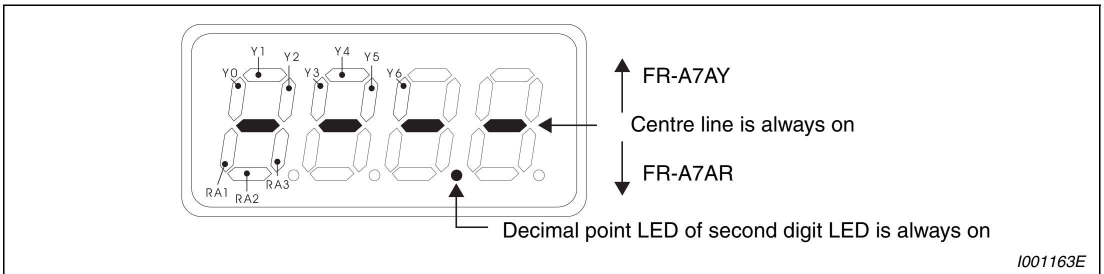


Fig. 6-75: *Displaying the signal states when the option FR-A7AY or FR-A7AR is mounted*

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

On the cumulative energizing 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:

FR-DU07 ①		FR-PU04/FR-PU07 ②		Communication		
Range	Unit	Range	Unit	Range		Unit
				Pr. 170 = 10	Pr. 170 = 9999	
0–99.99kWh	0.01kWh	0–999.99kWh	0.01kWh	0–9999kWh	0–65535kWh (initial value)	1kWh
100–9.999kWh	0.1kWh	1000–9999.9kWh	0.1kWh			
1000–9999kWh	1kWh	1000–99999kWh	1kWh			

Tab. 6-24: *Units and range of the cumulative energizing monitor*

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 99999.99kWh, 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 set in Pr. 891. 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.

Writing "0" to Pr. 170 clears the cumulative energizing power monitor.

NOTE

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

Cumulative energizing 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 energizing time monitor exceeded 65535h with Pr. 563 and the numbers of actual operation time monitor exceeded 65535h with Pr. 564.

Writing "0" to Pr. 171 clears the actual operation time monitor. (Energizing time monitor can not be cleared.)

NOTES

The actual operation time is not added up unless the inverter is operated one or more hours continuously.

If "0" is written to Pr. 171 and Pr. 171 is read again, "9999" is always displayed. Setting "9999" does not clear the actual operation time meter.

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	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.

Tab. 6-25: *Selection of decimal digits*

NOTE

The number of display digits on the cumulative energizing time (Pr. 52 = 20), actual operation time (Pr. 52 = 23), cumulative energizing power (Pr. 52 = 25) or cumulative saving power monitor (Pr. 52 = 51) does not change.

6.10.3 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.

Pr. No.	Name	Initial Value	Setting Range		Description
55	Frequency monitoring reference ①	50Hz	0–400Hz		Set the full-scale value to output the output frequency monitor value to terminal CA and AM.
56	Current monitoring reference ①	Rated inverter output current	01160 or less	0–500A	Set the full-scale value to output the output current monitor value to terminal CA and AM.
			01800 or more	0–3600A	
867	AM output filter	0.01s	0–5s		Set the output filter of terminal AM.
869	Current output filter	0.02s	0–5s		Adjust response level of current output.

Parameters referred to		Refer to Section
37	Speed display	6.10.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in Pr. 77 "Parameter write selection".

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 20mA DC. The analog current output and inverter output frequency at terminal CA are proportional. (The maximum output current is 20mA DC.)
- Set the frequency (output frequency/set frequency) when the voltage output at terminal AM is 10V DC. The analog voltage output and frequency at terminal AM are proportional. (The maximum output voltage is 10V DC.)

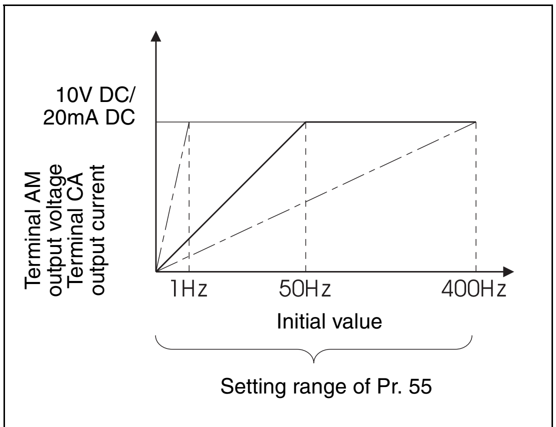


Fig. 6-76:
Frequency monitoring reference

I001164E

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 20mA DC. The analog current output and current value at terminal CA are proportional. (The maximum output current is 20mA DC.)
- Set the current value when the voltage output at terminal AM is 10V DC. The analog voltage output and current value at terminal AM are proportional. (The maximum output voltage is 10V DC.)

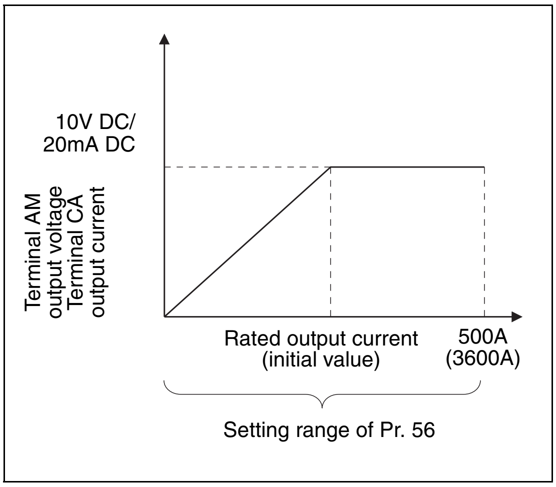


Fig. 6-77:
Current monitoring reference

I001165E

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.)

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.)

6.10.4 Terminal CA, AM calibration [C0 (Pr. 900), C1 (Pr. 901), C8 (Pr. 930) to C11 (Pr. 931)]

These parameters are used to calibrate the CA and AM analog outputs for the minimum and maximum values, and you can also use them to compensate for the tolerances of your measuring instruments. The same monitor signal can be output to the AM and the CA terminals. However, zero point calibration and the entry of a value to be associated with the zero point for the monitor signal to be output are both only possible for the CA terminal.

Pr. No.	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%	0–100%	Output signal value for minimum analog current output.
C9 (930)	Current output bias current	0%	0–100%	Output current value for minimum analog current output (e.g. 0 or 4mA)
C10 (931)	Current output gain signal	100%	0–100%	Output signal value for maximum analog current output.
C11 (931)	Current output gain current	100%	0–100%	Output current value for maximum analog current outpu (e.g. 20mA)

Parameters referred to		Refer to Section
54	CA terminal function selection	6.10.3
55	Frequency monitoring reference	6.10.3
56	Current monitoring reference	6.10.3
158	AM terminal function selection	6.10.3

The above parameters can be set when Pr. 160 "User group read selection" = 0.

The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/ FR-PU07).

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".

CA terminal calibration [C0 (Pr. 900), C8 (Pr. 930) to C11 (Pr. 931)]

Terminal CA is factory-set to provide a 20mA DC 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 20mA DC.

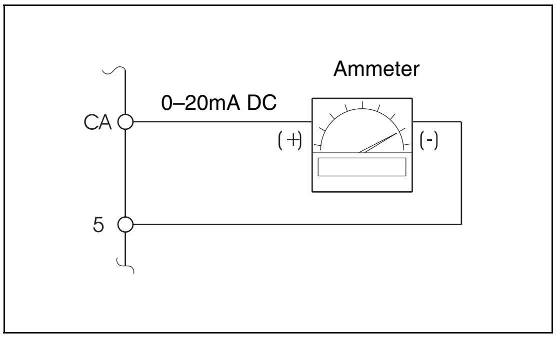


Fig. 6-78:
Connecting an analog meter to the CA output

Calibration of the zero point of the meter connected to terminal CA is performed with C9 (Pr. 930). Calibration of the maximum meter deflection is performed with C11 (Pr. 931).

The value to be associated with the zero point for the signal output to terminal CA is entered in C8 (Pr. 930). The value for the signal to be associated with the maximum analog output value (maximum deflection) is entered in C10 (Pr. 931). You can also set these parameters to use the analog meter for only a defined sub-range of the full scale of the monitor signal to be output. For example, if you only want to show the value of the output voltage between 100 and 400V (i.e. output 4mA for all voltages between 0 and 100V and 20mA for all voltages above 400V) then set C8 to 12.5% (100V is 12.5% of the maximum inverter output voltage of 800V) and C9 to 20% (corresponds to approx. 20 mA at the CA terminal).

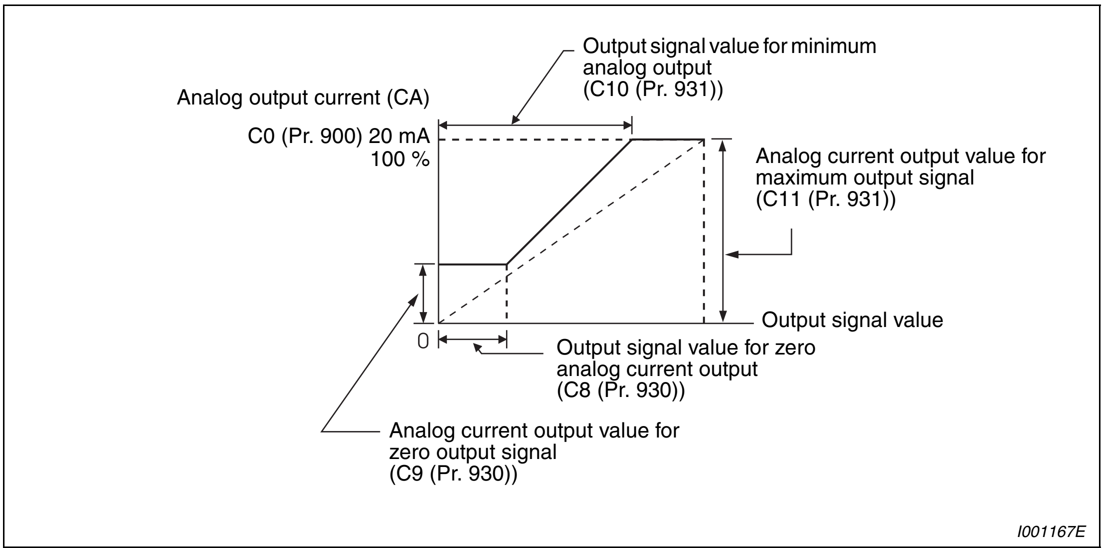


Fig. 6-79: *CA terminal calibration*

CA terminal calibration procedure:

① Connect an 0-20mA DC meter (DC ammeter) to inverter terminals CA and 5, taking care to correct with the correct polarity. CA is positive.

② Set Pr. 54 to select the monitor signal you want to output to analog output CA. To display the output frequency or the output current set Pr. 55 or Pr. 56, respectively, to the maximum frequency or current value at which you wish to output 20mA to the terminal.

③ Zero point calibration: The zero point of the meter is calibrated with C9 (Pr. 930). The calibration display is shown in percent. A value of 0% corresponds to approx. 0mA, a value of 20% to approx. 4mA. The value for the monitor signal up to which the minimum analog current is to be output is set with C8 (Pr. 930). Here too, the calibration display is in percent, and 100% corresponds to the full scale value of the monitor signal selected (refer to Tab. 6-21).

④ Start the frequency inverter in PU mode with the operation panel or the control terminals (external operation).

⑤ Calibrate the full deflection of the meter by selecting C0 (Pr. 900) and then operating the digital dial. Note that the value shown on the operating panel for the monitor signal associated with C0 does not change when you turn the digital dial! However, the analog current output to CA will change as you turn the dial. Confirm the calibration value found by pressing the SET key (this assigns the maximum analog current output to the displayed value of the monitor signal.)

NOTES

If it is not possible to adjust the signal to be used for calibration to its maximum value you can set Pr. 54 to "21". This outputs a continuous signal of approx. 20mA to terminal CA, which makes it possible to calibrate the maximum value on the meter. When C0 is used to calibrate the full meter deflection in this mode a value of "1000" is shown on the operating panel display. Afterwards you can then reset Pr. 54 to the required monitor signal setting.

Current is also output to terminal CA when the parameters are configured as follows:
C8 (Pr. 930) ≥ C10 (Pr. 931) and C9 (Pr. 930) ≥ C11 (Pr. 931).

AM terminal calibration [C1 (Pr. 901)]

Terminal AM is factory-set to provide a 10V DC 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 10V DC, the maximum output current 1mA.

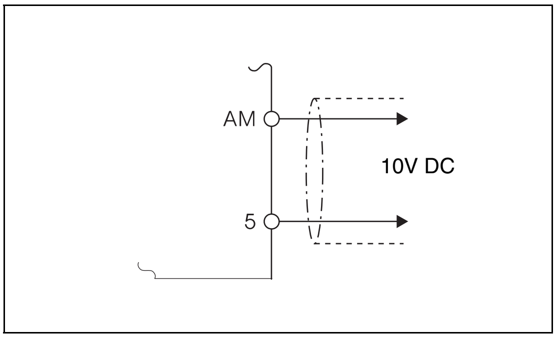


Fig. 6-80:
Connecting an analog meter to the AM output

I001168C

AM terminal calibration procedure:

① Connect an 0-10V DC voltmeter to inverter terminals AM and 5, taking care to correct with the correct polarity. AM is positive.

② Set Pr. 158 to select the monitor signal you want to output to analog output AM (refer to page 6-130). To display the output frequency or the output current set Pr. 55 or Pr. 56, respectively, to the maximum frequency or current value for which you want to output 10V to the terminal.

③ Start the frequency inverter in PU mode with the operation panel or the control terminals (external operation).

④ Calibrate the full deflection of the meter by setting C1 (Pr. 901) and then operating the digital dial. Note that the value shown on the operating panel for the monitor signal associated with C1 does not change when you turn the digital dial, but the analog current output to AM will change as you turn the dial. Confirm the calibration value found by pressing the SET key (this assigns the maximum voltage output to the displayed value of the monitor signal.)

NOTE

If it is not possible output the signal to be measured for calibration at its maximum value you can set Pr. 158 to "21". This outputs a continuous signal of approx. 10V to terminal AM, which makes it possible to calibrate the maximum value on the meter. When C1 is used to calibrate the full meter deflection in this mode a value of "1000" is displayed. Afterwards you can then reset Pr. 158 to the required monitor signal setting.

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

The following example shows how to calibrate the maximum value of the CA terminal to the 60Hz output frequency. This operation is performed in PU mode.

Operation

① Confirmation of the RUN indication and operation mode indication

② Press the MODE key to choose the parameter setting mode.

③ Turn the digital dial until P.160 (Pr. 160) appears.

④ Press the SET key to show the currently set value. The initial value "9999" appears.

⑤ Turn the digital dial counter clockwise to change it to the setting value of "0".

⑥ Press the SET key to set.

⑦ Turn the digital dial until "C..." appears.

⑧ Press set to display "C---".

⑨ Turn the digital dial until "C 0" appears. Set to C0 "CA terminal calibration".

⑩ Press the set key to enable setting.

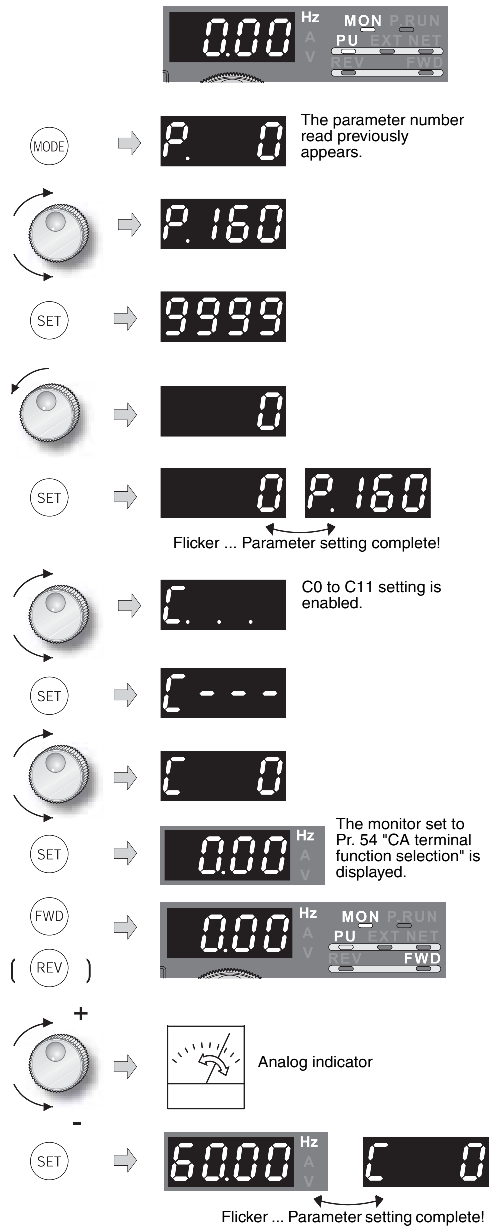
⑪ If the inverter is at a stop, press the FWD or REV key to start the inverter.
(Motor needs not be connected.)
Wait until the output frequency of 60Hz is reached.

⑫ Turn the digital dial to adjust the indicator needle to the desired position.
(In contrast to the output analog current the value shown for C0 does not change when turning the digital dial.)

⑬ Press the SET key to set. Setting is complete.

Display

(When Pr. 54 = 1)



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

I001169E

Fig. 6-81: *CA terminal calibration*

NOTES

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 operation procedure using the parameter unit (FR-PU04/FR-PU07), refer to the parameter unit instruction manual.

6.11 Operation selection at power failure

Purpose	Parameters that must be set		Refer to Section
At instantaneous power failure occurrence, restart inverter without stopping motor.	Automatic restart operation after instantaneous power failure	Pr. 57, Pr. 58, Pr. 162–Pr. 165, Pr. 299, Pr. 611	6.11.1
When undervoltage or a power failure occurs, the inverter can be decelerated to a stop.	Power failure-time deceleration-to-stop function	Pr. 261–Pr. 266	6.11.2

6.11.1 Automatic restart (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

Pr. No.	Name	Initial Value	Setting Range	Description
57	Restart coasting time	9999	0	00038 or less .... 0.5s 00052–00170....................... 1s 00250, 01160....................... 3s 01800 or more 5s
			01160 or less: 0.1–5s	Set the waiting time for inverter-triggered restart after an instantaneous power failure.
			01800 or more: 0.1–30s	
			9999	No restart
58	Restart cushion time	1s	0–60s	Set a voltage starting time at restart.
162	Automatic restart after instantaneous power failure selection	0	0	With frequency search
			1	No frequency search: The output voltage is increased until the preset frequency is reached, irrespective of the current motor speed.
			10	Frequency search at every start
			11	On every start the output voltage is increased until the preset frequency reached, irrespective of the current motor speed.
163	First cushion time for restart	0s	0–20s	Set a voltage starting time at restart. Consider using these parameters according to the load (inertia moment, torque) magnitude.
164	First cushion voltage for restart	0%	0–100%	
165	Stall prevention operation level for restart	110% ①	0–120% ①	Consider the rated inverter current according to the overload capacity as 100% and set the stall prevention operation level during restart operation.
299	Rotation direction detection selection at restarting	9999	0	Without rotation direction detection
			1	With rotation direction detection
			9999	When Pr. 78 = "0", the rotation direction is detected. When Pr. 78 = "1","2", the rotation direction is not detected.
611	Acceleration time at a restart	01160 or less: 5s 01800 or more: 15s	0–3600s, 9999	Set the acceleration time to reach the set frequency at a restart. Acceleration time for restart is the normal acceleration time (e.g. Pr. 7) when "9999" is set.

Parameters referred to		Refer to Section
7	Acceleration time	6.6.1
21	Acceleration/ deceleration time increments	6.6.1
13	Starting frequency	6.6.2
65	Retry selection	6.12.1
67–69	Retry function	16.12.1
178–189	Input terminal function selection	6.9.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① When Pr. 570 "Multiple rating setting" = 1, performing parameter clear changes the initial value and setting range.

Automatic restart after instantaneous power failure operation (Pr. 162, Pr. 299)

When Instantaneous power failure protection (E.IPF) and undervoltage protection (E.UVT) are activated, the inverter output is shut off. (Refer to section 7.2 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/undervoltage 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 (source logic) or 102 (sink logic)" to any of Pr. 190 to Pr. 196 "Output terminal function selection".

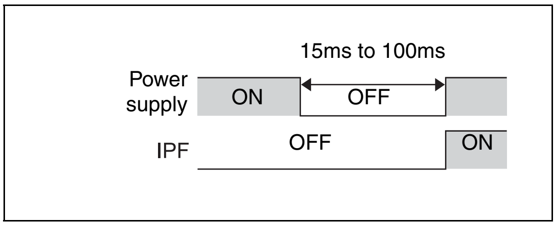


Fig. 6-82: *IPF signal*

I001353E

- 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)	With rotation direction detection	Without rotation direction detection	Without rotation direction detection
0	Without rotation direction detection	Without rotation direction detection	Without rotation direction detection
1	With rotation direction detection	With rotation direction detection	With rotation direction detection

Tab. 6-26: *Rotation direction direction*

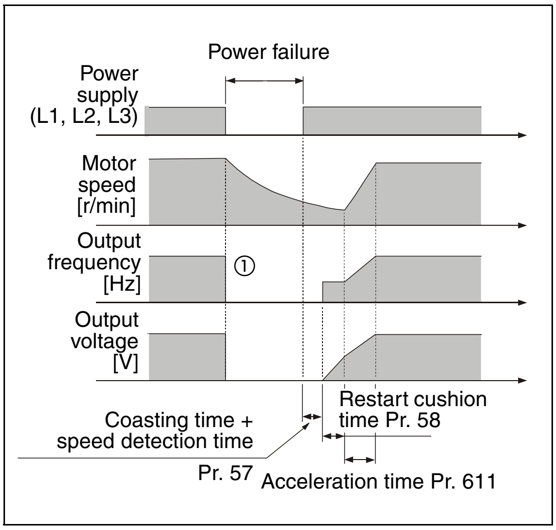


Fig. 6-83: *Automatic restart with frequency search (Pr. 162 = 0/10)*

I000722C

① The output shut off timing differs according to the load condition.

NOTES

Frequency search errors can occur if the output capacity of the frequency inverter is one or more classes higher than that of the motor or if the motor is a special model (e.g. with a frequency rating above 60Hz). If this happens it is possible for overcurrent error messages (OCT) to be generated during motor acceleration. In such configurations flying restarts are not possible and the frequency search function should not be used.

At motor frequencies of 10Hz or less the inverter accelerates from 0Hz to the set frequency.

If more than one motor is connected to the inverter in parallel the frequency search on automatic restart does not work correctly and overcurrent error messages (OCT) are likely. In such configurations deactivate frequency search (set Pr. 162 to "1" or "11"). Then configure by trial and error, starting with smaller values for Pr. 164 and larger values for Pr. 163 to find out whether the motor can be started without an overcurrent error (OCT).

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.

- Without frequency search
  When Pr. 162 is set to "1" or "11", automatic restart operation is performed in a reduced voltage system, where the voltage is gradually risen with the output frequency unchanged from prior to an instantaneous power failure independently of the coasting speed of the motor.

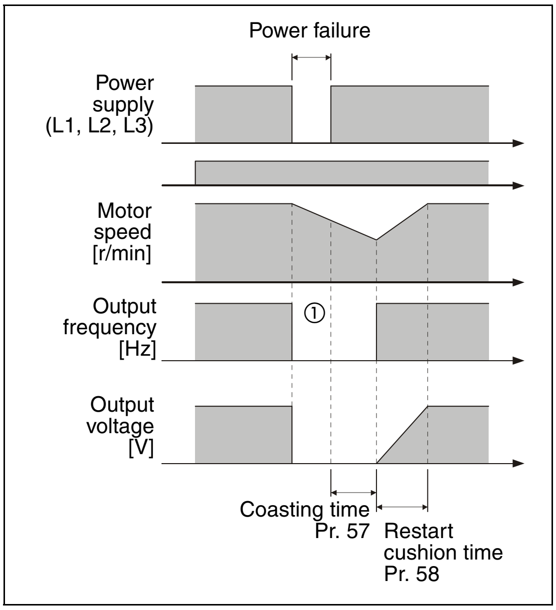


Fig. 6-84:
Automatic restart without frequency search (Pr. 162 = 1/11)

I000647C

① The output shut off timing differs according to the load condition.

NOTE

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 is set to "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 or 1, automatic restart operation is performed at the first start after power supply-on, but the inverter starts at the starting frequency at the second time or later.

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:
00038 or less ... 0.5s, 00052 to 00170 ... 1s, 00250 to 01160 ... 3.0s, 01800 or more ... 5.0s.

Operation may not be performed well depending on the load inertia moment (J) magnitude or operation frequency. Adjust the coasting time between 0.1s and 5s according to the load specifications.

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 inertia moment (J) or torque magnitude of the load

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 below.

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.

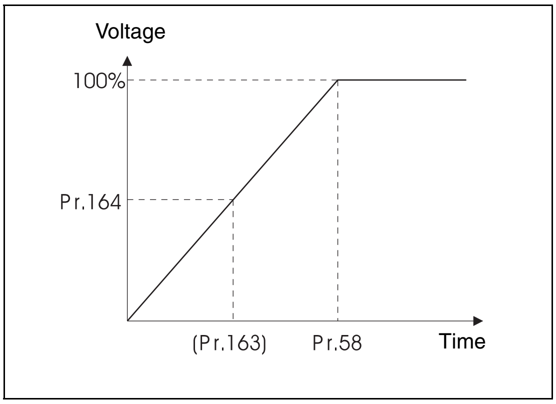


Fig. 6-85:
Voltage rise at automatic restart

I001170E

NOTE

If the setting of Pr. 21 "Acceleration/deceleration time increments" is changed, the setting increments of Pr. 611 does not change.

Connection of the 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.

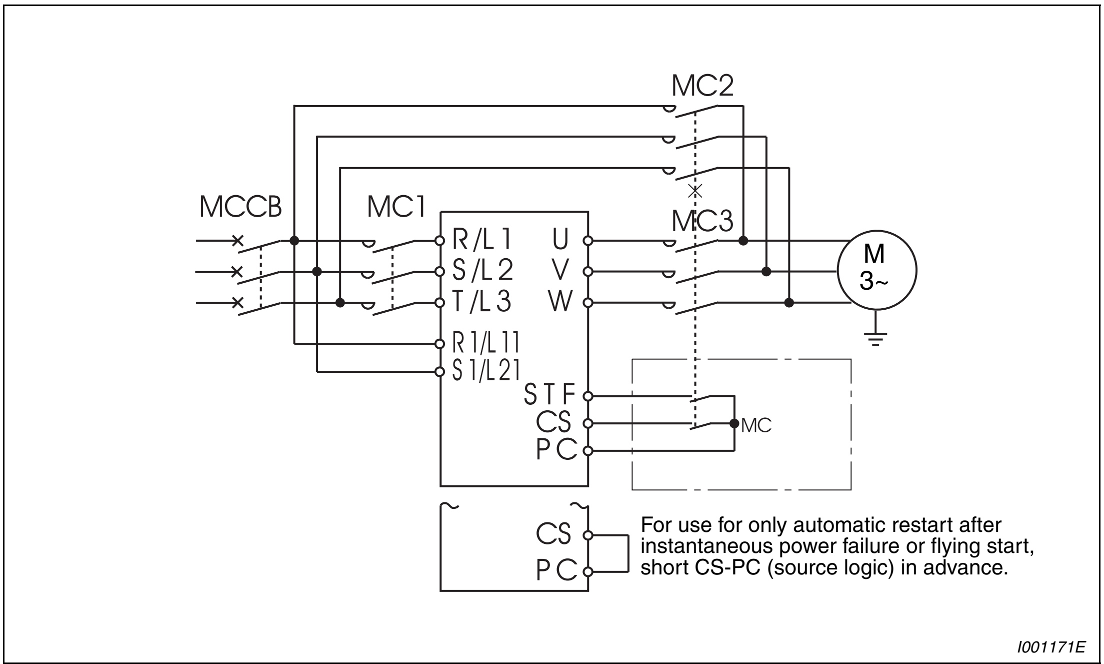


Fig. 6-86: *Connection example*

NOTES

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.

Changing the terminal assignment using Pr. 178 to Pr. 189 "Input terminal function selection" may affect the other functions. Please make setting after confirming the function of each terminal.

When automatic restart operation is selected, undervoltage protection (E.UVT) and instantaneous power failure protection (E.IPF) among the alarm output signals will not be provided at occurrence of an instantaneous power failure.

The SU and FU signals are not output during a restart. They are output after the restart cushion time has elapsed.

Automatic restart operation will also be performed after a reset made by an inverter reset is canceled or when a retry is made by the retry function.

CAUTION:

Before activating the automatic restart after power failure function please make sure that this mode is supported for the drive and permitted for your configuration.

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 CAUTION seals in easily visible places.

Provide mechanical interlocks for MC2 and MC3. The inverter will be damaged if the power supply is input to the inverter output section.

Before switching power to a motor that is already rotating it is essential to check that activating the inverter with the selected control method will generate the same phase sequence as that of the rotating motor. If this is not the case the motor could be reversed unexpectedly, which can damage or even destroy the motor.

6.11.2 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.

<table>
<tr><th>Pr. No.</th><th>Name</th><th>Initial Value</th><th>Setting Range</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">261</td><td rowspan="6">Power failure stop selection</td><td rowspan="6">0</td><td></td><td>Operation at undervoltage or power voltage</td><td>At power restoration during power failure deceleration</td><td>Deceleration time to a sop</td></tr>
<tr><td>0</td><td colspan="2">Coasts to a stop</td><td>—</td></tr>
<tr><td>1</td><td colspan="2">Decelerates to a stop</td><td rowspan="2">Depends on Pr. 262 to Pr. 266 settings</td></tr>
<tr><td>2</td><td rowspan="3">Decelerates to a stop</td><td>Accelerates again</td></tr>
<tr><td>21</td><td>Decelerates to a stop</td><td rowspan="2">Automatically adjusts the deceleration time</td></tr>
<tr><td>22</td><td>Accelerates again</td></tr>
<tr><td>262</td><td>Subtracted frequency at deceleration start</td><td>3Hz</td><td>0–20Hz</td><td colspan="3">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).</td></tr>
<tr><td rowspan="2">263</td><td rowspan="2">Subtraction starting frequency</td><td rowspan="2">50Hz</td><td>0–120Hz</td><td colspan="3">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</td></tr>
<tr><td>9999</td><td colspan="3">Decelerate from the speed obtained from output frequency minus Pr. 262.</td></tr>
<tr><td>264</td><td>Power-failure deceleration time 1</td><td>5s</td><td>0–3600/360s ①</td><td colspan="3">Set a deceleration slope down to the frequency set in Pr. 266.</td></tr>
<tr><td rowspan="2">265</td><td rowspan="2">Power-failure deceleration time 2</td><td rowspan="2">9999</td><td>0–3600/360s ①</td><td colspan="3">Set a deceleration slope below the frequency set in Pr. 266.</td></tr>
<tr><td>9999</td><td colspan="3">Same slope as in Pr. 264</td></tr>
<tr><td>266</td><td>Power failure deceleration time switchover frequency</td><td>50Hz</td><td>0–400Hz</td><td colspan="3">Set the frequency at which the deceleration slope is switched from the Pr. 264 setting to the Pr. 265 setting.</td></tr>
</table>

Parameters referred to		Refer to Section
12	DC injection brake operation voltage	6.8.1
20	Acceleration/deceleration reference frequency	6.6.1
21	Acceleration/deceleration time increments	6.6.1
30	Regenerative function selection	6.8.2
57	Restart coasting time	6.11.1
190–196	Output terminal function selection	6.9.5
872	Input phase loss protection selection	6.12.3

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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

Connection and parameter setting

Remove the jumpers across terminals R/L1-R1/L11 and across terminals S/L2-S1/L21, and connect the terminal R1/L11 to the terminal P/+ and the terminal S1/L21 to the terminal N/– (the inverter's internal control circuit is then powered by the DC bus).

When setting of Pr. 261 is not "0", the inverter decelerates to a stop if an undervoltage, power failure or input phase loss (when Pr. 872 ="1"(input phase loss enabled)) occurs.

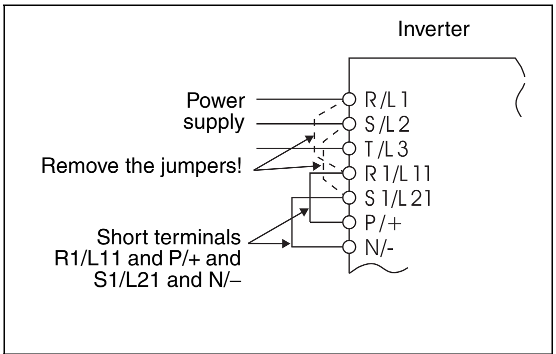


Fig. 6-87: *Connection*

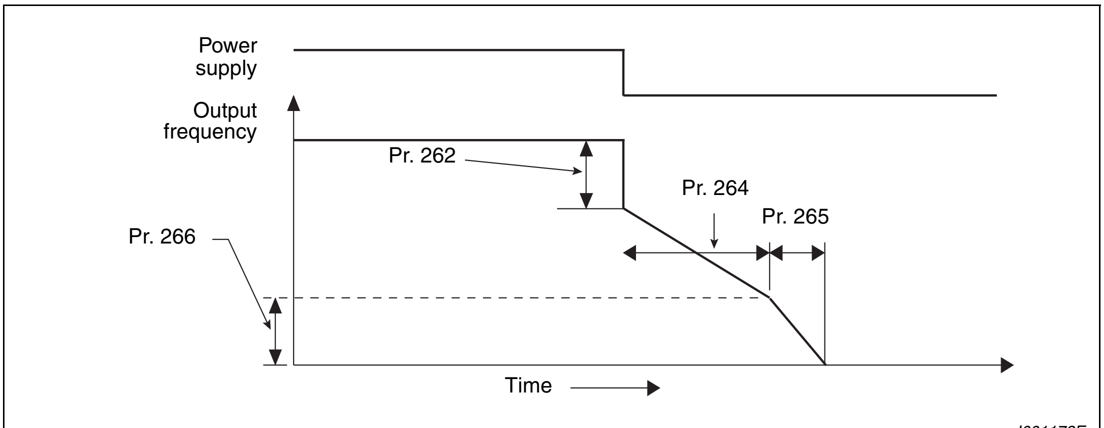
I001172E

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 to Pr. 262.

Deceleration is made in the deceleration time set to 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.



I001173E

Fig. 6-88: *Parameters for stop selection at power failure*

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.

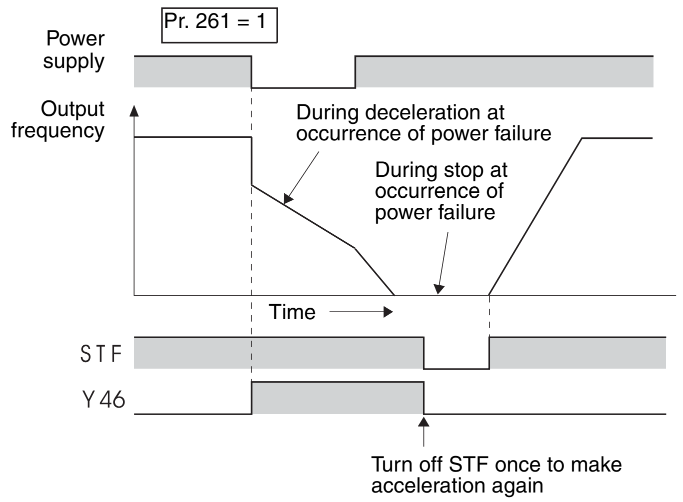


Fig. 6-89: Power restoration

NOTES

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.

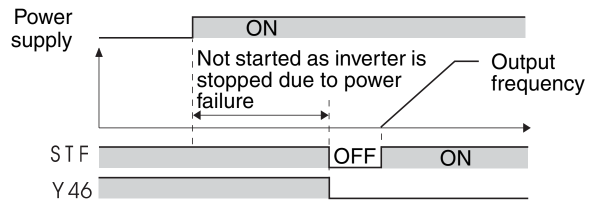


Fig. 6-90: Restart at power restoration

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.

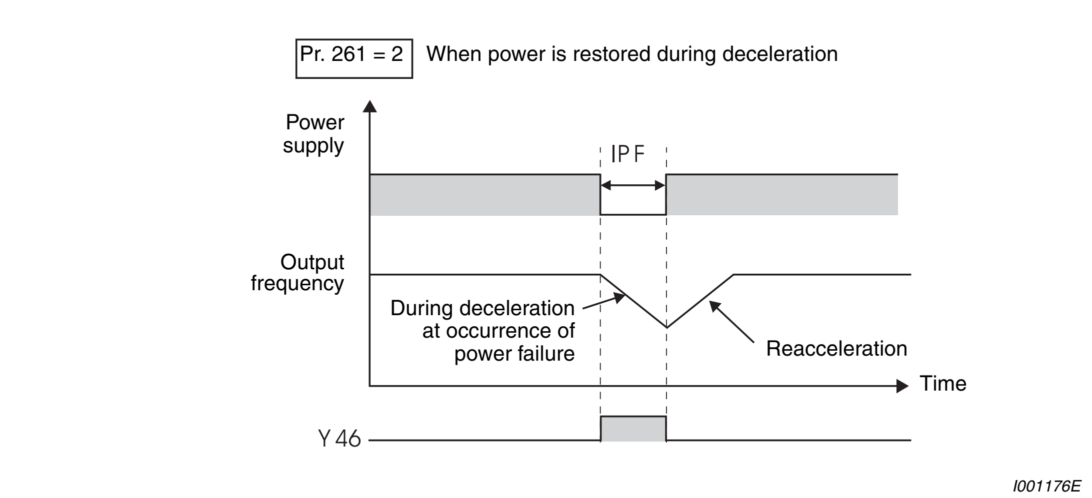


Fig. 6-91: *Operation continuation at instantaneous power failure*

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).

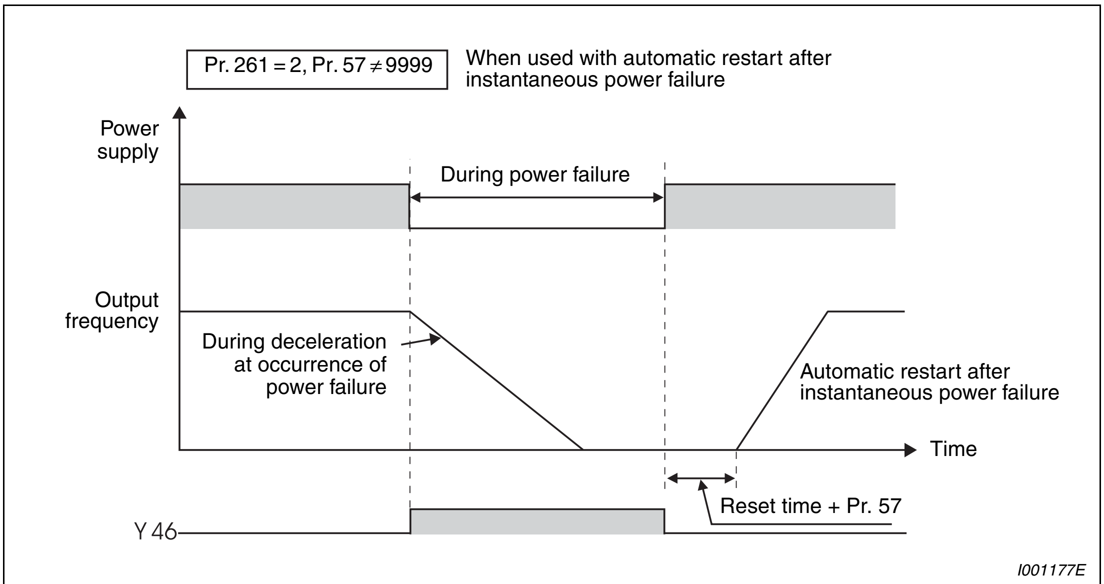


Fig. 6-92: *Operation continuation at instantaneous power failure*

Power failure stop function (with DC bus voltage constant control) (Pr. 261 = 21)

Deceleration time is automatically adjusted to keep (DC bus) voltage constant in the converter when the inverter decelerates to a stop. Even 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.

Setting Pr. 261 = "21" disables the settings of Pr. 262 to Pr. 266.

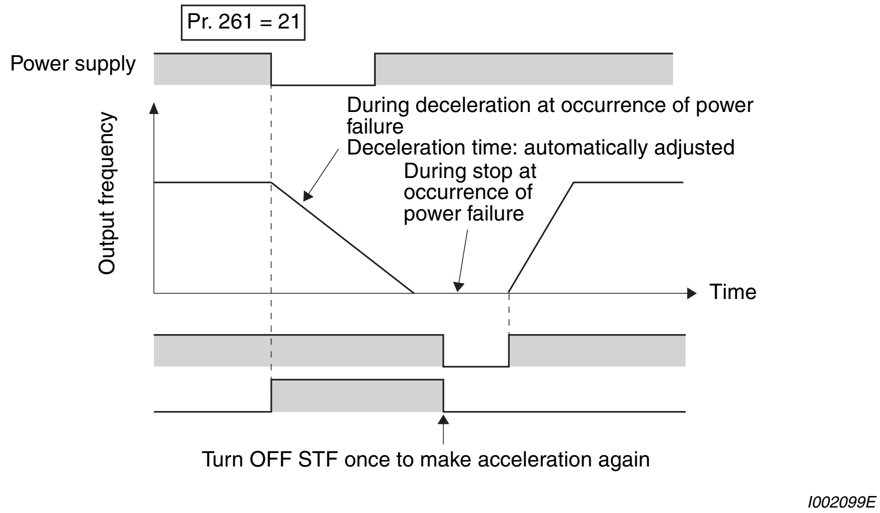
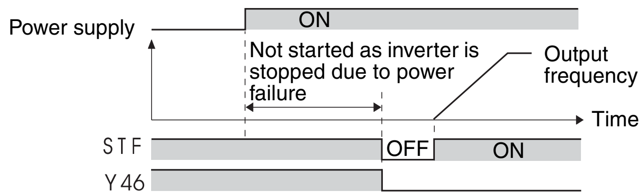


Fig. 6-93: *Power failure stop function*

NOTES



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.

Operation continuation at instantaneous power failure function (with DC bus voltage constant control) (Pr. 261 = "22")

Deceleration time is automatically adjusted to keep (DC bus) voltage constant in the converter when the inverter decelerates to a stop. When power is restored during deceleration after an instantaneous power failure, acceleration is made again up to the set frequency.

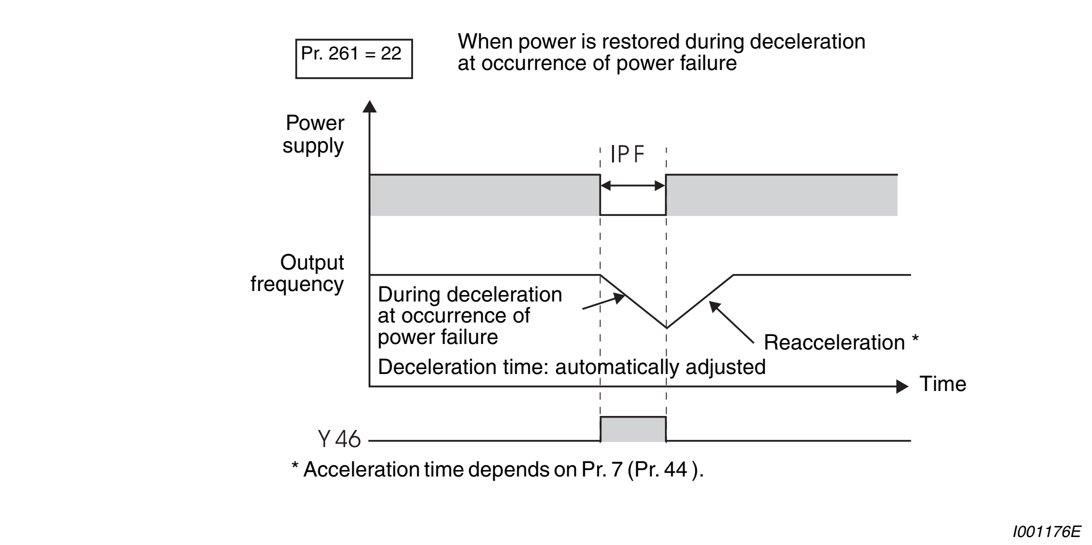


Fig. 6-94: *Operation continuation at instantaneous power failure (Pr. 261 = 22)*

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).

Setting Pr. 261 = "22" disables the settings of Pr. 262 to Pr. 266.

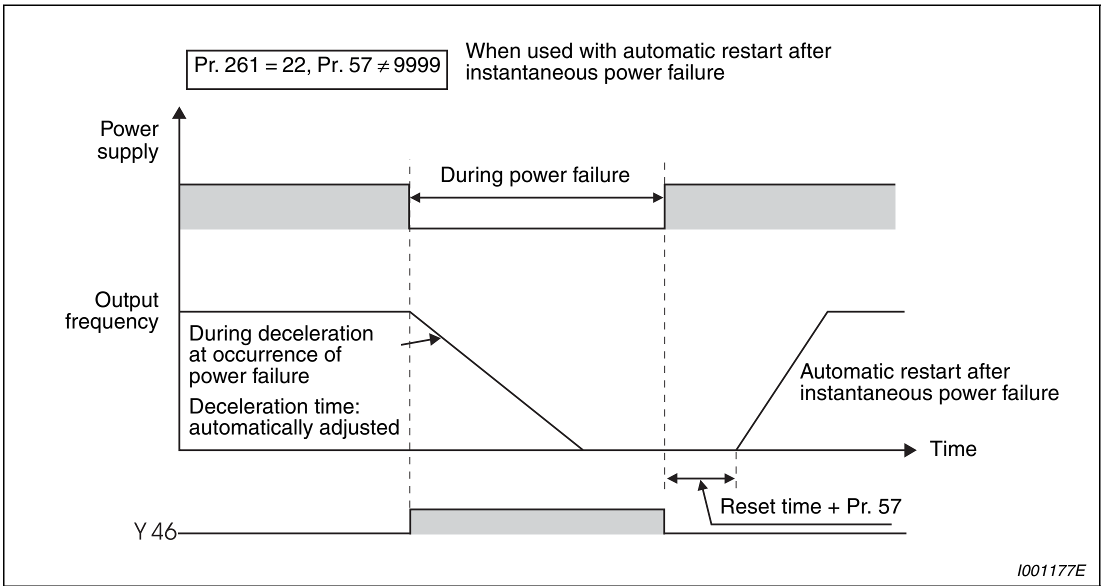


Fig. 6-95: *Operation continuation at instantaneous power failure (Pr. 261 = 22, Pr. 57 ≠ 9999)*

Power failure deceleration signal (Y46)

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

NOTES

Stop selection function is disabled while inverter decelerates due to a power failure, even though stop selection (Pr. 250) is set.

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.

Y46 signal turns on when undervoltage occurs even when the motor is not decelerating at an instantaneous power failure. For this reason, Y46 signal outputs instantly at powering off, which is not a fault.

When power failure deceleration stop function is selected, undervoltage protection (E.UVT), instantaneous power failure protection (E.IPF), and input phase loss protection (E.ILF) do not function.

Changing the terminal assignment using Pr. 190 to Pr. 196 "Output terminal function selection" may affect the other functions. Please make setting after confirming the function of each terminal.

CAUTION:

If power-failure deceleration operation is set, some loads may cause the inverter to trip and the motor to coast. The motor will coast if enough regenerative energy is given from the motor.

6.12 Operation setting at alarm occurrence

Purpose	Parameters that must be set		Refer to section
Recover by retry operation at alarm occurrence	Retry operation	Pr. 65, Pr. 67–Pr. 69	6.12.1
Output alarm code from terminal	Alarm code output function	Pr. 76	6.12.2
Do not input/output phase loss alarm	Input/output phase loss protection selection	Pr. 251, Pr. 872	6.12.3

6.12.1 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 section 6.11.1 for the restart function.)

Pr. No.	Name	Initial Value	Setting Range	Description
65	Retry selection	0	0–5	An alarm for retry can be selected.
67	Number of retries at alarm occurrence	0	0	No retry function
			1–10	Set the number of retries at alarm occurrence. An alarm output is not provided during retry operation.
			101–110	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	50Hz	0–10s	Set the waiting time from when an inverter alarm occurs until a retry is made.
69	Retry count display erase		0	Clear the number of restarts succeeded by retry.

Parameters referred to	Refer to Section
57 Restart coasting time	6.11.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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 to Pr. 67, a retry count excess alarm (E.RET) occurs, stopping the inverter output. (Refer to retry failure example in Fig. 6-97.)

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" to Pr. 69 clears the cumulative count.

During a retry, the Y64 signal is on. For the Y64 signal, assign the function by setting "64" (positive operation) or "164" (negative operation) to any of Pr. 190 to Pr. 196 "Output terminal function selection".

NOTE

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.

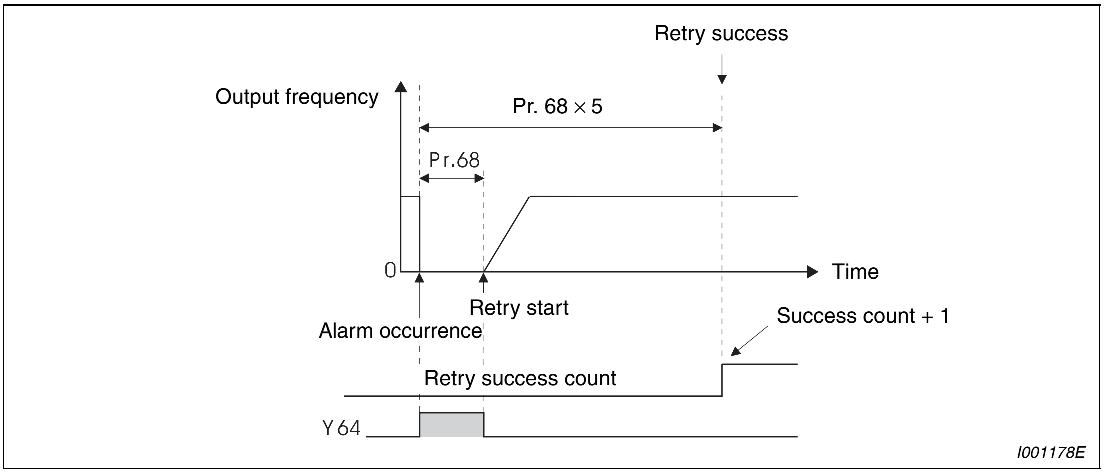


Fig. 6-96: *Retry success example*

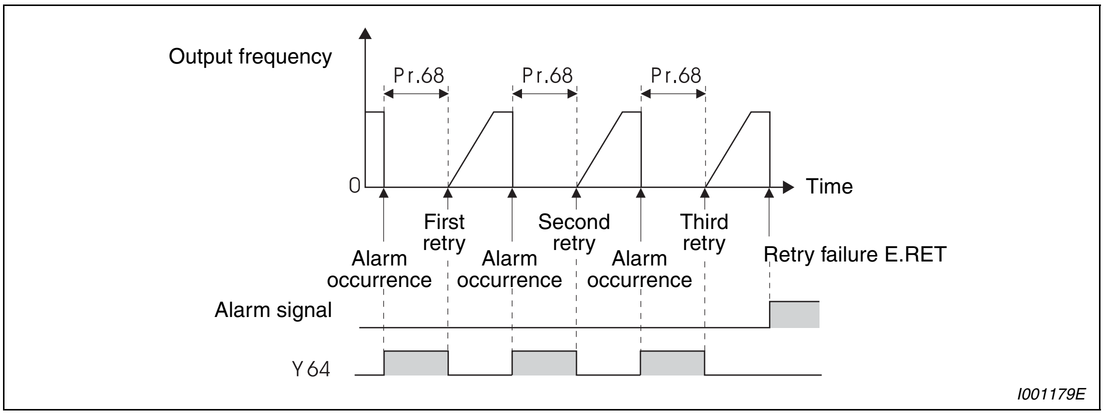


Fig. 6-97: *Retry failure example*

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.

Alarm Display for Retry	Name	Parameter 65 Setting					
		0	1	2	3	4	5
E.OC1	Overcurrent shut-off during acceleration	✔	✔	—	✔	✔	✔
E.OC2	Overcurrent shut-off during constant speed	✔	✔	—	✔	✔	
E.OC3	Overcurrent shut-off during deceleration or stop	✔	✔	—	✔	✔	✔
E.OV1	Regenerative over voltage shut-off during acceleration	✔	—	✔	✔	✔	—
E.OV2	Regenerative over voltage shut-off during constant speed	✔	—	✔	✔	✔	—
E.OV3	Regenerative over voltage shut-off during deceleration or stop	✔	—	✔	✔	✔	—
E.THM	Motor overload shut-off (electronic thermal relay function)	✔	—	—	—	—	—
E.THT	Inverter overload shut-off (electronic thermal relay function)	✔	—	—	—	—	—
E.IPF	Instantaneous power failure protection	✔	—	—	—	✔	—
E.UVT	Undervoltage protection	✔	—	—	—	✔	—
E.BE	Brake transistor alarm detection/Internal circuit error	✔	—	—	—	✔	—
E.GF	Output side earth (ground) fault overcurrent protection	✔	—	—	—	✔	—
E.OHT	External thermal relay operation	✔	—	—	—	—	—
E.OLT	Stall Prevention	✔	—	—	—	✔	—
E.OPT	Option alarm	✔	—	—	—	✔	—
E.OP1	Option slot alarm	✔	—	—	—	✔	—
E.PE	Parameter storage device alarm	✔	—	—	—	✔	—
E.PTC	PTC thermistor operation	✔	—	—	—	—	—
E.CDO	Output current detection value exceeded	✔	—	—	—	✔	—
E.SER	Communication error (inverter)	✔	—	—	—	✔	—
E.ILF	Input phase loss	✔	—	—	—	✔	—
E.PID	PID signal fault	✔	—	—	—	✔	—

Tab. 6-27: *Errors selected for retry*

NOTES

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 CAUTION seals in easily visible places.

6.12.2 Alarm code output selection (Pr. 76)

At alarm occurrence, its description can be output as a 4-bit digital signal from determined 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.

Pr. No.	Name	Initial Value	Setting Range	Description
76	Alarm code output selection	0	0	Without alarm code output
			1	With alarm code output
			2	Alarm state: Alarm code output No Alarm: Output of information assigned with Parameter 190–196

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5

The above parameter can be set when Pr. 160 "User group read selection" = 0.

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 ①	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 E.OV2 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

Tab. 6-28: *Alarm codes*

① When Pr. 76 = "2", the output terminals output the signals assigned to Pr. 190 to Pr. 196.

NOTES

Refer to page 6-268 for details of alarm code.

When a value other than "0" is set in Pr. 76.
When an alarm occurs, the output terminals SU, IPF, OL, FU output the signal in the above table, independently of the Pr. 190 to Pr. 196 "Output terminal function selection" settings. Please be careful when inverter control setting has been made with the output signals of Pr. 190 to Pr. 196.

6.12.3 Input/output phase loss protection selection (Pr. 251, Pr. 872)

You can disable the output phase loss function that stops the inverter output if one of the inverter output side (load side) three phases (U, V, W) opens.

The input phase loss protection selection of the inverter input side (R/L1, S/L2, T/L3) can be made valid.

Pr. No.	Name	Initial Value	Setting Range	Description
251	Output phase loss protection selection	1	0	Without output phase loss protection
			1	With output phase loss protection
872	Input phase loss protection selection	0	0	Without input phase loss protection
			1	With input phase loss protection

Parameters referred to	Refer to Section
261 Power failure stop selection	6.11.2

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Output phase loss protection selection (Pr. 251)

When Pr. 251 is set to "0", output phase loss protection (E.LF) becomes invalid.

Input phase loss protection selection (Pr. 872)

When Pr. 872 is set to "1", input phase loss protection (E.ILF) is provided if a phase failure of one phase among the three phases is detected for 1s continuously.

NOTES

If an input phase loss has occurred when Pr. 872 = 1 "Input phase loss protected" and a value other than "0" (power failure stop function valid) is set in Pr. 261, input phase loss protection (E.ILF) is not provided but power-failure deceleration is made.

When an input phase loss occurs in the R/L1 and S/L2 phases, input phase loss protection is not provided but the inverter output is shut off.

If an input phase loss continues for a long time during inverter operation, the converter section and capacitor lives of the inverter will be shorter.

6.13 Energy saving operation and energy saving monitor

Purpose	Parameters that must be set		Refer to Section
Energy saving operation	Energy saving operation and optimum excitation control	Pr. 60	6.13.1
How much energy can be saved	Energy saving monitor	Pr. 52, Pr. 54, Pr. 158, Pr. 891–Pr. 899	6.13.2

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

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

Pr. No.	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

Parameters referred to		Refer to Section
80	Motor capacity (simple magnetic flux vector control)	6.2.2

① When parameter is read using the FR-PU04, a parameter name different from an actual parameter is displayed.

Energy saving operation mode (Pr. 60 = 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. This inverter is appropriate for machines, such as a fan and a pump, which operate for long hours at a constant speed.

NOTE

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

Optimum excitation control mode (OEC) (Pr. 60 = 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 system which controls excitation current to improve the motor efficiency to maximum and determines output voltage as an energy saving method.

NOTES

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.

When the energy saving mode and optimum excitation control mode are selected (parameter 60 = 4 or 9), deceleration time may be longer than the setting value. Since over voltage 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.

6.13.2 Energy saving monitor (Pr. 52, Pr. 54, Pr. 158, 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.

Pr. No.	Name	Initial Value	Setting Range	Description
52	DU/PU main display data selection	0 (Output frequency)	0/5/6/8–14/17/20/ 23–25/50–57/100	50: Power saving monitor 51: Cumulative saving power monitor
54	CA terminal function selection	1 (Output frequency)	1–3/5/6/8–14/17/ 21/24/50/52/53	50: Power saving monitor
158	AM terminal function selection			
891	Cumulative power monitor digit shifted times	9999	0–4	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.
892	Load factor	100%	30–150%	Set the load factor for commercial power-supply operation. Multiplied by the power consumption rate (page 6-165) during commercial power supply operation.
893	Energy saving monitor reference (motor capacity)	SLD/LD value of Applied motor Capacity	01160 or less: 0.1–55kW	Set the motor capacity (pump capacity). Set when calculating power saving rate, average power saving rate value, commercial operation power.
			01800 or more: 0–3600W	
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	0–500	Set the power unit cost. Display 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
			1–1000h	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	0–100%	Use for calculation of annual power saving amount. Set the annual operation ratio (consider 365 days × 24hr as 100%).
			9999	No function

Parameters referred to	Refer to Section
3 Base frequency	6.4.1
52 DU/PU main display data selection	6.10.2
54 CA terminal function selection	6.10.3
158 AM terminal function selection	6.10.3

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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".

Energy saving monitor list

The following table provides the items that can be monitored by the power saving monitor (Pr. 52 = Pr. 54 = Pr. 158 = 50). (Only ❶ "Power saving" and ❸ "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
❶	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	—
❷	Power saving rate	Ratio of power saving on the assumption that power during commercial power supply operation is 100% $\frac{\text{❶ Power saving}}{\text{Power during commercial power supply operation}} \times 100$	0.1%	0			
		Ratio of power saving on the assumption that Pr. 893 is 100% $\frac{\text{❶ Power saving}}{\text{Pr. 893}} \times 100$		1			
❸	Power saving average value	Average value of power saving amount per hour during predetermined time (Pr. 897) $\frac{\Sigma(\text{❶ Power saving} \times \Delta t)}{\text{Pr. 897}}$	0.01kW/ 0.1kW [3]	9999	9999	0 – 1000h	
❹	Power saving rate average value	Ratio of power saving average value on the assumption that the value during commercial power supply operation is 100% $\frac{\Sigma(\text{❷ Power saving rate} \times \Delta t)}{\text{Pr. 897}} \times 100$	0.1%	0			
		Ratio of power saving average value on the assumption that Pr. 893 is 100% $\frac{\text{❸ Power saving average value}}{\text{Pr. 893}} \times 100$		1			
❺	Power savings amount average value	Power saving average value represented in terms of charge ❸ Power saving average value × Pr. 896	0.01/0.1 [3]	—	0–500		

Tab. 6-29: *Power saving monitor list*

The following table 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
❻	Power saving amount	Power saving is added up per hour. Σ(❶ Power saving $\times \Delta t$)	0.01kWh/ 0.1kWh ①②③	—	9999	—	9999
❼	Power saving amount charge	Power saving amount represented in terms of charge ❻ Power saving amount $\times$ Pr. 896	0.01/ 0.1 ①③	—	0–500		
❽	Annual power saving amount	Estimated value of annual power saving amount $\frac{\text{❻ Power saving amount}}{\text{Operation time during accumulation of power saving amount}} \times 24 \times 365 \times \frac{\text{Pr. 899}}{100}$	0.01kWh/ 0.1kWh ①②③	—	9999		0 – 100%
❾	Annual power saving amount charge	Annual power saving amount represented in terms of charge ❽ Annual power saving amount $\times$ Pr. 896	0.01/ 0.1 ①③	—	0–500		

Tab. 6-30: *Cumulative saving power monitor list*

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)

NOTES

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".

Power saving instantaneous monitor (❶ Power savings and ❷ Power saving rate)

On the power saving monitor ❶, 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 ❶ is "0":

- Calculated values of the power saving monitor are negative values.
- During the DC injection brake operation.
- Motor is not connected (output current monitor is 0A).

On the power saving rate monitor ❷, 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.

Power saving average value monitor (❸ power saving average value, ❹ average power saving rate value, ❺ 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 ❸ 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.

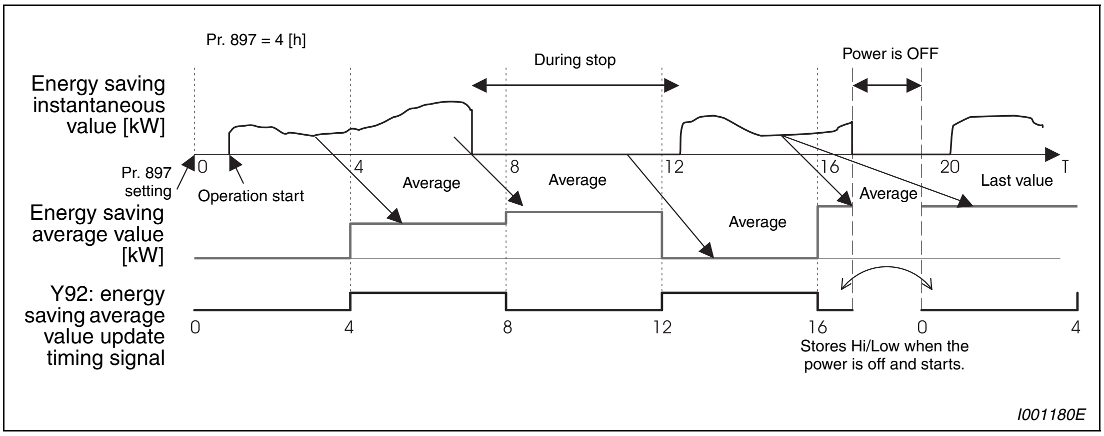


Fig. 6-98: *Update of the average value*

The power saving average value monitor ❹ displays the average value per unit time of power saving rate ❷ 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 ❺ displays the charge relative to the power saving average value (power saving average value ❸ × Pr. 896).

Cumulative saving power monitor (❻ power saving amount, ❼ power saving amount charge, ❽ annual power saving amount, ❾ annual power saving amount charge)

On the cumulative saving power monitor, the monitor data digit can be shifted to the right by the number set in Pr. 891 "Cumulative power monitor digit shifted times". 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 ❻ 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.

NOTE

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.)

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) to 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.

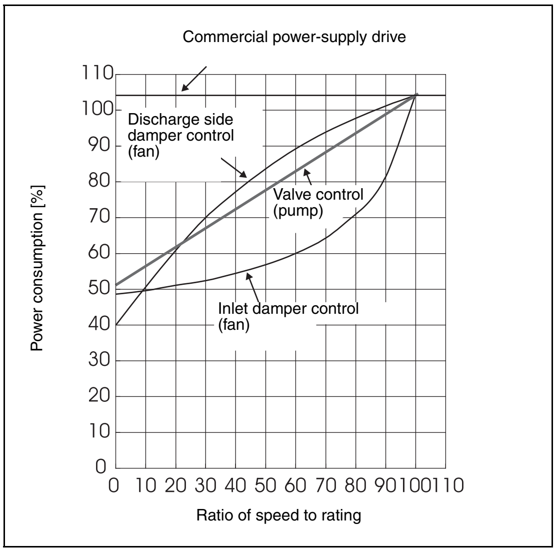


Fig. 6-99:
Characteristic of the power consumption

I001181C

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:

$$\text{Power estimated value [kW] during commercial power supply operation} = \text{Pr. 893 [kW]} \times \frac{\text{Power consumption [\%]}}{100} \times \frac{\text{Pr. 892 [\%]}}{100}$$

NOTE

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".

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) to 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.

$$\text{Annual operation time} = \text{Average time [h/day]} \times \text{Operation days [days/year]}$$

④ Calculate the operation time rate and set it to Pr. 899.

$$\text{Operation time rate [\%]} = \frac{\text{Annual operation time [h/year]}}{24\ \text{[h/day]} \times 365\ \text{[days/year]}} \times 100\ [\%]$$

Example ▽

Operation time rate setting example:
When operation is performed for about 21 hours per day and the monthly average operation days are 16 days.

$$\text{Annual operation time} = 21\ \text{[h/day]} \times 16\ \text{[days/month]} \times 12\ \text{month} = 4032\ \text{[h/year]}$$

$$\text{Operation time rate [\%]} = \frac{4032\ \text{[h/year]}}{24\ \text{[h/year]} \times 365\ \text{[days/year]}} \times 100\ [\%] = 46{,}03\%$$

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:

$$\text{Annual power saving amount [kWh/year]} = \frac{\text{Power saving average value [kW] during}}{\text{totalization when Pr. 898 = 10 or 9999}} \times 24\text{h} \times 365\ \text{days} \times \frac{\text{Pr. 899}}{100}$$

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:

$$\text{Annual power saving amount charge} = \text{Annual power saving amount [kWh/year]} \times \text{Pr. 896}$$

NOTE

In the regeneration mode, make calculation on the assumption that "power saving = power during commercial power supply operation (input power = 0)".

6.14 Motor noise, noise reduction

Purpose	Parameters that must be set		Refer to Section
Reduction of the motor noise Measures against EMI and leakage currents	Carrier frequency and Soft-PWM selection	Pr. 72, Pr. 240, Pr. 260	6.14.1
Reduce mechanical resonance	Speed smoothing control	Pr. 653, Pr. 654	6.14.2

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

You can change the motor sound.

Pr. No.	Name	Initial Value	Setting Range		Description
72	PWM frequency selection ①	2	01160 or less	0–15 (integral value)	PWM carrier frequency can be changed. The setting displayed is in [kHz]. The settings indicate the following frequencies: 0 ....0.7kHz Settings between 1–14 correspond directly to the frequency values. 15 ....14.5kHz 25 .... 2.5kHz
			01800 or more	0–6/25	
240	Soft-PWM operation selection ①	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.

Parameters referred to		Refer to Section
156	Stall prevention operation selection	6.2.4

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in Pr. 77 "Parameter write selection".

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" in Pr. 72 (2.5kHz).

Soft-PWM control (Pr. 240)

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

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 in appendix A 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.

NOTES

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 section 6.2.5.)

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 suchcase, set fast-response current limit operation invalid using Pr. 156 "Stall prevention operation selection".

When connecting a sine wave output filter please observe the manufacturer’s specifications for the necessary carrier frequency (the carrier frequency of the inverter).

6.14.2 Speed smoothing control (Pr. 653, Pr. 654)

Vibration due to mechanical resonance influences the inverter control, causing the output current (torque) to be unstable. In this case, the output current (torque) fluctuation can be reduced to ease vibration by changing the output frequency.

Pr. No.	Name	Initial Value	Setting Range	Description
653	Speed smoothing control	0	0–200%	The torque fluctuation is reduced to reduce vibration due to mechanical resonance.
654	Speed smoothing cutoff frequency	20Hz	0–120Hz	Set the minimum value for the torque variation cycle (frequency).

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Control block diagram

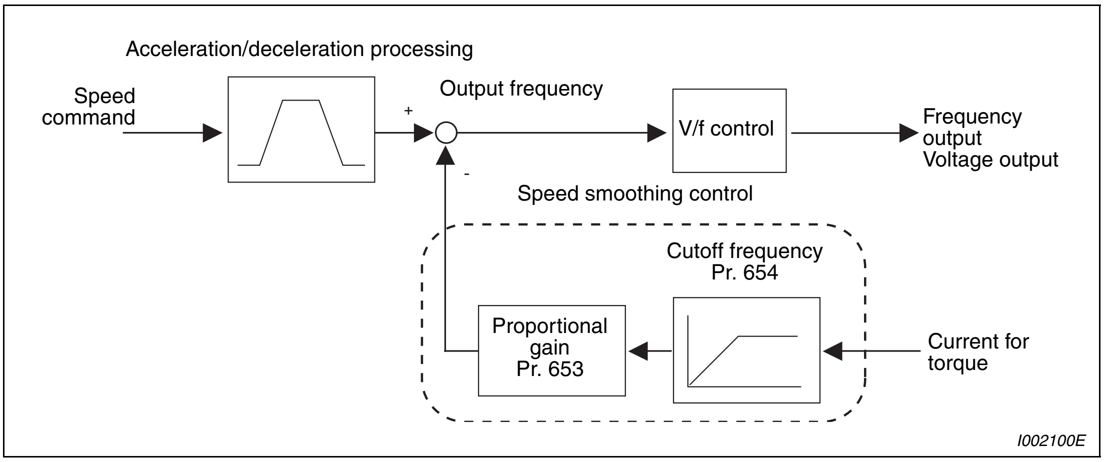


Fig. 6-100: *Control block diagram*

Setting method

If vibration due to mechanical resonance occurs, set 100% in Pr. 653, run the inverter at the frequency which generates maximum vibration and check if the vibration will be reduced or not after several seconds. If effect is not produced, gradually increase the Pr. 653 setting and check the effect repeatedly until the most effective value is set in Pr. 653.
If vibration becomes large by increasing the Pr. 653 setting, gradually decrease the Pr. 653 setting from 100% to check the effect in a similar manner.
When the vibrational frequency due to the mechanical resonance (fluctuation of torque, speed, and converter output voltage) is known using a tester and such, set 1/2 to 1 time of the vibrational frequency to Pr.654. (Setting vibrational frequency range can suppress the vibration better.)

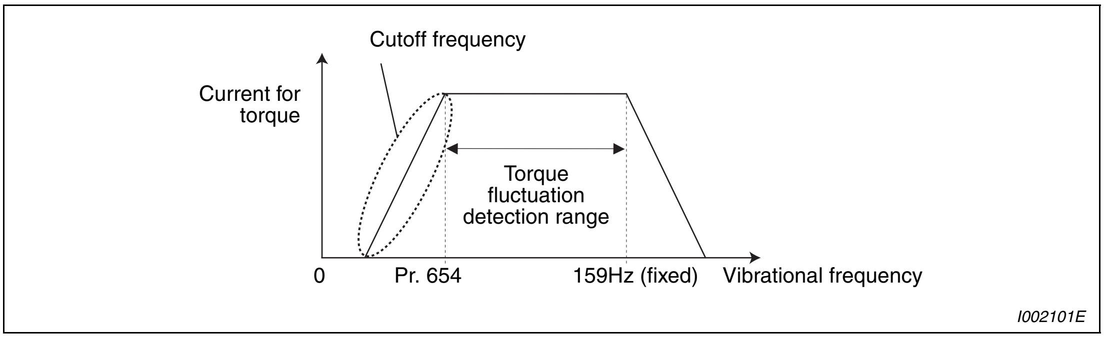


Fig. 6-101: *Setting method*

NOTES

Depending on the machine, vibration may not be reduced enough or an effect may not be produced.

6.15 Frequency setting by analog input (terminals 1, 2 and 4)

Purpose	Parameters that must be set		Refer to Section
Selection of voltage/current input (terminal 1, 2, 4) Perform forward/ reverse rotation by analog input.	Analog input selection	Pr. 73, Pr. 267	6.15.1
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	6.15.2
Noise elimination at the analog input	Input filter	Pr. 74	6.15.3
Adjustment (calibration) of analog input frequency and voltage (current)	Bias and gain of frequency setting voltage (current)	Pr. 125, Pr. 126, Pr. 241, C2–C7 (Pr. 902–Pr. 905)	6.15.4

6.15.1 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 selection specifications, the override function and the input signal polarity.

The following settings are possible:

- Select reference voltages and currents: 0 to ±10V, 0 to ±5V or 0/4 to 20mA
- Select an arithmetical or percentage compensation
- Suppress motor reversing when there is a negative set point signal voltage at terminal 1

Pr. No.	Name	Initial Value	Setting Range	Description: Voltage/current input switch	Description
73	Analog input selection	1	0–5/ 10–15	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

Parameters referred to		Refer to Section
22	Stall prevention operation level	6.2.4
125	Terminal 2 frequency setting gain frequency	6.15.4
126	Terminal 4 frequency setting gain frequency	6.15.4
252	Override bias	6.15.2
253	Override gain	6.15.2

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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.

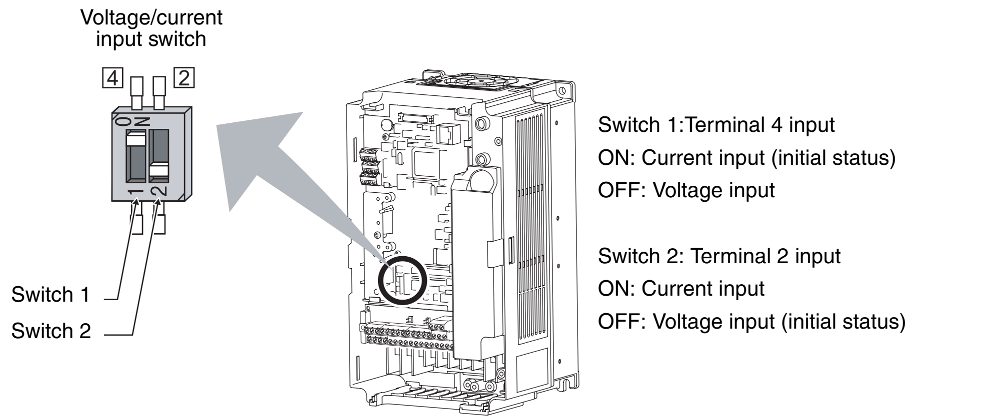


Fig. 6-102: *Selection of input specifications (voltage/current input)*

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 20V DC

Current input: Input resistance 245Ω ± 5Ω, Maximum permissible current 30mA

NOTES

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 could cause component damage. Incorrect settings other than below can cause abnormal operation.

Setting Causing Component Damage		Operation
Switch setting	**Terminal input**	
ON (Current input)	Voltage input	This could cause component damage to the analog signal output circuit of signal output devices. (electrical load in the analog signal output circuit of signal output devices increases)
OFF (Voltage input)	Current input	This could cause component damage of the inverter signal input circuit. (output power in the analog signal output circuit of signal output devices increases)

Refer to the following table and set Pr. 73 and Pr. 267. The half-tone screened areas indicate the main speed setting. The other inputs are used for compensation.

Pr. 73 setting	AU Signal	Terminal 2 Input	Terminal 1 Input	Terminal 4 Input	Compensation Input Terminal and Compensation Method	Polarity Reversible
0	OFF	0–10V	0–±10V	—	Terminal 1 Added compensation	No ①
1 (initial value)		0–5V	0–±10V			
2		0–10V	0–±5V			
3		0–5V	0–±5V			
4		0–10V	0–±10V		Terminal 2 Override	
5		0–5V	0–±5V			
6		0/4–20mA	0–±10V		Terminal 1 Added compensation	
7		0/4–20mA	0–±5V			
10		0–10V	0–±10V			Yes
11		0–5V	0–±10V			
12		0–10V	0–±5V			
13		0–5V	0–±5V			
14		0–10V	0–±10V		Terminal 2 Override	
15		0–5V	0–±5V			
16		0/4–20mA	0–±10V		Terminal 1 Added compensation	
17		0/4–20 mA	0–±5V			
0	ON	—	0–±10V	According to Pr. 267 setting: 0: 4–20mA (initial value) 1: 0–5V 2: 0–10V	Terminal 1 Added compensation	No ①
1 (initial value)			0–±10V			
2			0–±5V			
3			0–±5V			
4		0–10V	—		Terminal 2 Override	
5		0–5V				
6		—	0–±10V		Terminal 1 Added compensation	
7			0–±5V			
10		—	0–±10V			Yes
11			0–±10V			
12			0–±5V			
13			0–±5V			
14		0–10V	—		Terminal 2 Override	
15		0–5V				
16		—	0–±10V		Terminal 1 Added compensation	
17			0–±5V			

Tab. 6-31: *Setting of parameter 73 and 267*

① Indicates that a frequency command signal of negative polarity is not accepted.

Set the voltage/current input switch referring to the table below.

Terminal 2 Input Specifications	Pr. 73 setting	Switch 2	Terminal 4 Input Specifications	Pr. 267 setting	Switch 1
Voltage input (0 to 10V)	0, 2, 4, 10, 12, 14	OFF	Voltage input (0 to 10V)	2	OFF
Voltage input (0 to 5V) ①	1 (initial value), 3, 5, 11, 13, 15	OFF	Voltage input (0 to 5V)	1	OFF
Current input (0 to 20mA)	6, 7, 16, 17	ON	Current input (0 to 20mA) ①	0 (initial value)	ON

Tab. 6-32: *Setting the voltage/current input switch*

① Indicates an initial value.

NOTES

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.

Perform operation by analog input voltage

The frequency setting signal inputs 0 to 5V DC (or 0 to 10V DC) 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 5V DC across terminals 10-5, or 10V across terminals 10E-5.

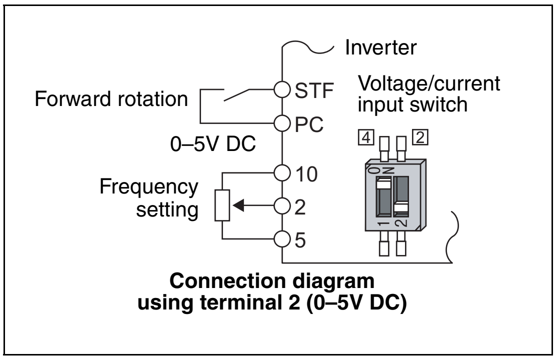


Fig. 6-103:
Frequency setting by voltage 0–5V DC using terminal 2

I002103E

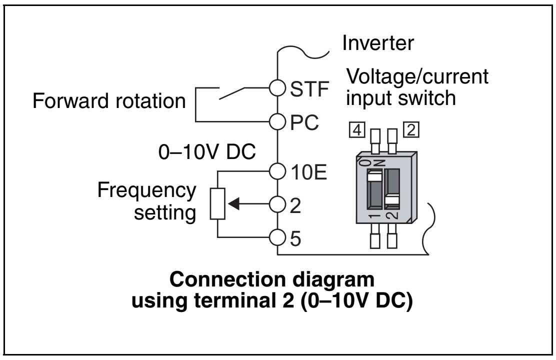


Fig. 6-104:
Frequency setting by voltage 0–10V DC using terminal 2

I002104E

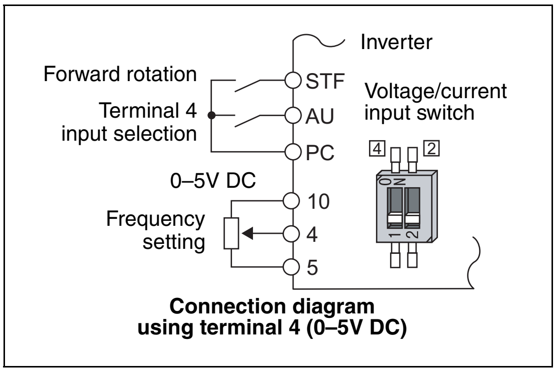


Fig. 6-105:
Frequency setting by voltage 0–5V DC using terminal 4

I002105E

Terminal	Inverter Built-in Power Supply Voltage	Frequency Setting Resolution	Pr. 73 (terminal 2 input voltage)
10	5V DC	0.024/50Hz	0–5V DC
10E	10V DC	0.012/50Hz	0–10V DC

Tab. 6-33: *Built-in power supply voltage*

When inputting 10V DC 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 5V DC) or "2" (0 to 10V DC) in Pr. 267 changes the terminal 4 to the voltage input specification. When the AU signal turns on, the terminal 4 input becomes valid.

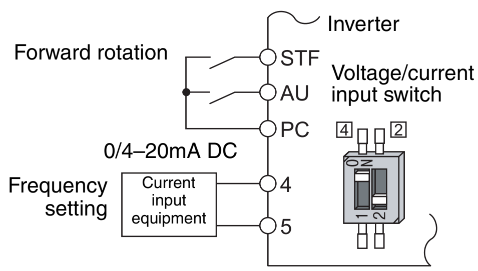
NOTE The wiring length of the terminal 10, 2, 5 should be 30m maximum.

Perform operation by analog input current

When the pressure or temperature is controlled constant by a fan, pump, etc., automatic operation can be performed by inputting the output signal 0/4 to 20mA of the adjuster to across the terminals 4-5.

The AU signal must be turned on to use the terminal 4.

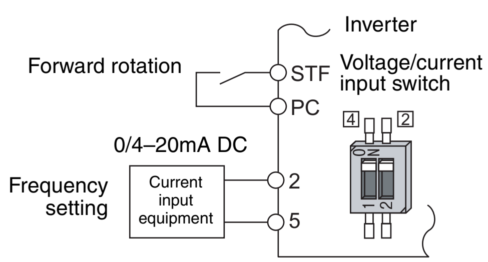
Setting any of "6, 7, 16, 17" in Pr. 73 changes the terminal 2 to the current input specification. At this time, the AU signal need not be turned on.



Connection diagram using terminal 4 (0/4–20mA DC)

I002106E

Fig. 6-106:
Frequency setting by the function "Current input 0/4–20mA" assigned to terminal 4



Connection diagram using terminal 2 (0/4–20mA DC)

I002107E

Fig. 6-107:
Frequency setting by the function "Current input 0/4–20mA" assigned to terminal 2

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.

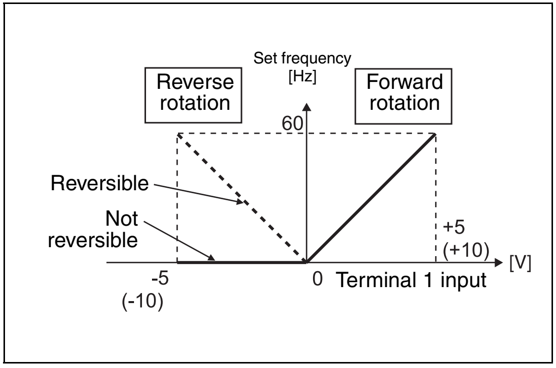


Fig. 6-108:
Compensation input characteristic when STF is on

I001185E

6.15.2 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.

Pr. No.	Name	Initial Value	Setting Range	Description
73	Analog input selection	1	0–3/6/7/ 10–13/ 16/17	Added compensation
			4/5/14/17	Override compensation
242	Terminal 1 added compensation amount (terminal 2)	100%	0–100%	Set the ratio of added compensation amount when terminal 2 is the main speed.
243	Terminal 1 added compensation amount (terminal 4)	75%	0–100%	Set the ratio of added compensation amount when terminal 4 is the main speed.
252	Override bias	50%	0–200%	Set the bias side compensation value of override function.
253	Override gain	150%	0–200%	Set the gain side compensation value of override function.

Parameters referred to		Refer to Section
28	Multi-speed input compensation selection	6.5.3
73	Analog input selection	6.15.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Added compensation (Pr. 242, Pr. 243)

A compensation signal can be input to the main speed setting for synchronous/continuous speed control operation, etc.

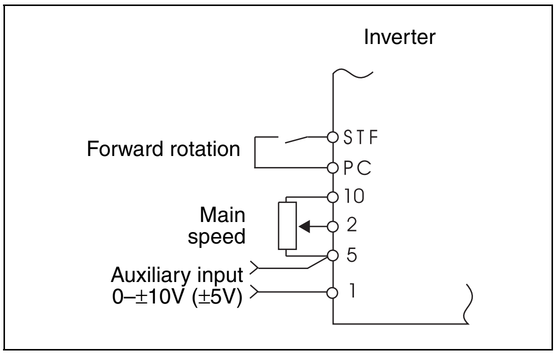


Fig. 6-109:
Added compensation connection example

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 0/4 to 20mA).

The added compensation for terminal 2 can be adjusted by Pr. 242, and the compensation for terminal 4 by Pr. 243:

$$\text{Analog command value using terminal terminal 2} = \text{Terminal 2 input} + \text{Terminal 1 input} \times \frac{\text{Pr. 242}}{100\ [\%]}$$

$$\text{Analog command value using terminal terminal 4} = \text{Terminal 4 input} + \text{Terminal 1 input} \times \frac{\text{Pr. 243}}{100\ [\%]}$$

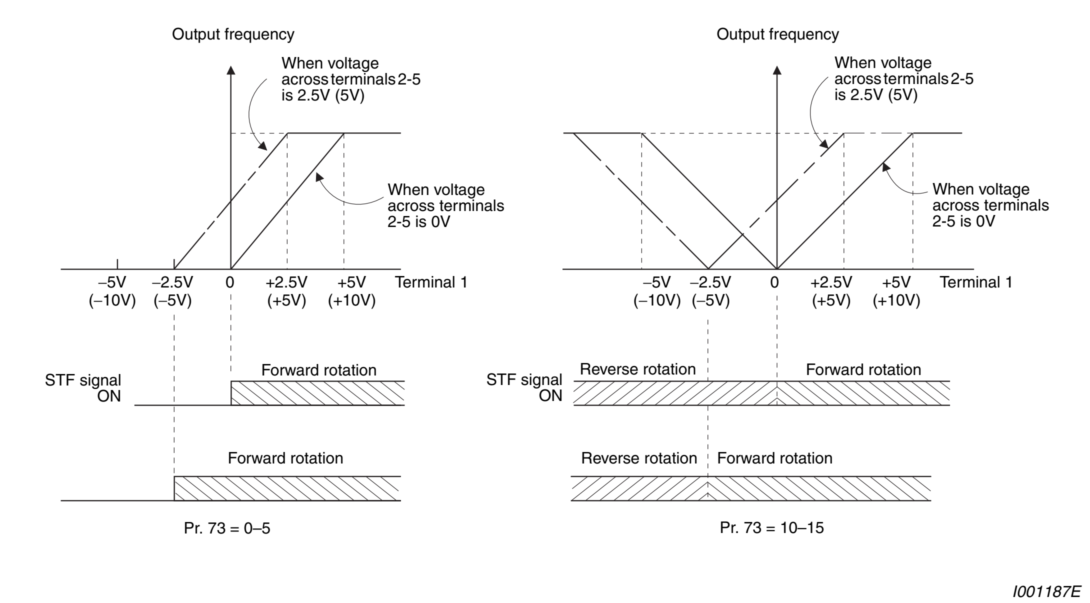


Fig. 6-110: *Auxiliary input characteristics*

Override function (Pr. 252, Pr. 253)

Use the override function to change the main speed at a fixed ratio.

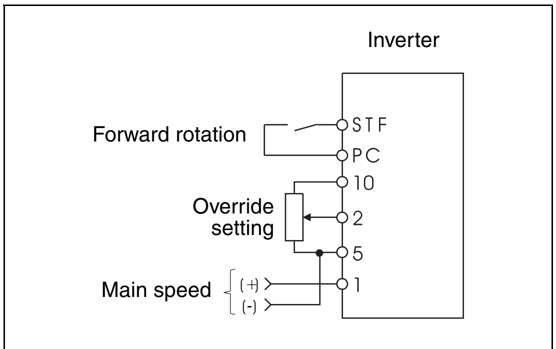


Fig. 6-111:
Override connection diagram

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 or multi-speed setting
Compensation amount [%]: Terminal 2 input

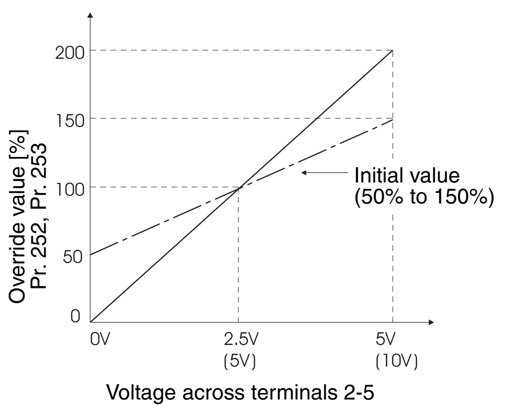
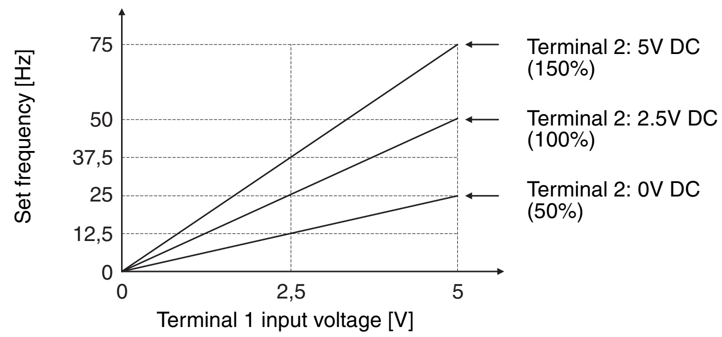


Fig. 6-112: *Override*

I001189E

Example ▽

Pr. 73 = 5
The set frequency changes as shown below according to the terminal 1 (main speed) and terminal 2 (auxiliary) inputs.



I001190E

Fig. 6-113: *Set frequency in dependence on the terminal 1 and terminal 2 signals*

△

NOTES

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 6-170 for setting.)

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".)

6.15.3 Input filter time constant (Pr. 74)

If the set point signal (terminal 1, 2 or 4) is an unstable signal or contains noise you can filter out the instability or noise by increasing the setting value of Pr. 74.

Pr. No.	Name	Initial Value	Setting Value	Description
74	Input filter time constant	1	0–8	Set the primary delay filter time constant for the analog input. A larger setting results in a larger filter.

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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.)

6.15.4 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 0/4 to 20mA DC).

These parameters can be used to configure the inverter precisely for set point signals that either exceed or do not quite reach 5Vor 10V or 20mA. These settings can also be used to configure inverse control (i.e. high output frequency at minimum set point signal, minimum output frequency at maximum set point signal).

Pr. No.	Name	Initial Value	Setting Range	Description	
125	Terminal 2 frequency setting gain frequency	50Hz	0–400Hz	Set the frequency of terminal 2 input gain (maximum).	
126	Terminal 4 frequency setting gain frequency	50Hz	0–400Hz	Set the frequency of terminal 4 input gain (maximum).	
241	Analog input display unit switchover ① ③	0	0	Displayed in %	Select the unit of analog input display.
			1	Displayed in V/mA	
C2 (902)	Terminal 2 frequency setting bias frequency ① ②	0Hz	0–400Hz	Set the frequency on the bias side of terminal 2 input.	
C3 (902)	Terminal 2 frequency setting bias ① ②	0%	0–300%	Set the converted % of the bias side voltage (current) of terminal 2 input.	
C4 (903)	Terminal 2 frequency setting gain ① ②	100%	0–300%	Set the converted % of the gain side voltage of terminal 2 input.	
C5 (904)	Terminal 4 frequency setting bias frequency ① ②	0Hz	0–400Hz	Set the frequency on the bias side of terminal 4 input.	
C6 (904)	Terminal 4 frequency setting bias ① ②	20%	0–300%	Set the converted % of the bias side current (voltage) of terminal 4 input.	
C7 (905)	Terminal 4 frequency setting gain ① ②	100%	0–300%	Set the converted % of the gain side current (voltage) of terminal 4 input.	

Parameters referred to		Refer to Section
20	Acceleration/ deceleration reference frequency	6.6.1
73	Analog input selection	6.15.1
267	Terminal 4 input selection	6.15.1
79	Operation mode selection	6.17.1

① The above parameters can be set when Pr. 160 "User group read selection" = 0.

② The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/ FR-PU07).

③ The above parameter allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in Pr. 77 "Parameter write selection".

Change the frequency at maximum analog input (Pr. 125, Pr. 126)

Set a value to 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.)

Analog input bias/gain calibration [C2 (Pr. 902) to C7 (Pr. 905)]

The parameters for input bias and gain can be used to configure the inverter for set point signals that do not exactly match 5Vor 10V or 20mA. You can enter the exact output frequencies to be associated with the minimum and maximum signal values separately for terminals 2 and 4. This feature can also be used to configure an inverse control characteristic (i.e. high output frequency at minimum set point signal, minimum output frequency at maximum set point signal).

Set the bias frequency of the terminal 2 input using C2 (Pr. 902). (Factory-set to the frequency at 0V.)

Parameter C3 (Pr. 902) is the frequency setting bias for the input signal at terminal 2, i.e. the minimum value of the analog signal. When signals are smaller than this value the frequency set point signal will be limited to the value set with C2.

Parameter 125 sets the gain for the terminal 2 output frequency. This is the frequency set point value that corresponds to the maximum analog signal defined with Pr. 73. (Pr. 125 is set to a default value of 50Hz at the factory.)

Parameter C4 (Pr. 903) sets the gain for the input signal on terminal 2, i.e. the maximum value of the analog signal connected to terminal 2. When signals exceed this value the frequency set point value is limited to the value stored in Pr. 125.

Parameter C5 (Pr. 904) sets the frequency set point bias frequency for terminal 4. This is the frequency corresponding to the minimum analog signal. (This parameter is set to a default value of 0Hz at the factory.)

Parameter C6 (Pr. 904) sets the bias of the input signal on terminal 4, i.e. the minimum value of the analog signal connected to terminal 4. When the signal on this terminal is lower than this value the frequency set point value is limited to the value set with C5. (This parameter is set to a default value of 20% at the factory, which corresponds to approx. 4mA.)

Parameter 126 sets the gain for the terminal 4 output frequency. This is the frequency set point value that corresponds to the maximum analog signal defined with Pr. 73. (Pr. 126 is set to a default value of 50Hz at the factory.)

Parameter C7 (Pr. 905) sets the gain of the input signal on terminal 4, i.e. the maximum value of the analog signal connected to terminal 4. When the signal on this terminal is higher than this value the frequency set point value is limited to the value set with Pr. 126.

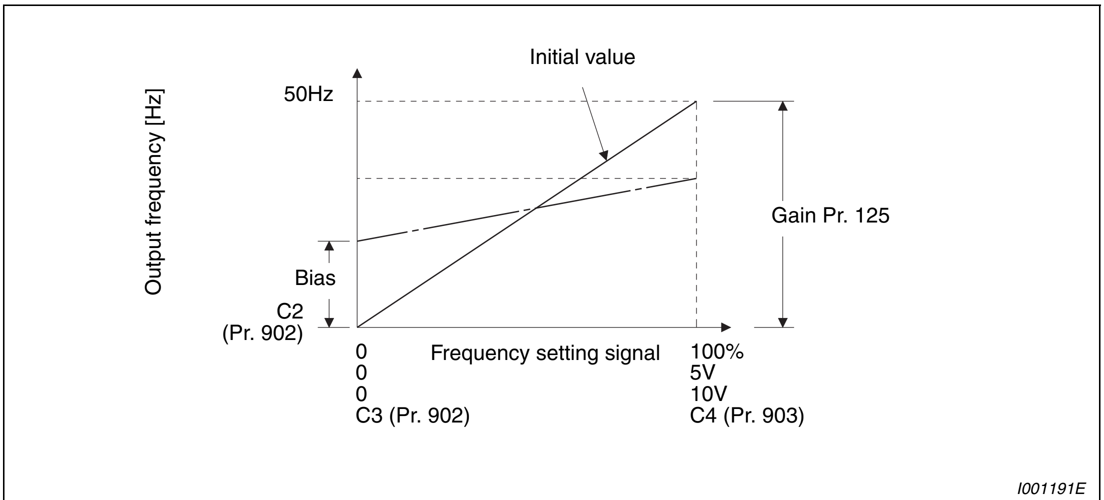


Fig. 6-114: *Signal adjustment of terminal 2*

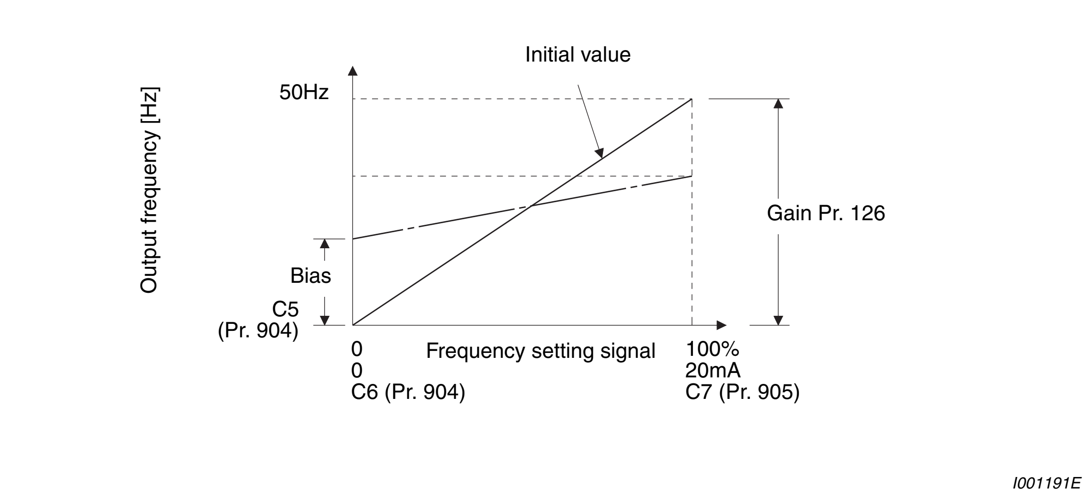


Fig. 6-115: *Signal adjustment of terminal 4*

There are three methods to adjust the frequency setting voltage (current) bias/gain:

- Method to adjust any point by application of voltage (current) to across the terminals 2-5 (4-5). (Refer to page 6-185.)
- Method to adjust any point without application of a voltage (current) to across terminals 2-5 (4-5). (Refer to page 6-187.)
- Adjusting only the frequency without adjusting the voltage (current). (Refer to page 6-188.)

NOTES

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.

Analog input display unit changing (Pr. 241)

The level display for the analog signal connected to terminal 2 or terminal 4 can be switched between a % display and a display in V or mA.

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
0–5V	0 to 5V → 0 to 100% is displayed.	0 to 5V → 0 to 5V is displayed.
0–10V	0 to 10V → 0 to 100% is displayed.	0 to 10V → 0 to 10V is displayed.
0/4–20mA	0 to 20mA → 0 to 100% is displayed.	0 to 20mA → 0 to 20mA is displayed.

Tab. 6-34: *Units when displaying the set value*

Note that the LEDs V or A also light up as an additional indicator when Pr. 241 is set to "1" and the display is set to the settings for C3/C4 or C6/C7.

NOTES

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.

Frequency setting signal (current) bias/gain adjustment method

1. Method to adjust any point by application of voltage (current) to across the terminals 2-5 (4-5). The following example illustrating the procedure assumes that Pr. 241 is set to "0":

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 the PU/EXT key).

② Press the MODE key to choose the parameter setting mode.

③ Turn the digital dial until P.160 (Pr. 160) appears.

④ Press the SET key to show the currently set value. The initial value "9999" appears.

⑤ Turn the digital dial counter clockwise to change it to the setting value of "0".

⑥ Press the SET key to set.

⑦ Turn the digital dial until "C..." appears.

⑧ Press the SET key to display "C---".

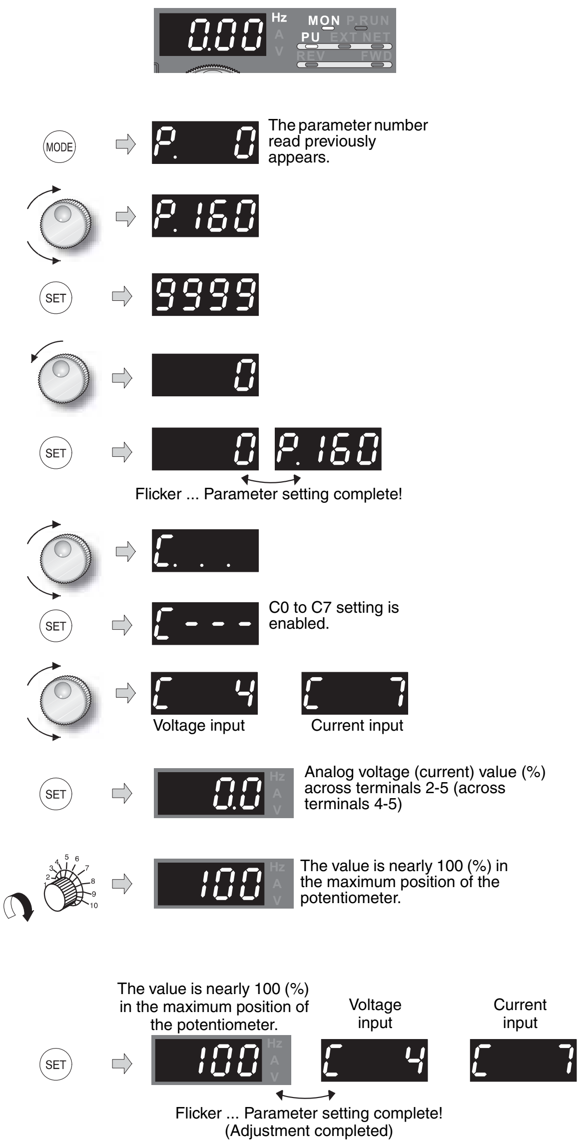
⑨ Turn the digital dial until "C 4 (C 7)" appears. Set to C4 "Terminal 2 frequency setting gain".

⑩ Press the SET key to display the analog voltage (current) value (%).

⑪ Apply the maximum set value. (Turn the external potentiometer to its maximum)
CAUTION:
After performing the operation in step ⑪ do not touch the digital dial until completion of calibration.

⑫ Press the SET key to set.

Display



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

I001193E

Fig. 6-116: *Bias and gain adjustment by application of an reference signal*

NOTES

Error code Er3 may be displayed when you save if the frequency values for gain and bias are less than approx. 5% apart. If this happens correct the frequency settings and save again.

If you try to set Pr. 125/126, C2–C7 in external mode (EXT LED is on) error code Er4 will be displayed when you save. If this happens switch to PU mode and repeat the setting procedure, then save your settings.

If you try to set Pr. 125/126, C2–C7 while the motor is being operated by the inverter error code Er2 will be displayed. If this happens stop the inverter, repeat the setting procedure and save your settings.

2. Method to adjust any point without application of a voltage (current) to across terminals 2-5 (4-5).
   (This example shows how to change from 4V to 5V, assuming that Pr. 241 is set to "1".)

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 the PU/EXT key).

② Press the MODE key to choose the parameter setting mode.

③ Turn the digital dial until P.160 (Pr. 160) appears.

④ Press the SET key to show the currently set value. The initial value "9999" appears.

⑤ Turn the digital dial counter clockwise to change it to the setting value of "0".

⑥ Press the SET key to set.

⑦ Turn the digital dial until "C..." appears.

⑧ Press the SET key to display "C---".

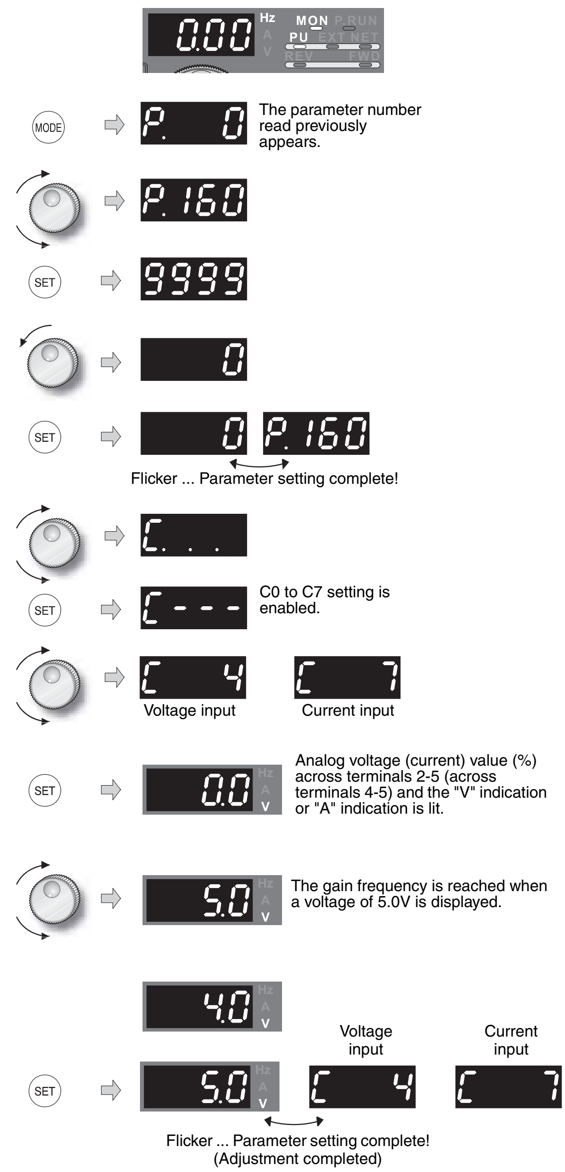
⑨ Turn the digital dial until "C 4 (C 7)" appears.
Set to C4 "Terminal 2 frequency setting gain".

⑩ Press the SET key to display the analog value in V or mA (voltage for C4 and current for C7).

⑪ Turn the digital dial to set the gain of the voltage signal value. If Pr. 241 is set to "1" the value will be displayed directly.
CAUTION:
When you start turning the digital dial the value that is currently stored (in this example 4V) will be displayed.

⑫ Press the SET key to set.

Display



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

I001194E

Fig. 6-117: *Bias and gain adjustment without application of an reference signal*

NOTE

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

3. Method to adjust only the frequency without adjustment of a gain voltage (current). (The gain frequency is changed from 50Hz to 60Hz.)

Operation

① Turn the digital dial until P.125 (Pr. 125) or P.126 (Pr. 126) appears

② Press the SET key to show the currently set value (50.00Hz).

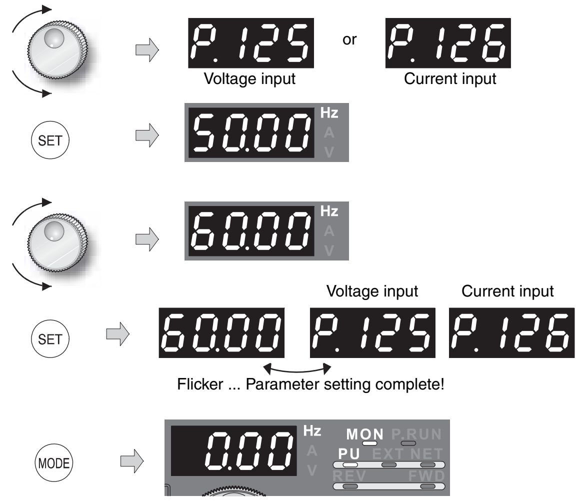
③ Turn the digital dial to change it to the setting value of "60.00" (60.00Hz).

④ Press the SET key to set.

⑤ Press the MODE key twice to choose monitor/ frequency monitor.

⑥ Apply the maximum signal value to the terminals 2-5 (4-5) and turn the start signal (STF or STR) on. The inverter will accelerate the motor to 60Hz.

Display



I001195E

Fig. 6-118: *Adjusting only the frequency without adjustment of a voltage (current)*

NOTES

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 operation 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 6-45.)

Make the bias frequency setting using calibration parameter C2 (Pr. 902) or C5 (Pr. 904). (Refer to page 6-182.)

CAUTION:

Take care when setting any value other than "0" as the bias speed at 0V (0/4mA). Even if a frequency command is not given, merely turning on the start signal will start the motor at the preset frequency.

6.15.5 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.

Pr. No.	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.

Parameters referred to		Refer to Section
73	Analog input selection	6.15.2
267	Terminal 4 input selection	6.15.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

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

When the input current of terminal 4 (terminal 2) falls to 2mA or below, output minor fault signal (LF) is output. 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" (source logic) or "198" (sink 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.

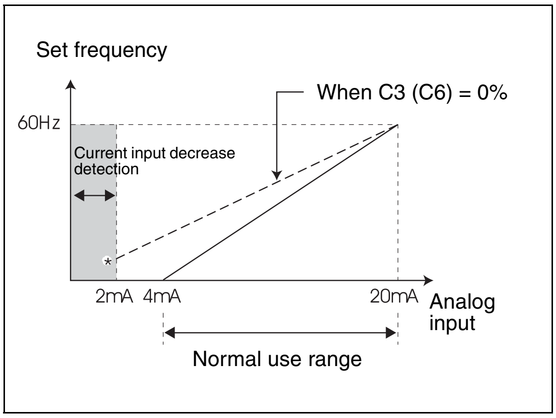


Fig. 6-119:
4mA input check of current input

* 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.

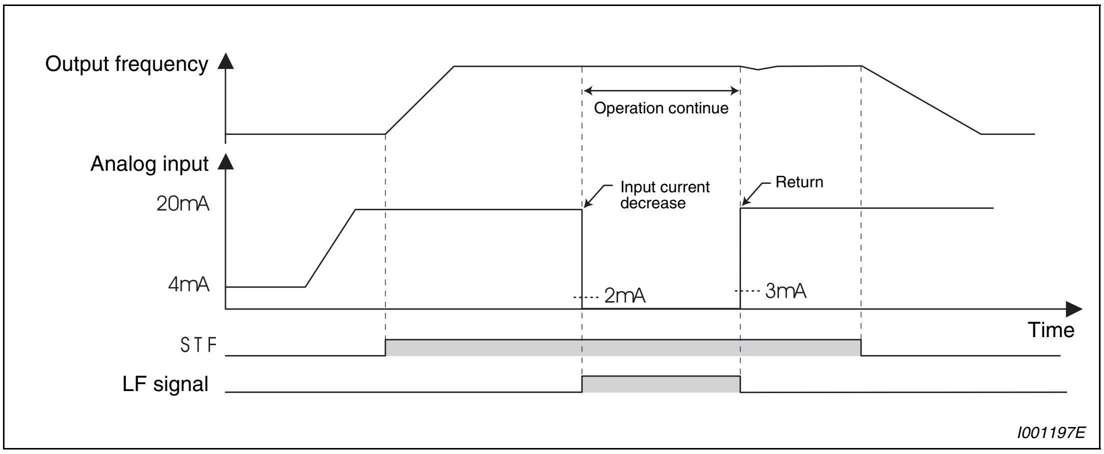


Fig. 6-120: *4mA input check during external operation (Pr. 573 = 1)*

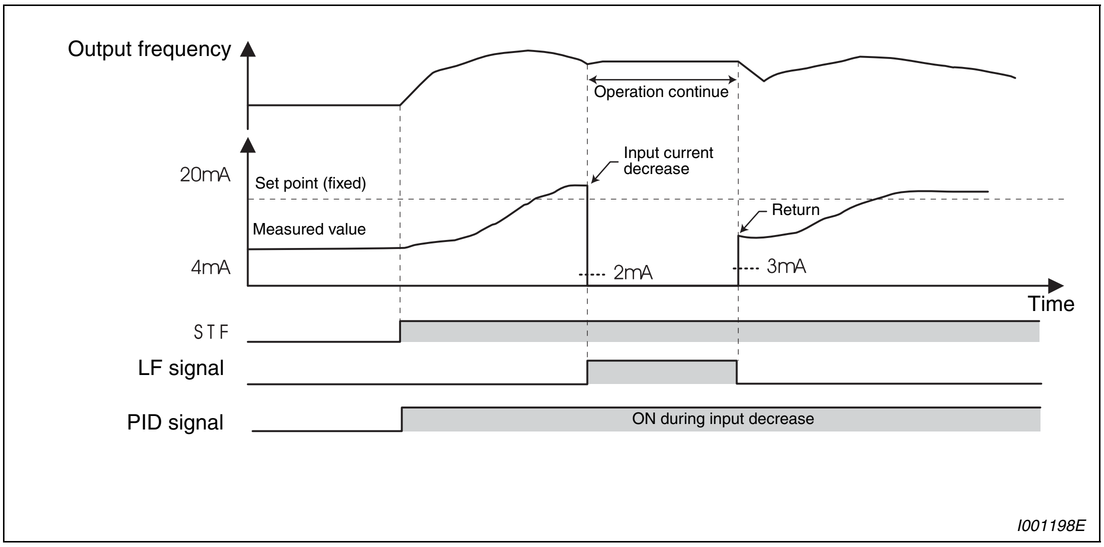


Fig. 6-121: *4mA input check during PID control (reverse action, Pr. 573 = 1)*

NOTE

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.

The function 4mA input check is related to following functions:

Function	Operation (Pr. 573 = 1)	Refer to Page
Minimum frequency	Even if the input current decreases, minimum frequency setting clamp is valid.	6.3.1
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.	6.5.1
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.	6.5.2
MRS	Output is shut off by the MRS signal even if input current decreases. (The inverter stops when the MRS signal is turned off.)	6.9.2
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.	6.5.4
Retry	When retry was successful at error occurrence during decrease in input current, retained frequency was not cleared and operation continues.	6.12.1
Added compensation, override function	Operation of added compensation (terminal 1) and override compensation (terminal 2) are invalid during decrease in input current.	6.15.2
Input filter time constant	The value before filtering is detected. When input current decreases, frequency after filtering (average value) is retained.	6.15.3
Forward/reverse rotation prevention	Motor rotation direction can be restricted independently of 4mA input check setting.	6.16.3
PID control	Although PID operation is stopped when input current decreases, the X14 signal remains on. (PID operation is valid.)	6.19.1
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.	6.11.2
Pump function	If auxiliary motor switchover conditions of pump function is satisfied even when input current decreases, motor connection/release operation is performed.	6.19.3
Traverse function	When input current decreases, traverse operation is performed using retained frequency as reference.	6.19.4
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.	6.17.1

Tab. 6-35: *Functions related to the 4mA input check function*

6.16 Misoperation prevention and parameter setting restriction

Purpose	Parameters that must be set		Refer to Section
Limit reset function Make alarm stop when PU is disconnected Stop from PU	Reset selection/ disconnected PU detection/ PU stop selection	Pr. 75	6.16.1
Prevention of parameter rewrite	Parameter write selection	Pr. 77	6.16.2
Prevention of reverse rotation of the motor	Reversierverbot	Pr. 78	6.16.3
Display necessary parameters	Reverse rotation prevention selection	Pr. 160, Pr. 172–Pr. 174	6.16.4
Control of parameter write by communication	E²PROM write selection	Pr. 342	6.18.4

6.16.1 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.

<table>
<tr><th>Pr. No.</th><th>Name</th><th>Initial Value</th><th colspan="2">Setting Range</th><th>Description</th></tr>
<tr><td rowspan="2">75</td><td rowspan="2">Reset selection/
disconnected PU detection/
PU stop selection</td><td rowspan="2">14</td><td>01160 or less</td><td>0–3/
14–17</td><td rowspan="2">For the initial value, reset always enabled, without disconnected PU detection, and with PU stop function are set.</td></tr>
<tr><td>01800 or more</td><td>0–3/
14–17/
100–103/
114–117</td></tr>
</table>

Parameters referred to	Refer to Section
250 Stop selection	

The above parameter can be set when Pr. 160 "User group read selection" = 0.

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.

<table>
<tr><th>Pr. 75</th><th>Reset Selection</th><th>Disconnected PU Detection</th><th>PU Stop Selection</th><th>Reset Limit (01800 or more)</th></tr>
<tr><td>0</td><td>Reset input always enabled.</td><td rowspan="2">If the PU is disconnected, operation will be continued.</td><td rowspan="4">Pressing the STOP key decelerates the motor to a stop only in the PU operation mode.</td><td rowspan="8">No function</td></tr>
<tr><td>1</td><td>Enabled only when the protective function is activated</td></tr>
<tr><td>2</td><td>Reset input always enabled.</td><td rowspan="2">When the PU is disconnected, the inverter output is shut off.</td></tr>
<tr><td>3</td><td>Enabled only when the protective function is activated</td></tr>
<tr><td>14 (initial value)</td><td>Reset input always enabled.</td><td rowspan="2">If the PU is disconnected, operation will be continued.</td><td rowspan="4">Pressing the STOP key decelerates the motor to a stop in any of the PU, external and communication operation modes.</td></tr>
<tr><td>15</td><td>Enabled only when the protective function is activated</td></tr>
<tr><td>16</td><td>Reset input always enabled.</td><td rowspan="2">When the PU is disconnected, the inverter output is shut off.</td></tr>
<tr><td>17</td><td>Enabled only when the protective function is activated</td></tr>
<tr><td>100</td><td>Reset input always enabled.</td><td rowspan="2">If the PU is disconnected, operation will be continued.</td><td rowspan="4">Pressing the STOP key decelerates the motor to a stop only in the PU operation mode.</td><td rowspan="8">Function</td></tr>
<tr><td>101</td><td>Enabled only when the protective function is activated</td></tr>
<tr><td>102</td><td>Reset input always enabled.</td><td rowspan="2">When the PU is disconnected, the inverter output is shut off.</td></tr>
<tr><td>103</td><td>Enabled only when the protective function is activated</td></tr>
<tr><td>114</td><td>Reset input always enabled.</td><td rowspan="2">If the PU is disconnected, operation will be continued.</td><td rowspan="4">Pressing the STOP key decelerates the motor to a stop in any of the PU, external and communication operation modes.</td></tr>
<tr><td>115</td><td>Enabled only when the protective function is activated</td></tr>
<tr><td>116</td><td>Reset input always enabled.</td><td rowspan="2">When the PU is disconnected, the inverter output is shut off.</td></tr>
<tr><td>117</td><td>Enabled only when the protective function is activated</td></tr>
</table>

Tab. 6-36: *Setting of parameter 75*

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.

NOTES

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.

When the RESET signal is applied continuously while the frequency inverter is in an error-free condition the message "err" will blink in the display.

The reset key of the PU is valid only when the protective function is activated, independently of the Pr. 75 setting.

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.

NOTES

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.

PU stop selection

In any of the PU operation, external operation and network operation modes, the motor can be stopped by pressing the STOP key of the PU

When the inverter is stopped by the PU stop function (refer to section 4.3 "Operation panel FR-DU07") in the external operation mode, "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 the STOP key is valid only in the PU operation mode.

NOTE

The motor will also decelerate to a stop (PU stop) when 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 terminal).

Restarting method when stop was made by pressing the STOP key from the PU during external operation ("PS" is displayed)

Operation panel FR-DU07

① After the motor has decelerated to a stop, turn off the STF or STR signal.

② Press the PU/EXT key to change to the PU operation mode. The PU indication is lit. The message "PS" is canceled.

③ Press the PU/EXT key to change to the external operation mode. The EXT indication is lit.

④ Turn on the STF or STR signal.

Parameter unit FR-PU04/FR-PU07

① After the motor has decelerated to a stop, turn off the STF or STR signal.

② Press the EXT key. The message "PS" is 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.

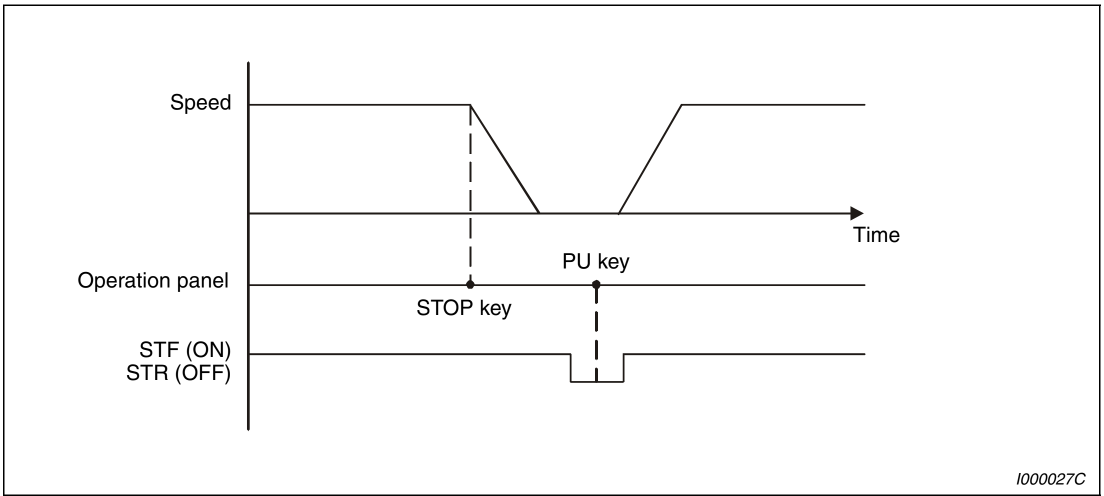


Fig. 6-122: *Stop during external operation*

NOTE

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.

WARNING:

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.

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.

NOTE

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

6.16.2 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.

Pr. No.	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 operation status.

Parameters referred to	Refer to Section
79 Operation mode selection	6.17.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

Pr. 77 can be always set independently of the operation mode and operation status.

Write parameters only at a stop (Pr. 77 = 0)

Parameters can be written only during a stop in the PU operation mode.

The half-tone screened parameters in the parameter list (Tab. 6-1) can always be written, regardless of the operation mode and operation 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.

Disable parameter write (Pr. 77 = 1)

Parameter write is not enabled. (Reading is enabled.)

Parameter clear and all parameter clear cannot be performed, either.

The parameters given below can be written if Pr. 77 = 1.

Parameter	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

Tab. 6-37: *Parameters that can be written even if Pr. 77 = 1*

Write parameters during operation (Pr. 77 = 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	Description
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)
100–109	Adjustable 5 points V/F parameter
135	Commercial power-supply switchover sequence output terminal selection
136	MC switchover interlock time
137	Waiting time at a start
138	Commercial power-supply operation switchover selection at an alarm
139	Automatic switchover frequency between inverter and commercial power-supply operation
178–196	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	Energizing time carrying-over times
564	Operating time carrying-over times
570	Multiple rating setting

Tab. 6-38: *Parameters that cannot be written during operation*

6.16.3 Reverse rotation prevention selection (Pr. 78)

In some applications (fans, pumps) it is necessary to ensure that the motor cannot be reversed. This can be achieved with Pr. 78.

Pr. No.	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

Parameters referred to	Refer to Section
79 Operation mode selection	6.17.1

The above parameter can be set when Pr. 160 "User group read selection" = 0.

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.

6.16.4 User groups (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.

Pr. No.	Name	Initial Setting	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	User group registered display/batch clear ①	0	(0–16)	Displays the number of cases registered as a user group (Read only)
			9999	Batch clear the user group registration
173	User group registration ①②	9999	0–999/ 9999	Set the parameter numbers to be registered to the user group.
174	User group clear ①②	9999	0–999/ 9999	Set the parameter numbers to be cleared from the user group.

Parameters referred to		Refer to Section
550	NET mode operation command source selection	6.17.3
551	PU mode operation command source selection	6.17.3

① The above parameter can be set when Pr. 160 "User group read selection" = 0.

② The values read from Pr. 173 and Pr. 174 are always "9999".

Display of simple mode parameters and extended parameters (Pr. 160)

When Pr. 160 is set to "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 Tab. 6-1 for the simple mode parameters.)

Setting "0" to Pr. 160 enables the display of the simple mode parameters and extended parameters.

NOTES

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 terminal, all parameters can be read regardless of the Pr. 160 setting by setting Pr. 550 "NET mode operation command source selection" and Pr. 551 "PU mode operation command source selection".

Pr. 551	Pr. 550	Pr. 160 Valid/Invalid
1 (RS-485 terminal)	—	Valid
2 (PU) (initial value)	0 (communication option)	Valid
	1 (RS-485)	Invalid (all readable)
	9999 (auto-detect) (initial value)	With communication option: valid
		Without communication option: invalid (all readable)

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.

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".

Registration of parameter to user group (Pr. 173))

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 the PU/EXT key).

② Press the MODE key to choose the parameter setting mode.

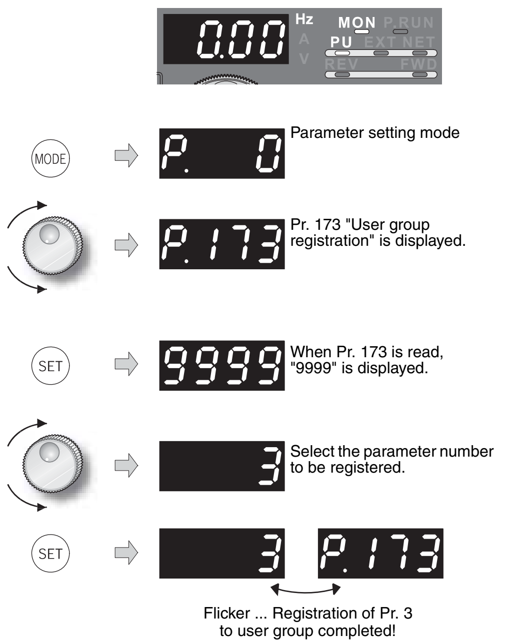
③ Turn the digital dial until P.173 (Pr. 173) appears.

④ Press the SET key to display "9999".

⑤ Turn the digital dial until "3" appears.

⑥ Press the SET key to set.
"P.173" and "3" are displayed alternately.
To continue parameter registration, repeat steps ③ to ⑥.

Display



I001199E

Fig. 6-123: *When registering Pr. 3 to user group*

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

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 the PU/EXT key).

② Press the MODE key to choose the parameter setting mode.

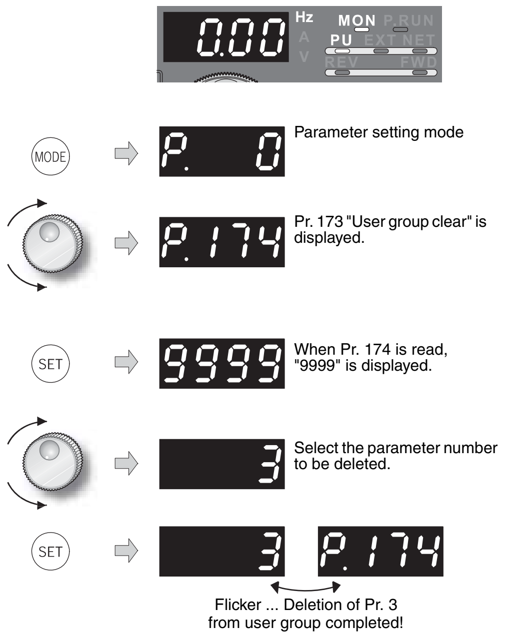
③ Turn the digital dial until P.174 (Pr. 174) appears.

④ Press the SET key to display "9999".

⑤ Turn the digital dial until "3" appears.

⑥ Press the SET key to set.
"P.174" and "3" are displayed alternately.
To continue parameter deletion, repeat steps ③ to ⑥.

Display



I001200E

Fig. 6-124: *When deleting Pr. 3 from user group*

NOTES

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. 173 or Pr. 174 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.

6.17 Selection of operation mode and operation location

Purpose	Parameters that must be set		Refer to Section
Operation mode selection	Operation mode selection	Pr. 79	6.17.1
Started in network operation mode	Operation mode at power on	Pr. 79, Pr. 340	6.17.2
Selection of control source	Selection of control source, speed command source and control location during communication operation	Pr. 338, Pr. 339, Pr. 550, Pr. 551	6.17.3

6.17.1 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).

Pr. No.	Name	Initial Value	Setting Range	Description
79	Operation mode selection	0	0	External/PU switchover mode External operation mode at power on
			1	Fixed to PU operation mode
			2	Fixed to external operation mode Operation can be performed by switching between external and NET operation mode
			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)
			4	External/PU combined operation mode 2 Running frequency: External signal input (terminal 2, 4, 1, JOG, multi-speed setting, etc.) Start signal: Input from the PU (FR-DU07/FR-PU04/FR-PU07) (FWD/REV keys)
			6	Switch-over mode Switch among PU operation, external operation, and NET operation while keeping the same operation status.
			7	External operation mode (PU operation interlock) X12 signal ON:: Can be shifted to PU operation mode (output stop during external operation) X12 signal OFF: Operation mode can not be switched to PU operation mode.

Parameters referred to		Refer to Section
15	Jog frequency	6.5.2
4–6 24–27 232–239	Multi-speed operation	6.5.1
75	Reset selection/ disconnected PU detection/ PU stop selection	6.16.1
161	Frequency setting/ key lock operation selection	6.21.2
178–189	Input terminal function selection	6.9.1
190–196	Output terminal function selection	6.9.5
340	Communication start-up mode selection	6.17.2
550	NET mode operation command source selection	6.17.3

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

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.
- 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.

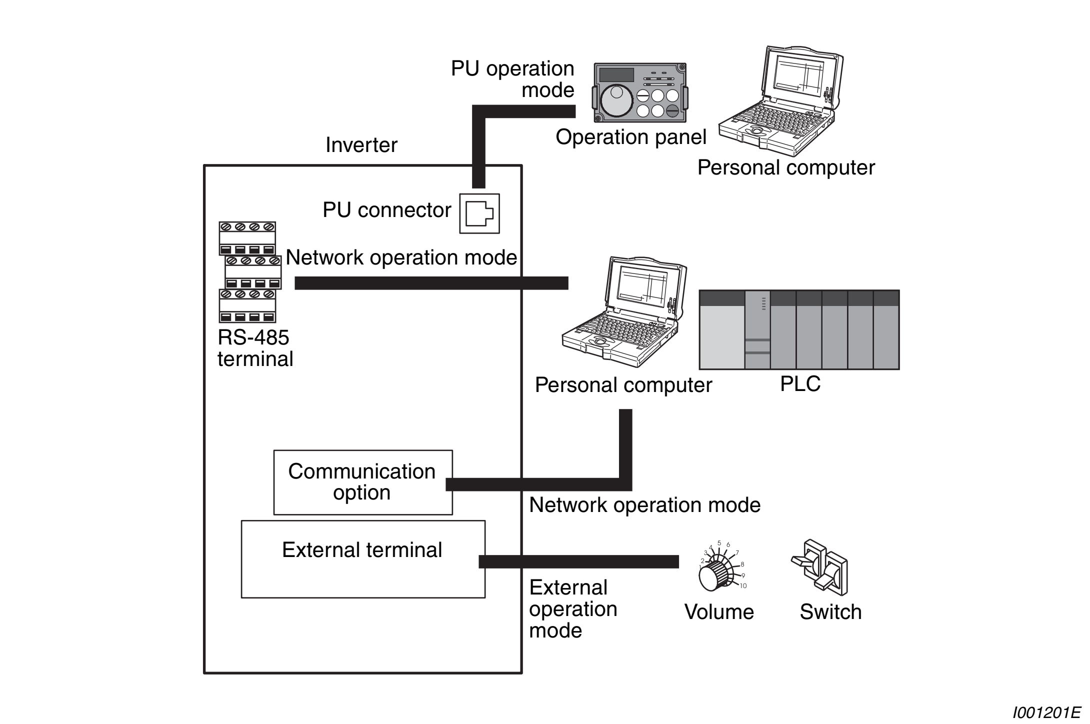


Fig. 6-125: *Operation modes of the inverter*

NOTES

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 of the PU (FR-DU07) (PU stop selection) is valid also in other than the PU operation mode. (Refer to Pr. 75 "Reset selection/disconnected PU detection/PU stop selection".)

Operation mode switching method

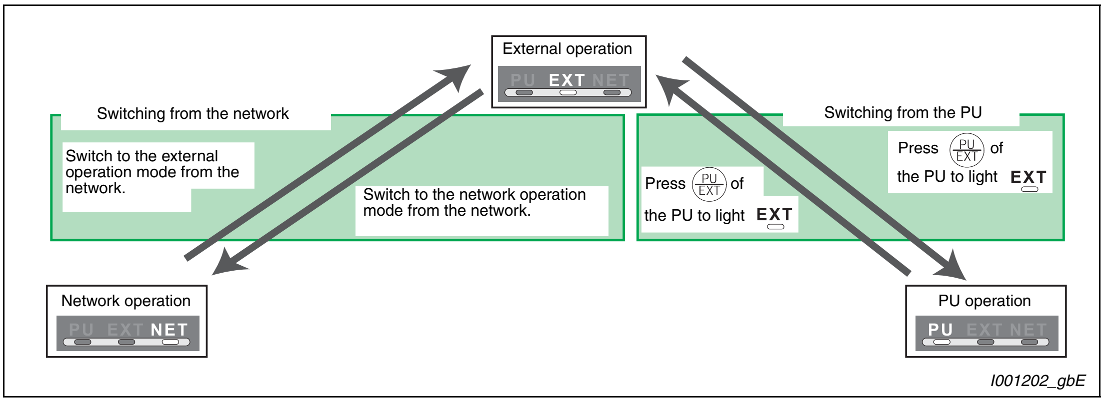


Fig. 6-126: *Switching the operation mode when Pr. 340 = 0, 1 or 2*

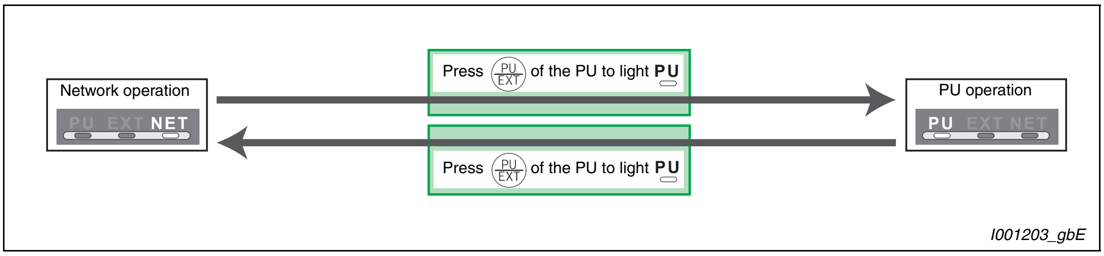


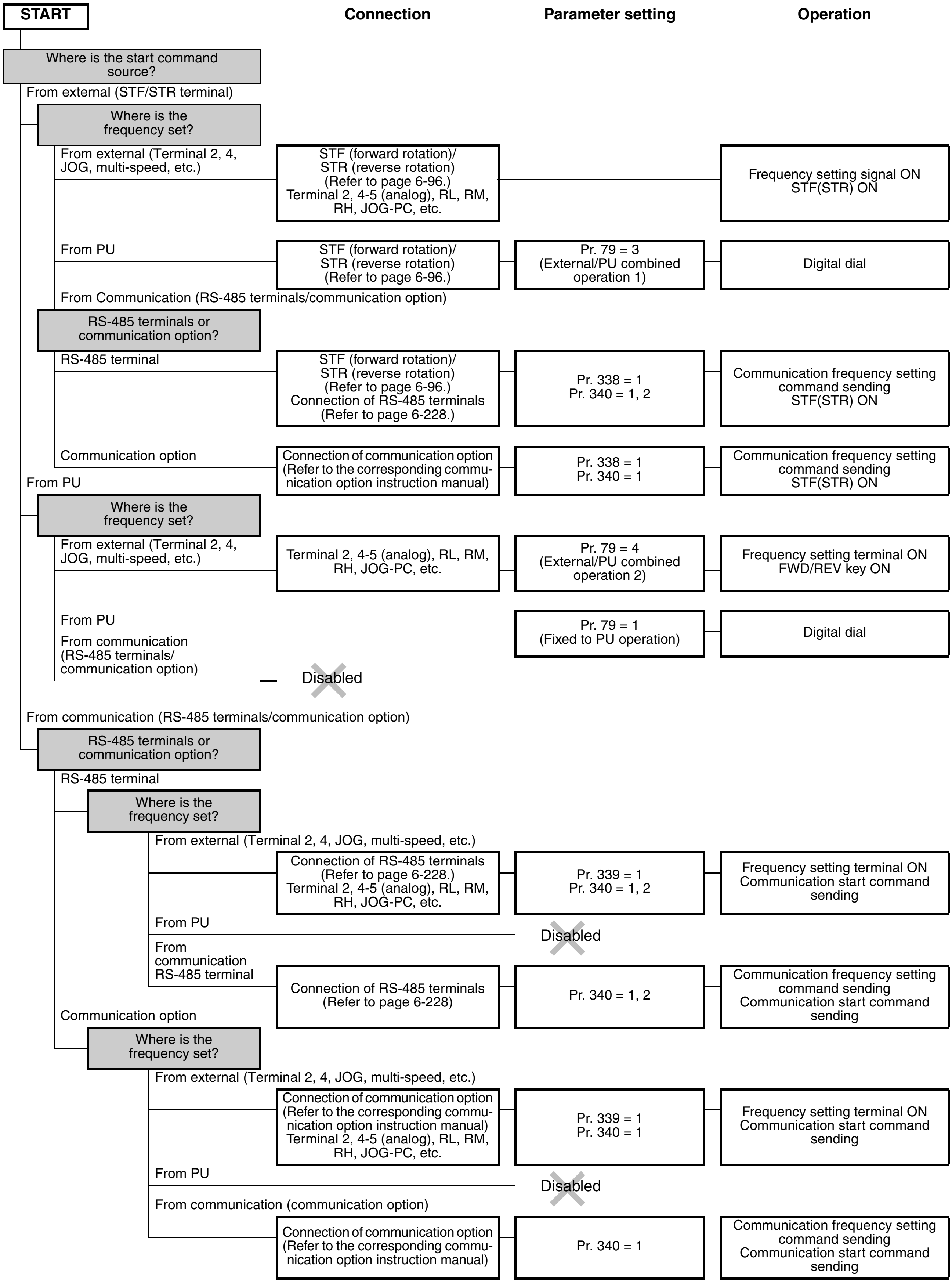
Fig. 6-127: *Switching the operation mode when Pr. 340 = 10 or 12*

NOTE

For switching of operation by external terminals, refer to the following:
- PU operation external interlock signal (X12 signal) (refer to page 6-211)
- PU-external operation switch-over signal (X16) (refer to page 6-212)
- PU-NET operation switchover signal (X65) (refer to page 6-213)
- External-NET operation switchover signal (X66) (refer to page 6-213)
- Pr. 340 "Communication start-up mode selection" (refer to page 6-215)

Operation mode selection flow

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



External operation mode (Pr. 79 = 0, 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 Tab. 6-1 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 section 6.17.2.)

If you don't need to change the parameter settings frequently you can set the unit to external mode permanently by setting Pr. 79 to "2". (If you need to change parameter settings frequently external mode should be activated by setting Pr. 79 to "0". Then the frequency inverter will switch to external mode automatically when the power is switched on but it can be switched to PU mode by pressing the PU/EXT key. You can then make the parameter changes in PU mode and switch back to external mode again afterwards by pressing PU/EXT again.)

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.

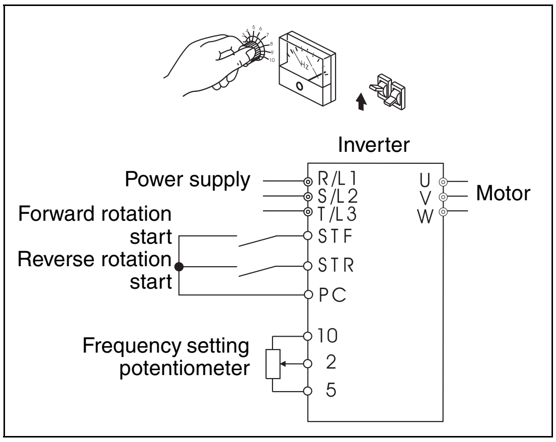


Fig. 6-128:
External operation mode

I001205E

PU operation mode (Pr. 79 = 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 section 6.21.2.)

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 (source logic) or 110 (sink logic)" in any of Pr. 190 to Pr. 196 "output terminal function selection".

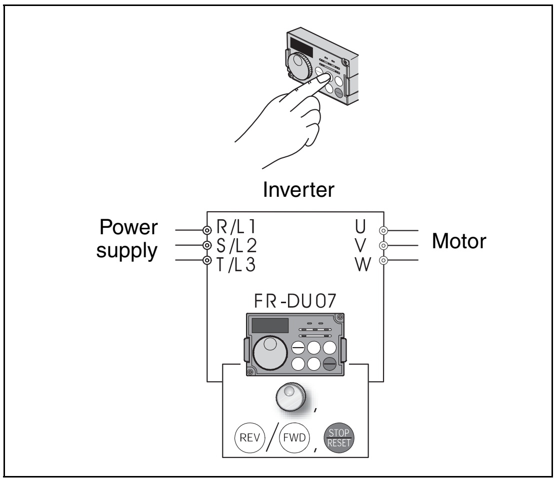


Fig. 6-129:
PU operation mode

I001206E

PU/external combined operation mode 1 (Pr. 79 = 3)

Select the PU/external combined operation mode 1 when making frequency setting from the operation panel FR-DU07 (digital dial) 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 by using the PU/EXT-key.

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.

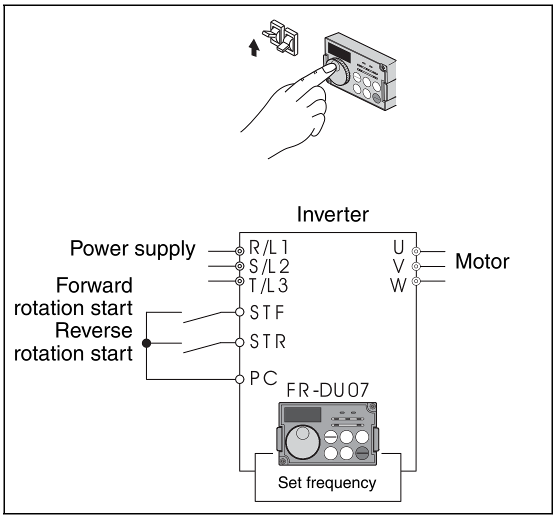


Fig. 6-130:
Combined operation mode 1

I001207E

PU/external combined operation mode 2 (Pr. 79 = 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 by using the PU/EXT-key.

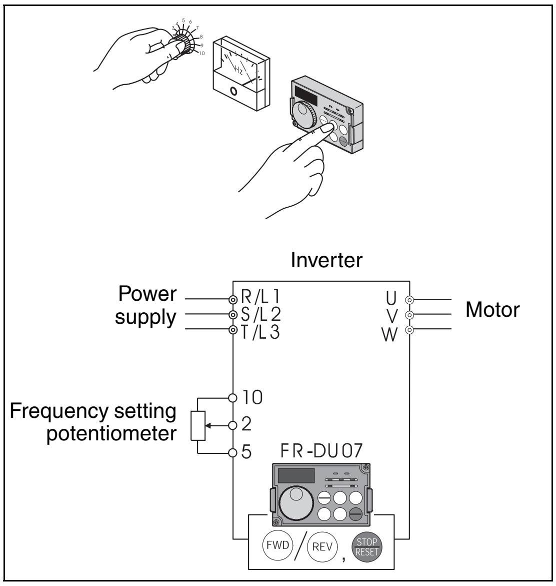


Fig. 6-131:
Combined operation mode 2

I001208E

Switch-over mode (Pr. 79 = 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.

Tab. 6-39: *Operation states in the switch-over mode*

WARNING:

When using switch-over mode please note that in some switch-over operations the rotation direction command and the frequency setting value are "transferred" to the "new" operating mode (refer to Tab. 6-39 for details). When this happens the drive will run in the new operating mode even though it has not (yet) received any control commands.
It is extremely important to take this into account and take the necessary steps to ensure that performing these switch-over operations cannot cause hazardous conditions.

PU operation interlock (Pr. 79 = 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" to any of Pr. 178 to Pr. 189 "Input terminal function selection" to assign the function. (Refer to section 6.9.1 for Pr. 178 to Pr. 189.) When the X12 signal has not been assigned, the function of the MRS signal switches from MRS (output stop) to the PU operation interlock signal.

X12 (MRS) Signal	Function/Operation	
	Operation mode	Parameter write
ON	Operation mode (external, PU, NET) switching enabled Output stop during external operation	Parameter write enabled (Pr. 77 "Parameter write selection", depending on the corresponding parameter write condition (Refer to Tab. 6-1 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

Tab. 6-40: *Function of the X12 signal*

Function/operation changed by switching on-off the X12 (MRS) signal

Operation 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 signalare entered, operation is performed in that status.	Disallowed
	Running	ON → OFF ①			Disallowed
External	During stop	OFF → ON	External ②	Stop	Enabled
		ON → OFF			Disallowed
	Running	OFF → ON		During operation → output stop	Disallowed
		ON → OFF		Output stop → During operation	Disallowed

Tab. 6-41: *Switching the X12 (MRS) signal*

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 the STOP/RESET key of the operation panel resets the inverter.

NOTES

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.

Switching of operation mode by external terminal (X16)

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" to any of Pr. 178 to Pr. 189 "Input terminal function selection" to assign the function.

Pr. 79		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.)

Tab. 6-42: *Operation mode switching by signal X16*

NOTES

The operation mode status changes depending on the setting of Pr. 340 "Communication start-up mode selection" and the ON/OFF states of the X65 and X66 signals. (For details, refer to page 6-213.)

The priorities of Pr. 79, Pr. 340 and signals are:
Pr. 79 > X12 > X66 > X65 > X16 > Pr. 340

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.

Switching of operation mode by external terminal (X65, X66)

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 start-up mode selection".

③ Set "65" to any of Pr. 178 to Pr. 189 to assign the PU-NET operation switching 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.

<table>
<tr><th rowspan="2">Pr. 340</th><th rowspan="2" colspan="2">Pr. 79</th><th colspan="2">X65 Signal State</th><th rowspan="2">Remarks</th></tr>
<tr><th>ON (PU)</th><th>OFF (NET)</th></tr>
<tr><td rowspan="7">10 / 12</td><td colspan="2">0
(initial setting)</td><td>PU
operation mode ①</td><td>PU
operation mode ②</td><td>Cannot be switched to external operation mode</td></tr>
<tr><td colspan="2">1</td><td colspan="2">PU operation mode</td><td>Fixed to PU operation mode</td></tr>
<tr><td colspan="2">2</td><td colspan="2">NET operation mode</td><td>Fixed to NET operation mode</td></tr>
<tr><td colspan="2">3 / 4</td><td colspan="2">External/PU combined operation mode</td><td>External/PU combined mode fixed</td></tr>
<tr><td colspan="2">6</td><td>PU
operation mode ①</td><td>NET
operation mode ②</td><td>Operation mode can be switched with operation continued
Cannot be switched to external operation mode</td></tr>
<tr><td rowspan="2">7</td><td>X12 (MRS) ON</td><td>PU
operation mode ①</td><td>NET
operation mode ②③</td><td>Output stop in external operation mode</td></tr>
<tr><td>X12 (MRS) OFF</td><td colspan="2">External operation mode</td><td>Forcibly switched to external operation mode</td></tr>
</table>

Tab. 6-43: *Operation mode switching by signal X65*

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 start-up mode selection".

③ Set "66" to any of Pr. 178 to Pr. 189 to assign the external-NET operation switching 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.

<table>
<tr><th rowspan="2">Pr. 340</th><th rowspan="2" colspan="2">Pr. 79</th><th colspan="2">X66-Signal</th><th rowspan="2">Remarks</th></tr>
<tr><th>ON (PU)</th><th>OFF (NET)</th></tr>
<tr><td rowspan="7">0 (initial value)/ 1 / 2</td><td colspan="2">0 (initial value)</td><td>NET operation mode ①</td><td>External operation mode ②</td><td></td></tr>
<tr><td colspan="2">1</td><td colspan="2">PU operation mode</td><td>Fixed to PU operation mode</td></tr>
<tr><td colspan="2">2</td><td>NET operation mode ①</td><td>External operation mode</td><td>Cannot be switched to PU operation mode</td></tr>
<tr><td colspan="2">3 / 4</td><td colspan="2">External/PU combined operation mode</td><td>External/PU combined mode fixed</td></tr>
<tr><td colspan="2">6</td><td>NET operation mode ①</td><td>External operation mode ②</td><td>Operation mode can be switched with operation continued</td></tr>
<tr><td rowspan="2">7</td><td>X12 (MRS) ON</td><td>NET operation mode ①</td><td>External operation mode ②</td><td>Output stop in external operation mode</td></tr>
<tr><td>X12 (MRS) OFF</td><td colspan="2">External operation mode</td><td>Forcibly switched to external operation mode</td></tr>
</table>

Tab. 6-44: *Operation mode switching by signal X66*

① 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.

② PU operation mode when the X16 signal is off. When the X65 signal has been assigned, the operation mode changes with the ON/OFF state of the X65 signal.

NOTES

The priorities of Pr. 79, Pr. 340 and signals are:
Pr. 79 > X12 > X66 > X65 > X16 > Pr. 340

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.

6.17.2 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 inverter RS-485 terminals or communication option.

Pr. No.	Name	Initial Value	Setting Range	Description
79	Operation mode selection	0	0–4/6/7	Select the operation mode. (Refer to page 6-206.)
340	Communication start-up mode selection ①	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.

Parameters referred to		Refer to Section
57	Restart coasting time	6.11.1
79	Operation mode selection	6.17.1

① The above parameter can be set when Pr. 160 "User group read selection" = 0. However, the parameter can be set whenever the communication option is connected. (Refer to section 6.16.4.) It can also be changed independently of the operation mode. The above parameter can be changed during a stop in any operation mode.

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	Pr. 79	Operation Mode at Power on, Power Restoration, Reset	Operation Mode Switching
0 (initial value)	0 (initial value)	External operation mode	Can be switched to external, PU or NET operation mode ②
	1	PU operation mode	Fixed to PU operation mode
	2	External operation mode	Can be switched to external or NET operation mode Switching to PU operation mode disabled
	3 / 4	External/PU combined operation mode	Operation mode switching disabled
	6	External operation mode	Can be switched to external, PU or NET operation mode with operation continued
	7	X12 (MRS) signal ON: External operation mode	Can be switched to external, PU or NET operation mode 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	Can be switched to PU or NET operation mode 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	Can be switched to PU or NET operation mode with operation continued ③
	7	External operation mode	Same as when Pr. 340 = 0

Tab. 6-45: *Operation mode of the inverter at power on*

① The Pr. 340 setting "2" or "12" is mainly used for communication operation using the inverter RS-485 terminals. When Pr. 57 "Restart coasting time" ≠ 9999 (selection of automatic restart after instantaneous power failure), the inverter will resume the same operation state which was in before after power has been restored from an instantaneous power failure.

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 the PU/EXT key of the operation panel (FR-DU07) and X65 signal.

6.17.3 Operation command source and speed command source during communication operation (Pr. 338, Pr. 339, Pr. 550, Pr. 551)

When the inverter 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.

Pr. No.	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 ①	9999	0	Communication option valid
			1	Inverter RS-485 terminal valid
			9999	Automatic recognition of the communication option Normally, the RS-485 terminals are valid. When the communication option is fitted, the communication option is valid.
551	PU mode operation command source selection ①	2	1	Select the inverter RS-485 terminals as the PU operation mode control source.
			2	Select the PU connector as the PU operation mode control source.

Parameters referred to		Refer to Section
28	Multi-speed input compensation selection	6.5.3
59	Remote function selection	6.5.4
79	Operation mode selection	6.17.1

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 section 6.16.4.) It can also be changed independently of the operation mode.

① Pr 550 and Pr. 551 are always write-enabled.

Select the control source of the network operation mode (Pr. 550)

Either the inverter 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.

NOTE

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.)

Select the control source of the PU operation mode (Pr. 551)

Either the PU connector or inverter RS-485 terminals can be specified as the source of control in the PU operation mode.

In the PU operation mode, set Pr. 551 to "1" when executing parameter write, start command or frequency setting through communication from the inverter RS-485 terminals.

NOTE

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	Pr. 551	Operation Mode of Control Source			Remarks
		PU connector	RS-485 terminals	Communication option	
0	1	—	PU operation mode ①	NET operation mode ②	
	2 (initial value)	PU operation mode	—	NET operation mode ②	
1	1	—	PU operation mode ①	—	Switching to NET operation mode disabled
	2 (initial value)	PU operation mode	NET operation mode	—	
9999 (initial value)	1	—	PU operation mode ①	NET operation mode ②	
	2 (initial value)	PU operation mode	—	NET operation mode ②	Communication option fitted
			NET operation mode	—	Communication option not fitted

Tab. 6-46: *Parameter 550 and 551 settings*

① The Modbs-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.

Controllability through communication

<table>
<tr><th rowspan="2">Oper-ation Loca-tion</th><th rowspan="2">Condition (Pr. 551)</th><th rowspan="2">Command</th><th colspan="6">Operation Mode</th></tr>
<tr><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 communica-tion 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 terminal)</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 inverter RS-485 terminals</td><td rowspan="6">1 (RS-485 terminal)</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>
</table>

Tab. 6-47: *Functions in the single operation modes (1)*

Oper-ation Loca-tion	Condition (Pr. 551)	Command	Operation Mode					
			PU operation	External operation	External/PU combined operation mode 1 (Pr. 79 = 3)	External/PU combined operation mode 2 (Pr. 79 = 4)	NET operation (when RS-485 terminals are used) ⑥	NET operation (when communica-tion option is used) ⑦
Control by communication from communication option	—	Run command (start, stop)	—	—	—	—	—	✔ ①
		Running frequency setting	—	—	—	—	—	✔ ①
		Monitor	✔	✔	✔	✔	✔	✔
		Parameter write	— ⑤	— ⑤	— ⑤	— ⑤	— ⑤	✔ ④
		Parameter read	✔	✔	✔	✔	✔	✔
		Inverter reset	—	—	—	—	—	✔ ②
Control circuit external terminals	—	Inverter reset	✔	✔	✔	✔	✔	
		Run command (start, stop)	—	✔	✔	—	— ①	
		Frequency setting	—	✔	—	✔	— ①	

Tab. 6-47: *Functions in the single operation modes (2)*

✔: enabled
—: not enabled
◇: some are enabled

① As set in Pr. 338 "Communication operation command source" and Pr. 339 "Communication speed command source".

② At occurrence of RS-485 communication error, the inverter cannot be reset from the computer.

③ Enabled only when stopped by the PU. At a PU stop, "PS" is displayed on the operation panel. As set in Pr. 75 "Reset selection/disconnected PU detection/PU stop selection". (Refer to section 6.16.1.)

④ Some parameters may be write-disabled according to the Pr. 77 "Parameter write selection" setting and operating status. (Refer to section 6.16.2.)

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 Tab. 6-1 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.

Operation at alarm occurrence

Alarm Definition	Condition (Pr. 551)	Operation Mode					
		PU operation	External operation	External/PU combined operation mode 1 (Pr. 79 = 3)	External/PU combined operation mode 2 (Pr. 79 = 4)	NET operation (when RS-485 terminals are used) ⑤	NET operation (when communication option is used) ⑥
Inverter fault	—	Stop					
PU disconnection of the PU connector	2 (PU connector)	Stop/continued ① ④					
	1 (RS-485 terminal)	Stop/continued ①					
Communication alarm of PU connector	2 (PU connector)	Stop/ continued ②	Continued		Stop/ continued ②	Continued	
	1 (RS-485 terminal)	Continued					
Communication alarm of inverter RS-485 terminals	1 (RS-485 terminal)	Stop/ continued ②	Continued		Stop/ continued ②	Continued	
	2 (PU connector)	Continued				Stop/ continued ②	Continued
Communication alarm of communication option	—	Continued				Stop/ continued ③	Continued

Tab. 6-48: *Operation at alarm occurrence*

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.PUE) 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 (inverter 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.

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 (inverter RS-485 terminals or communication option) are as listed below.

Operation Location Selection			Communication operation command source (Pr. 338)	0: NET			1: External			Remarks
			Communication speed command source (Pr.339)	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						

Tab. 6-49: *Writing operation and speed commands (1)*

Operation Location Selection				Communication operation command source (Pr. 338)	0: NET			1: External			Remarks
				Communication speed command source (Pr.339)	**0: NET**	**1: External**	**2: External**	**0: NET**	**1: External**	**2: External**	
Selective function	Pr. 178 to Pr. 189 setting	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	PTC thermistor input	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						
		70	X70	DC feeding operation permission	NET			External			
		71	X71	DC feeding cancel	NET			External			
		72	X72	PID integral value reset	NET	External		NET	External		

Tab. 6-49: *Writing operation and speed commands (2)*

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.

NOTE

The control source of communication is as set in Pr. 550 and Pr. 551.

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 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.	

Tab. 6-50: *Switching of command source by the signal X67*

NOTES

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.

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.

6.18 Communication operation and setting

Purpose	Parameters that must be set		Refer to Section
Communication operation from PU connector	Initial setting of computer link communication (PU connector)	Pr. 117–Pr. 124	6.18.3
Communication operation from RS-485 terminal	Initial setting of computer link communication (RS-485 terminal)	Pr. 331–Pr. 337, Pr. 341	
	Modbus-RTU communication specification	Pr. 331, Pr. 332, Pr. 334, Pr. 343, Pr. 549	6.18.6
Restrictions on parameter write through communication	Communication E²PROM write selection	Pr. 342	6.18.4

6.18.1 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.

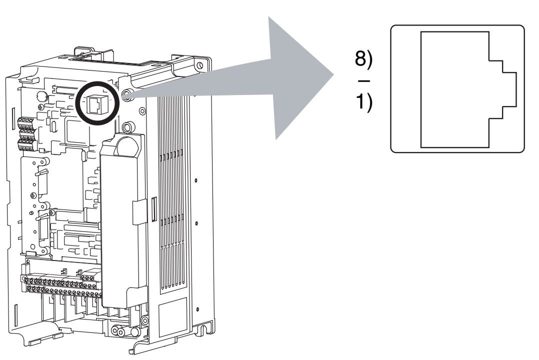


Fig. 6-132:
PU connector pin-outs

I001209E

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

Tab. 6-51: *PU connector (terminal description)*

NOTES

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.

PU connector communication system configuration and wiring

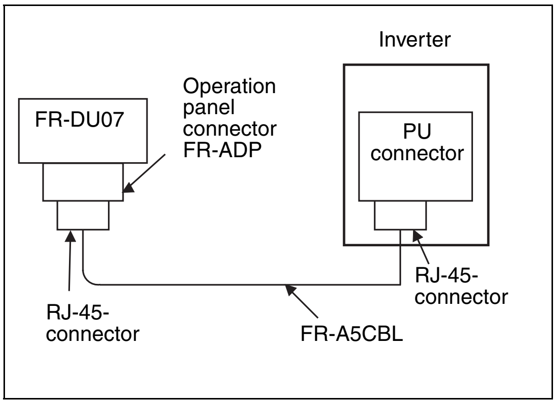


Fig. 6-133:
Connecting the PU to the PU connector

I001210E

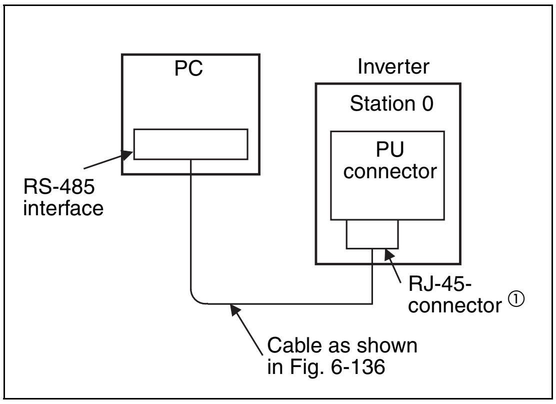


Fig. 6-134:
Connecting the RS-485 interface of a PC to the PU connector

I001211E

① Pins No. 2) and 8) provide power to the operation panel or parameter unit. Do not use these pins for RS-485 communication.

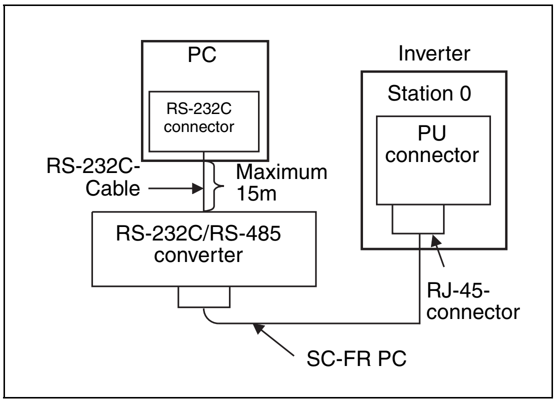


Fig. 6-135:
Connecting the RS-232C interface of a PC to the PU connector

I001212E

Connection with RS-485 computer

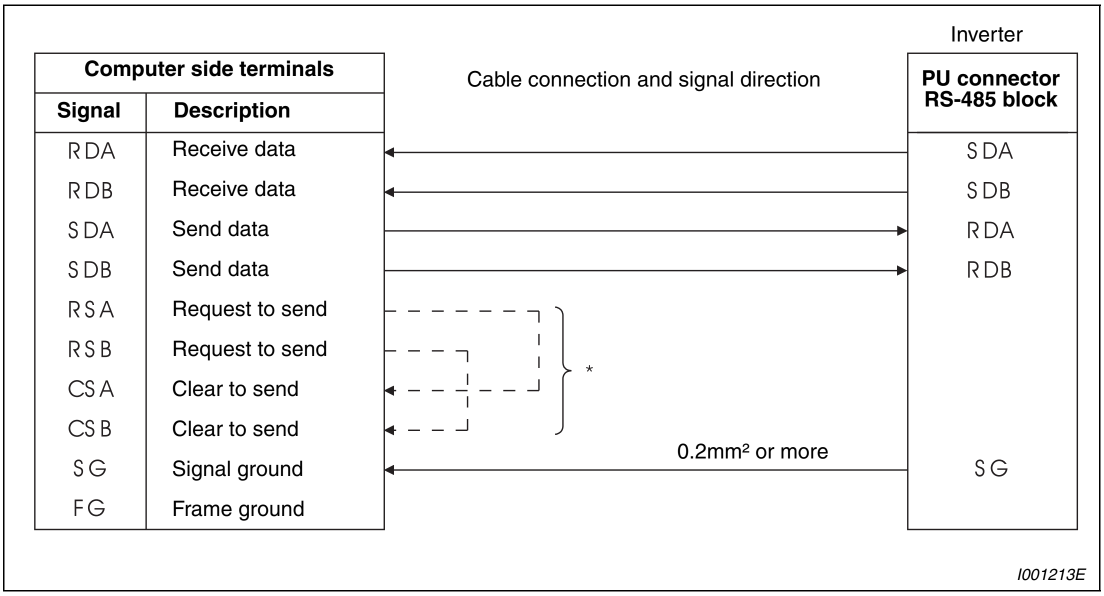


Fig. 6-136: *Connection to an inverter*

* 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.

NOTES

Use the SC-FR PC cable to connect the RS232C/RS485 converter to the RS232C port of the computer. Note that this cable can only be used for connection of a frequency inverter.

If you need to connect multiple frequency inverters to one another in series use the second serial interface (screw terminals).

6.18.2 RS-485 terminals

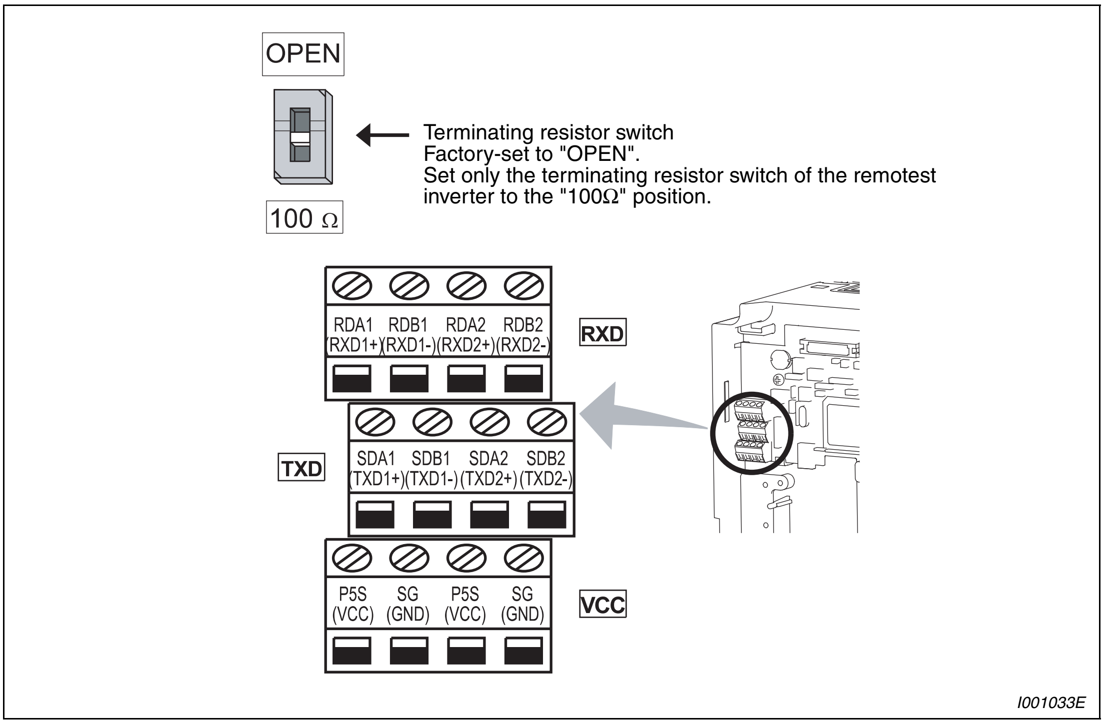


Fig. 6-137: *RS-485 terminals layout*

Name	Description
RDA1 (RXD1+)	Inverter receive+
RDB1 (RXD1–)	Inverter receive–
RDA2 (RXD2+)	Inverter receive+ (for connection of further stations)
RDB2 (RXD2–)	Inverter receive– (for connection of further stations)
SDA1 (TXD1+)	Inverter send+
SDB1 (TXD1–)	Inverter send–
SDA2 (TXD2+)	Inverter send+ (for connection of further stations)
SDB2 (TXD2–)	Inverter send– (for connection of further stations)
PS5 (VCC)	5V power supply, permissible load current: 100mA
SG (GND)	Earth (connected to terminal SD)

Tab. 6-52: *RS-485 terminal description*

Connection of RS-485 terminals and wires

① Strip about 5mm of the cable insulation. Twist the cable to prevent it from becoming loose. In addition, do not solder it. Use a bar terminal as necessary.

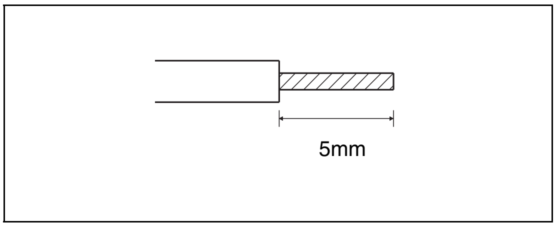


Fig. 6-138:
Preparing the cable

I001326E

② Loosen the terminal screw and insert the stripped cable into the terminal.

Item	Description
Screws size	M2
Tightening torque	0.22Nm–0.25Nm
Cable size	0.3mm²–0.75mm²
Screwdriver	Small flat-blade screwdriver Tip dimensions: 0.4mm × 2.5mm

Tab. 6-53: *Connection to the RS-485 terminals*

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

RS-485 terminal system configuration

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

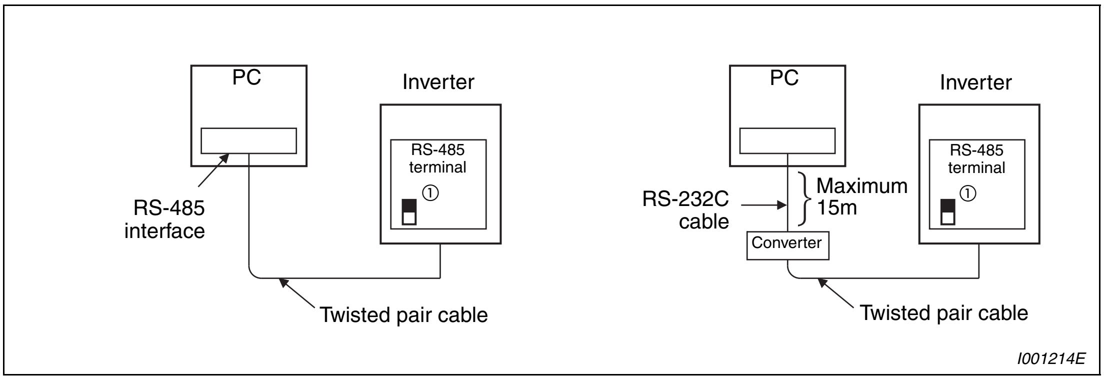


Fig. 6-139: *Connection of a computer to one inverter*

① Set the terminating resistor switch to the "100Ω" position.

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

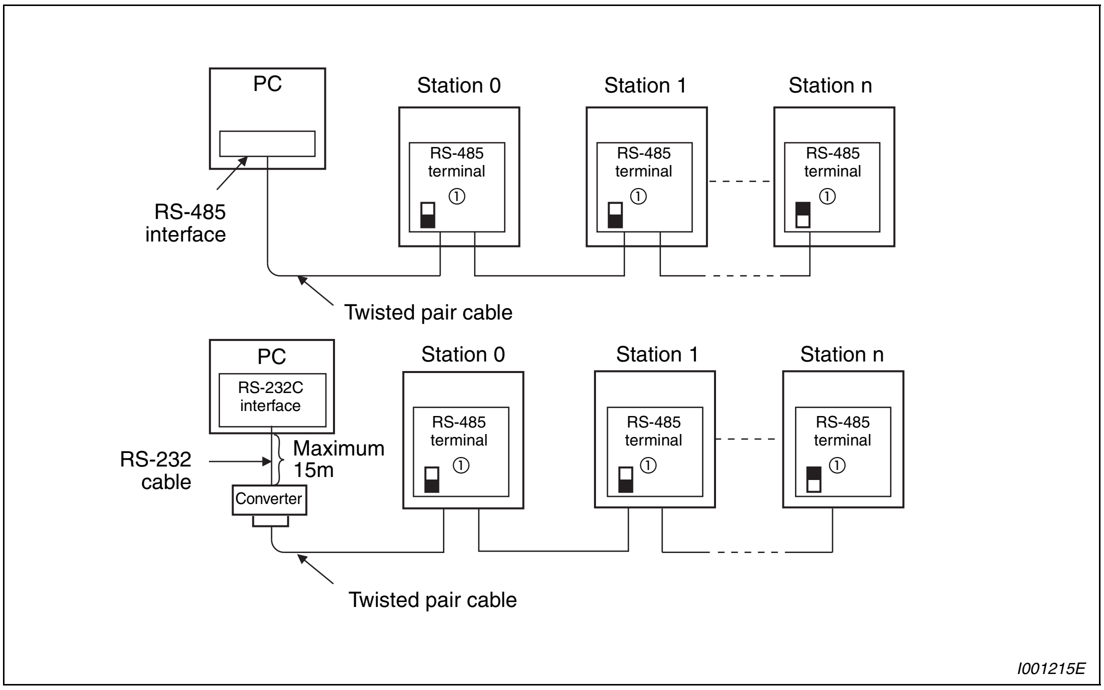


Fig. 6-140: *Connection of a computer to several inverters*

① Set only the terminating resistor switch of the remotest inverter to the "100Ω" position.

RS-485 terminal wiring method

- Wiring of one RS-485 computer and one inverter.

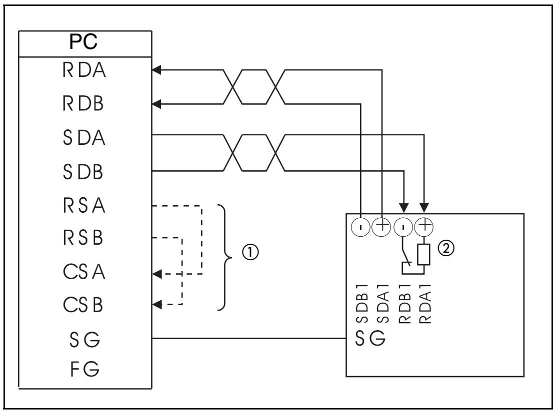


Fig. 6-141:
Connection to one inverter

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

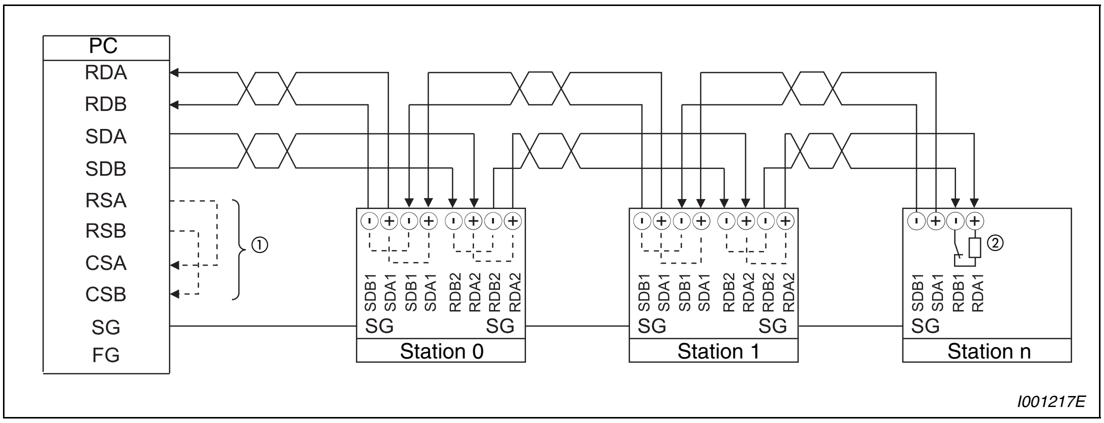


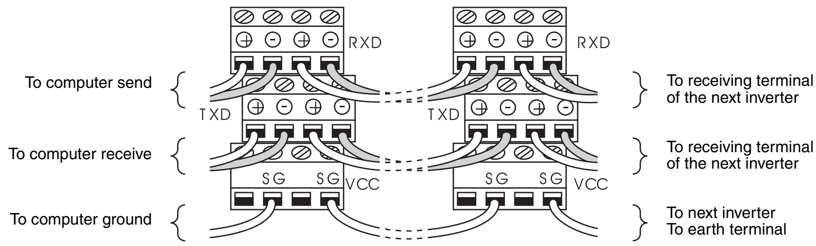
Fig. 6-142: *Connection to several inverter*

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

NOTE

For branching, connect the wires as shown below.



2-wire type connection

If the computer is 2-wire type, pass wires across reception terminals and transmission terminals of the RS-485 terminal to enable 2-wire type connection with the inverter.

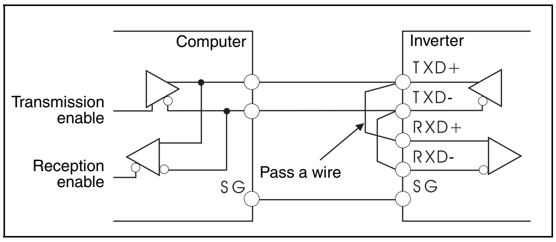


Fig. 6-143:
2-wire type connection

I001219E

NOTE Create a program 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.

6.18.3 Initial settings and specifications of RS-485 communication (Pr. 117 to Pr. 124, Pr. 331 to Pr. 337, Pr. 341, Pr. 549)

There are two basic types of communications between the inverter and personal computer:

- communication using the PU connector of the inverter
- 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

Pr. No.	Name	Initial Value	Setting Range	Description	
117	PU communication station number	0	0–31	Specify the inverter station number. Set the inverter station numbers when two or more inverters are connected to one personal computer.	
118	PU communication speed	192	48/96/ 192/384	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".	
119	PU communication stop bit length	1		**Stop bit length**	**Data length**
			0	1bit	8bit
			1	2bit	
			10	1bit	7bit
			11	2bit	
120	PU communication parity check	2	0	Without parity check	
			1	With odd parity check	
			2	With even parity check	
121	Number of PU communication retries	1	0–10	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.	
			9999	If a communication error occurs, the inverter will not come to an alarm stop.	
122	PU communication check time interval	9999	0	No PU connector communication	
			0.1–999.8s	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.	
			9999	No communication check	
123	PU communication waiting time setting	9999	0–150ms	Set the waiting time between data transmission to the inverter and response.	
			9999	Set with communication data.	
124	PU communication CR/LF presence/absence selection	1	0	Without CR/LF	
			1	With CR	
			2	With CR/LF	

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

RS-485 terminal communication related parameter

Pr. No.	Name	Initial Value	Setting Range	Description
331	RS-485 communication station	0	0–31 (0–247) 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	RS-485 communication stop bit length ②	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	RS-485 communication retry count ③	1	0–10/9999	Set the permissible number of retries at occurrence of a data receive error. (same specifications as Pr. 121)
336	RS-485 communication check time interval ③	0 s	0	RS-485 communication can be made, but the inverter will come to an alarm stop in the NET operation mode.
			0.1–999.8s	Set the interval of communication check time. (same specifications as Pr. 122)
			9999	No communication check
337	RS-485 communication waiting time setting ③	9999	0–150ms/ 9999	Set the waiting time between data transmission to the inverter and response. (same specifications as Pr. 123)
341	RS-485 communication CR/LF selection ③	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

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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 section 6.18.6.)

③ The Modbus-RTU protocol becomes invalid.

④ The Modbus-RTU protocol is valid for only communication from the RS-485 terminals.

NOTES

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 6-244.)

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.

6.18.4 Communication E²PROM 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.
When changing the parameter values frequently, set "1" in Pr. 342 to write them to the RAM. The life of the E²PROM will be shorter if parameter write is performed frequently with the setting unchanged from "0" (initial value) (E²PROM write).

Pr. No.	Name	Initial Value	Setting Range	Description
342	Communication E²PROM write selection	0	0	Parameter values written by communication are written to the E²PROM and RAM.
			1	Parameter values written by communication are written to the RAM.

Parameters referred to	Refer to Section
—	

The above parameter can be set when Pr. 160 "User group read selection" = 0. However, the parameter can be set whenever the communication option is connected. (Refer to section 6.16.4.)

NOTE

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 E²PROM previously.

6.18.5 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).

Communication specifications

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	1 bit	—
	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

Tab. 6-54: *Communication specifications*

Communication procedure

Data communication between the computer and inverter is made in the following procedure:

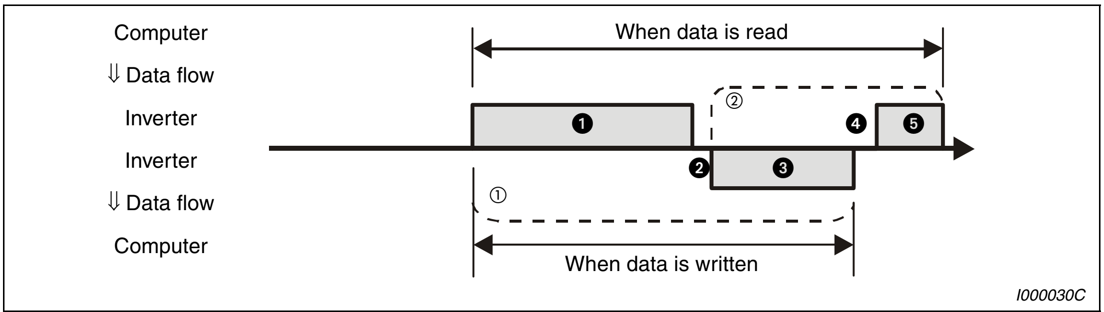


Fig. 6-144: *Schematic diagram of data exchange*

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 ❸" to the computer again. The inverter comes to an alarm stop if the number of consecutive data errors reaches or exceeds the parameter setting.

Communication operation presence/absence and data format types

Data communication between the computer and inverter is made in ASCII code (hexadecimal code). Data is automatically converted to ASCII format when it is exchanged between an external computer and the frequency inverter. In the following table the different data formats are referred to with the letters A – F. The corresponding formats are explained in the next section.

No.	Operation		Run Command	Running Frequency	Parameter Write	Inverter Reset	Monitor	Parameter Read
❶	Communication request is sent to the inverter in accordance with the user program in the computer.		A A’	A	A	A	B	B
❷	The inverter will not send data unless requested.		Present	Present	Present	Absent	Present	Present
❸	Reply data from the inverter (Data ❶) 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
❹	Computer processing delay time		Absent	Absent	Absent	Absent	Absent	Absent
❺	Answer from computer in response to reply data ❸ (Data ❸) is checked for error)	No error ① (No inverter processing)	Absent	Absent	Absent	Absent	Absent (C)	Absent (C)
		With error (Inverter re-outputs ❸)	Absent	Absent	Absent	Absent	F	F

Tab. 6-55: *Communication and data format*

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 6-241.)

② The inverter response to the inverter reset request can be selected. (Refer to page 6-247, Tab. 6-60.)

- 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				

- 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

- Reply data from the inverter to the computer 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						

- 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 (Refer to Tab. 6-56.)

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".

Data definitions

- 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)

Tab. 6-56: *Control codes*

- Inverter station number
  Specify the station number of the inverter which communicates with the computer.
  The inverter station numbers are specified between H00 and H1F (stations 0 to 31) in hexadecimal.

- 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 the appendix.)

- 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 the appendix.)

- 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).

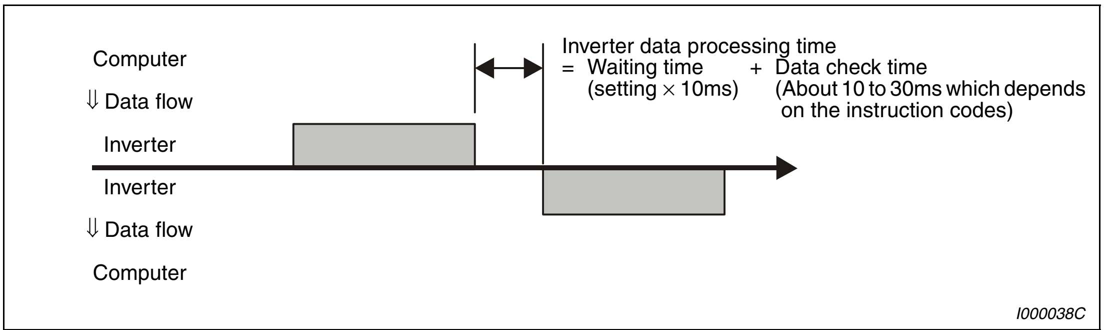


Fig. 6-145: *Specifying the waiting time*

NOTES

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 6-242.)

- 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.

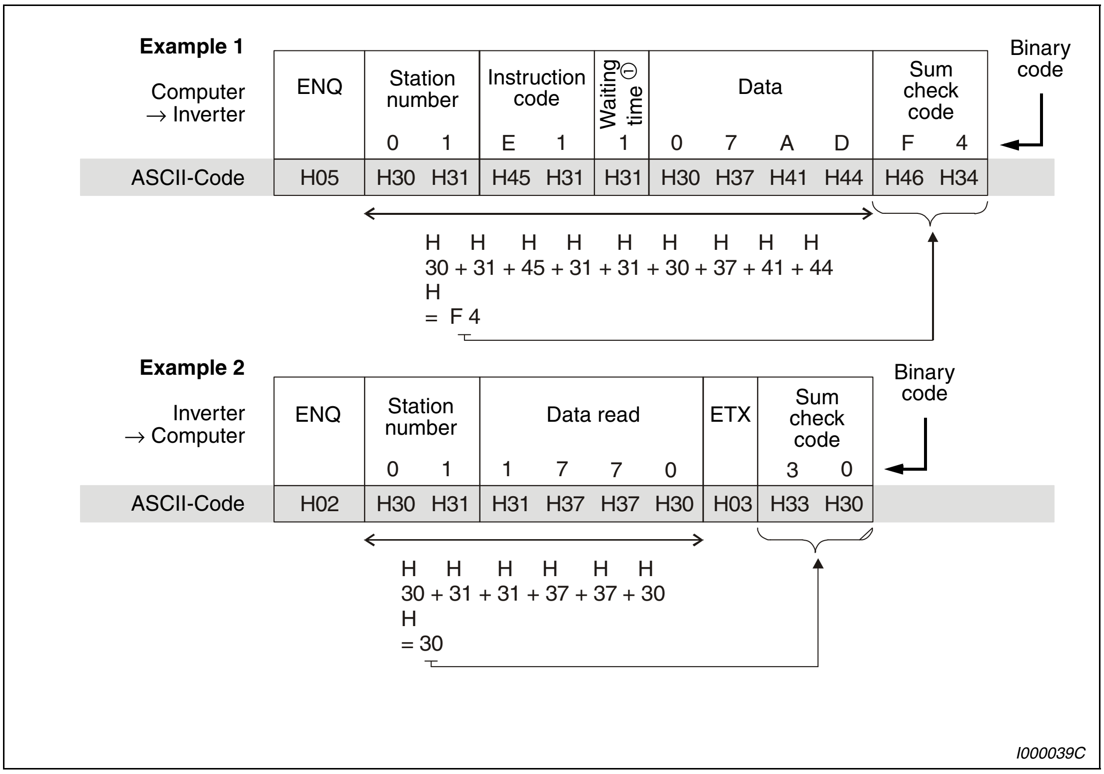


Fig. 6-146: *Sum check code (examples)*

① 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.)

- 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	—	—	—

Tab. 6-57: *Error codes*

- Response time

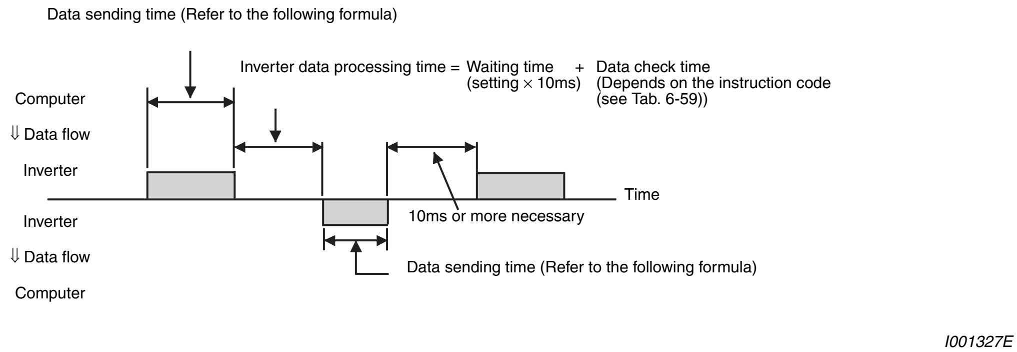


Fig. 6-147: *Response time*

Formula for data sending time:

$$\text{Data sending time [s]} = \frac{1}{\text{Communication speed (Baudrate)}} \times \text{Number of data characters (refer to page 6-238)} \times \text{Communications specifications (total number of bits)}^{①}$$

① The communication specifications are listed in the table below:

Name		Number of Bits
Stop bit length		1 bit
		2 bits
Data length		7 bit
		8 bits
Parity check	Yes	1 bit
	No	0 bits

Tab. 6-58: *Communication specifications*

NOTES

In addition to the above, 1 start bit is necessary.

Minimum number of total bits: 9 bits. Maximum number of total bits: 12 bits.

The data check time related to different functions is shown in the table below:

Function	Data Check Time
Various monitors, run command, frequency setting (RAM)	< 12ms
Parameter read/write, frequency setting (E^2PROM)	< 30ms
Parameter clear/all clear	< 5s
Reset command	— (no answer)

Tab. 6-59: *Data check time*

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

Set the permissible number of retries at occurrence of a data receive error.(Refer to page 6-241 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 (source logic) or 198 (sink logic)" in any of Pr. 190 to Pr. 196 "Output terminal function selection".

Example ▽

PU connector communication with different settings of parameter 121

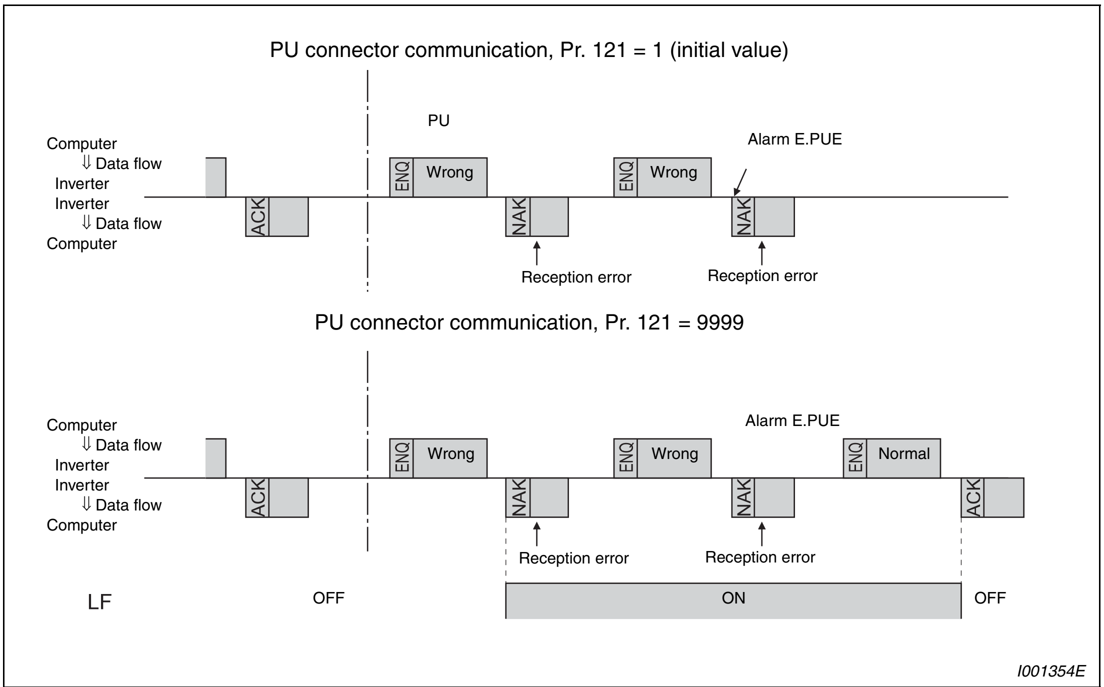


Fig. 6-148: *Data transmission error*

△

Open cable detection (Pr. 122, Pr. 336)

If disconnection (communication stop) is detected between the inverter and computer as a result of disconnection check, a communication error (PU connector communication: E.PUE, RS-485 terminal communication: E.SER) occurs and the inverter output is shut off.

Disconnection check is made when the setting is any of "0.1s" to "999.8s". To make disconnection check, it is necessary to send data (control code refer to page 6-239) 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 = 0,1–999.8s

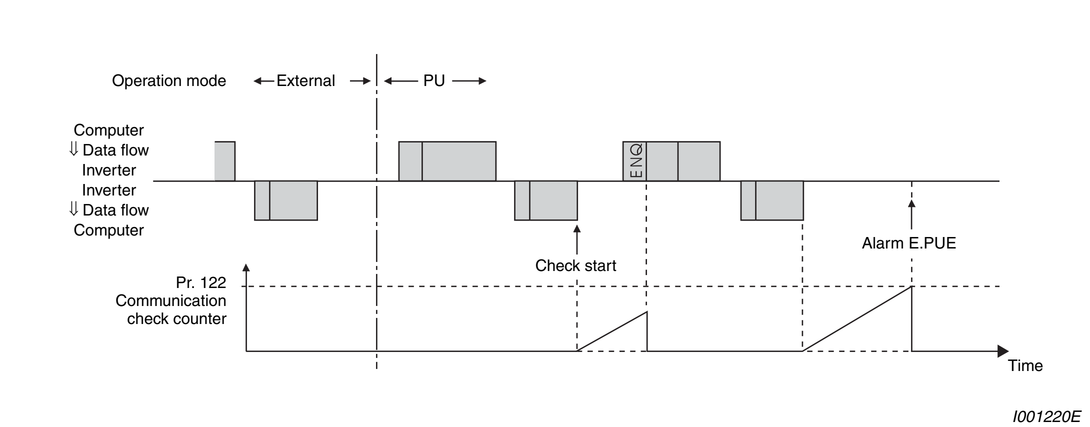


Fig. 6-149: *Open cable detection*

△

Instructions for the program

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.

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.

Program example
To change the operation mode to computer link operation:

Line number		
10	OPEN"COM1: 9600,E,8,2,HD"AS#1	**Initial setting of I/O file** 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$, I, 1)	
90	A=ASC(A$)	**Sum code calculation**
100	S=S+A	
110	NEXT I	
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	
1020	PRINT"RECEIVE DATA"	
1030	PRINT INPUT$(LOC(1), #1)	
1040	RETURN	

Fig. 6-150: *Program example*

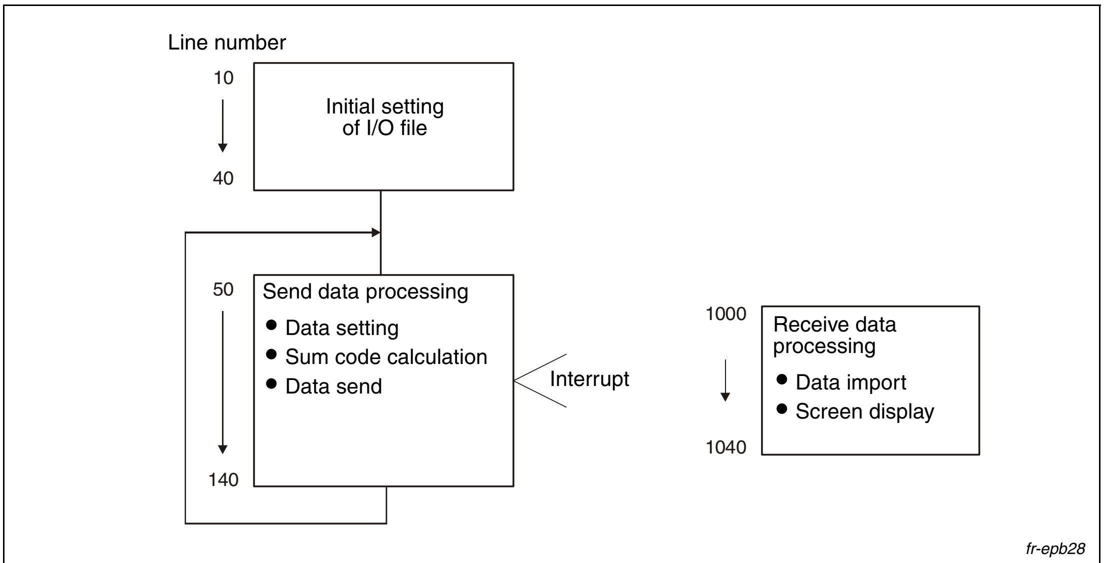


Fig. 6-151: *General flow*

NOTES

Always set the communication check time interval before starting operation to prevent hazardous conditions.

Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to 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 cable breakage, computer fault etc., the inverter does not detect such a fault. This should be fully noted.

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	H000: Network operation H0001: External operation H0002: PU operation (RS-485 communication operation via PU connector)	4 (B, E/D)
			Write	HFB		4 (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 (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 (B, E/D)
		Output voltage	Read	H71	H0000 to HFFFF: Output voltage (hexadecimal) in 0.1V increments	4 (B, E/D)
		Special monitor	Read	H72	H0000 to HFFFF: Monitor data selected in instruction code HF3	4 (B, E/D)
		Special monitor selection No.	Read	H73	H01 to H36: Monitor selection data (Refer to Tab. 6-62 on page 6-250.)	2 (B, E'/D)
			Write	HF3		2 (A', C/D)
		Alarm definition	Read	H74 to H77	H0000 to HFFFF: 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 (Refer to Tab. 6-63 on page 6-250.)	4 (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 6-251 for details.)	4 (A, C/D)
	Run command		Write	HFA		2 (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 6-251 for details.)	4 (B, E/D)
	Inverter status monitor		Read	H7A		2 (B, E'/D)

Tab. 6-60: *Setting of the instruction codes and data (1)*

<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 rowspan="4">5</td><td>Set frequency (RAM)</td><td rowspan="2">Read</td><td>H6D</td><td rowspan="2">Read the set frequency/speed from the RAM or E²PROM.
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)</td><td rowspan="2">4
(B, E/D)</td></tr>
<tr><td>Set frequency (E²PROM)</td><td>H6E</td></tr>
<tr><td>Set frequency (RAM)</td><td rowspan="2">Write</td><td>HED</td><td rowspan="2">Write the set frequency/speed into the RAM or E²PROM.
H0000 to H9C40 (0 to 400.00Hz): frequency in 0.01Hz increments
H0000 to H270E (0 to 9998): speed in 1r/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)</td><td rowspan="2">4
(A, C/D)</td></tr>
<tr><td>Set frequency (RAM, E²PROM)</td><td>HEE</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Inverter reset</td><td rowspan="2">Write</td><td rowspan="2">HFD</td><td>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.</td><td>4
(A, C/D)</td></tr>
<tr><td>H9966: Resets the inverter.
When data is sent normally, ACK is returned to the computer and then the inverter is reset.</td><td>4
(A, D)</td></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
(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</th><th>Comm.-Param. ①</th><th>Calibration ②</th><th>Other Param. 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 these parameters again.
①Refer to page 6-233 and 6-234.
②Refer to page 6-181.
③Pr. 73 is not cleared.</td><td>4
(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 of the parameter list (appendix) 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
(B, E/D)</td></tr>
<tr><td>10</td><td>Write</td><td>H80 to HE3</td><td>4
(A, C/D)</td></tr>
</table>

Tab. 6-60: *Setting of the instruction codes and data (2)*

No.	Item	Read/ write	Instruction Code	Data Description	Number of Data Digits (Format)
11	Link parameter extended setting	Read	H7F	parameter description is changed according to the H00 to H09 setting. For details of the setting, refer to the instruction code of the parameter list (appendix).	2 (B.E'/D)
		Write	HFF		2 (A', C/D)
12	Second parameter changing (instruction code HFF = 1)	Read	H6C	When setting the bias/gain (instruction codes H5E to H61, HDE to HE1) parameters: H00: Frequency ① H01: Parameter-set analog value (%) H02: Analog value input from terminal ①The gain frequency can also be written using Pr. 125 (instruction code H99) or Pr. 126 (instruction code H9A).	2 (B.E'/D)
		Write	HEC		2 (A', C/D)

Tab. 6-60: *Setting of the instruction codes and data (3)*

NOTES

Refer to page 6-238 for data formats A, A', B, B', C and D.

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" to the extended link parameter.
②	ENQ 00 EC 0 01 7E	ACK 00	Set "H01" to second parameter changing.
③	ENQ 00 5E 0 0F	STX 00 0000 ETX 25	C3 (Pr. 902) is read. 0% is read.
④	ENQ 00 60 0 FB	STX 00 0000 ETX 25	C6 (Pr. 904) is read. 0% is read.

Tab. 6-61: *Example for data transmission*

To read/write C3 (Pr. 902) and C6 (Pr. 904) after inverter reset or parameter clear, execute from step ① again.

△

- Special monitor selection No.
  Refer to section 6.10.2 for details of the monitor description.

Data	Description	Unit	Data	Description	Unit
H01	Output frequency/speed	0.01Hz/1 ④	H0F	Input terminal status ①	—
H02	Output current	0.01A/ 0.1A ③	H10	Output terminal status ②	—
H03	Output voltage	0.1V	H11	Load meter	0.1%
H05	Frequency setting value/ speed setting	0.01Hz/1 ④	H14	Cumulative energizing time	1h
H06	Running speed	1r/min	H17	Actual operation time	1h
H08	Converter output voltage	0.1V	H18	Motor load factor	0.1%
H09	Regenerative brake duty	0.1%	H19	Cumulative power	1kWh
H0A	Electronic thermal relay function load factor	0.1%	H32	Power saving effect	Variable
H0B	Output current peak value	0.01A/ 0.1A ③	H33	Cumulative saving power	Variable
H0C	Converter output voltage peak value	0.1V	H34	PID set point	0.1%
H0D	Input power	0.01kW/ 0.1kW ③	H35	PID measurement value	0.1%
H0E	Output power	0.01kW/ 0.1kW ③	H36	PID deviation value	0.1%

Tab. 6-62: *Special monitor selection No.*

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)

④ When Pr. 37 = "1 to 9998" or Pr. 144 = "2 to 10, 102 to 110," the unit is an integral value (one increment). (Refer to page 6-122).

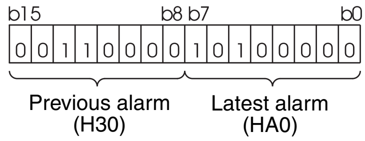
- Alarm data
  Refer to section 7.1 for details of alarm description.

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	HE6	PID
H30	THT	HA1	OP1	HF1	E.1
H31	THM	HB0	PE	HF5	E.5
H40	FIN	HB1	PUE	HF6	E.6
H50	IPF	HB2	RET	HF7	E.7
H51	UVT	HB3	PE2	HFD	E.13
H52	ILF	HC0	CPU		

Tab. 6-63: *Alarm data*

Example ▽ Alarm description display example (instruction code: H74)

For read data = H30A0
previous alarm .... THT
latest alarm .... OPT



I001222E

Fig. 6-152: *Alarm example*

△

● Run command

Item	Instruction Code	Bits	Description	Example
Run command	HFA	8	b0: AU (current input selection) ① b1: Forward rotation start b2: Reverse rotation start b3: RL (low speed) ① b4: RM (middle speed) ① b5: RH (high speed) 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	16	b0: AU (current input selection) ① b1: Forward rotation start b2: Reverse rotation start b3: RL (low speed) ① b4: RM (middle speed) ① b5: RH (high speed) ① b6: RT (second function selection) ① b7: MRS (output stop) ① b8: JOG (Jog operation) ② b9: CS (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

Tab. 6-64: *Run commands*

① The signal within parentheses is the initial setting. The description changes depending on the setting of Pr. 180 to Pr. 184 and Pr. 187 "Input terminal function selection". (Refer to section 6.9.1.)

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" (section 6.9.1). (Reset can be executed with the instruction code HFD.)

- Inverter status monitor

Item	Instruction Code	Bits	Description	Example
Inverter status monitor	H7A	8	b0: RUN (inverter running) ① b1: Forward rotation b2: Reverse rotation b3: SU (up to frequency) ① b4: OL (overload) ① b5: IPF (instantaneous power failure) ① b6: FU (frequency detection) ① b7: ABC1 (alarm) ①	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	16	b0: RUN (inverter running) ① b1: Forward rotation b2: Reverse rotation b3: SU (up to frequency) ① b4: OL (overload) ① b5: IPF (instantaneous power failure) ① b6: FU (frequency detection) ① b7: ABC1 (alarm) ① b8: ABC2 (—) ① 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

Tab. 6-65: *Monitoring the inverter status*

① 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". (Refer to section 6.9.5.)

6.18.6 Modbus-RTU communication (Pr. 331, Pr. 332, Pr. 334, Pr. 343, Pr. 539, Pr. 549)

Using the Modbus-RTU communication protocol, communication operation or parameter setting can be performed from the RS-485 terminals of the inverter.

Pr. No.	Name	Initial Value	Setting Range	Description
331	RS-485 communication station number	0	0	Broadcast communication is selected
			1–247	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	1	0/1/2	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 trip in the NET operation mode.
			0.1–999.8s	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

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

NOTES

When Modbus RTU communication is performed with "0" (initial value) set in Pr. 331 "RS-485 communication station number",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 6-256.)

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 section 6.17.3.)

Communication specifications

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	1 bit	—
	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	—	—
Waiting time setting		—	—

Tab. 6-66: *Communication specifications*

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.

NOTE

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 two hexadecimal coded characters are transmitted in one byte (8 bit) data. Only the communication protocol is defined by the Modbus protocol, and the physical layer is not stipulated.

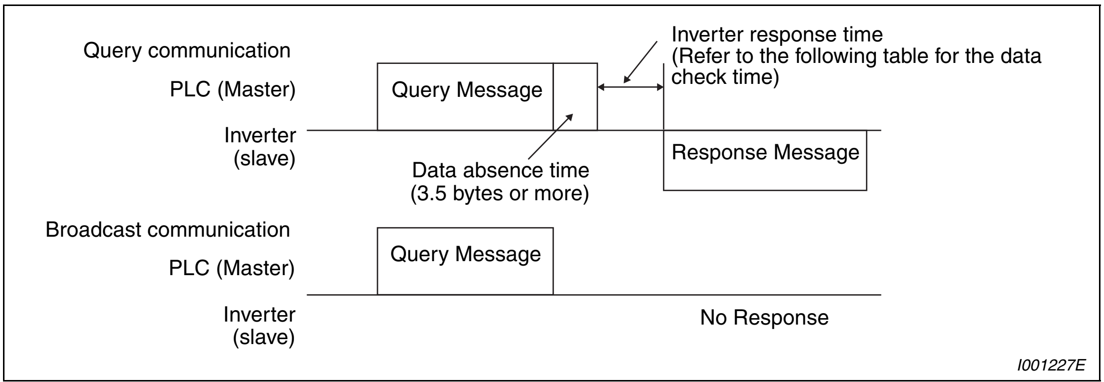


Fig. 6-153: *Message format*

The data check time related to different functions is shown in the table below:

Item	Check Time
Various monitors, operation command, frequency setting (RAM)	< 12ms
Parameter read/write, frequency setting (E^2PROM)	< 30ms
Parameter clear/all clear	< 5s
Reset command	—

Tab. 6-67: *Data check time*

- Query
  The master sends a message to the slave (= inverter) at the specified address.
- Normal
  Response after receiving the query from the master, the slave executes the requested function and returns the corresponding normal response to the master.
- 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.
- 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.

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.

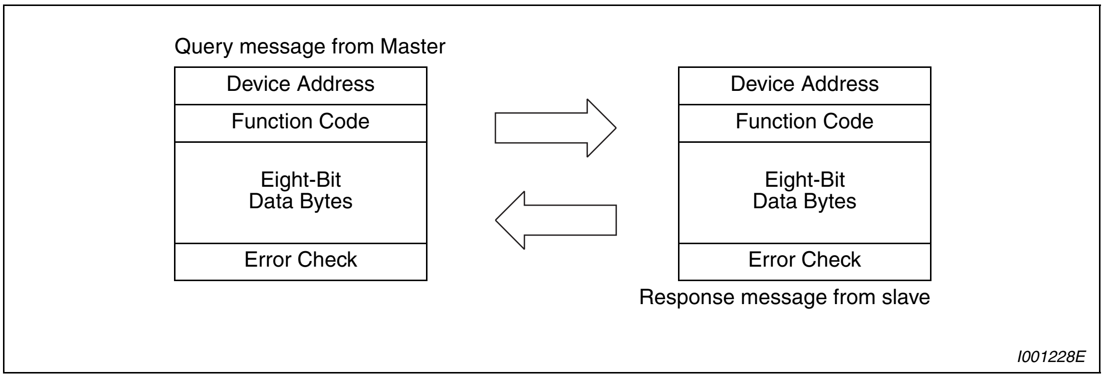


Fig. 6-154: *Data transmission*

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

Start	❶ Address	❷ Function	❸ Data	❹ CRC Check		End
T1	8 bits	8 bits	n × 8 bits	L 8 bits	H 8 bits	T1

<table>
<tr><th colspan="2">Message Field</th><th>Description</th></tr>
<tr><td>❶</td><td>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" is the slave address.</td></tr>
<tr><td>❷</td><td>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></td></tr>
<tr><td>❸</td><td>Data field</td><td>The format changes depending on the function code (refer to page 6-257). Data includes the byte count, number of bytes, description of access to the holding register, etc.</td></tr>
<tr><td>❹</td><td>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>

Tab. 6-68: *Protocol details*

Message format types

The message formats corresponding to the function codes in Tab. 6-68 will be explained.

- Read holding register data (H03 or 03)
  Can read the description of system environment variables, real-time monitor, alarm history, and inverter parameters assigned to the holding register area. (Refer to the register list on page 6-264.)

Query Message

❶ Slave Address	❷ Function	❸ Starting Address		❹ No. of Points		CRC Check	
(8 bits)	H03 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Response message

❶ Slave Address	❷ Function	❺ Byte Count	❻ Data			CRC Check	
(8 bits)	H03 (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... n × 16 bits	L (8 bits)	H (8 bits)

Message		Description
❶	Slave Address	Set the address to which the message will be sent. Broadcast communication cannot be made (0 is invalid)
❷	Function	Set H03.
❸	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.
❹	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.

Tab. 6-69: *Description of the query message*

Message		Description
❺	Byte Count	The setting range is H02 to H14 (2 to 20). Twice greater than the No. of Points specified at ❹ is set.
❻	Data	The number of data specified at ❹ 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, ...

Tab. 6-70: *Description of normal response*

Example ▽

To read the register values of 41004 (Pr. 4) to 41006 (Pr. 6) from the slave address 17 (H11).

Query message

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H11 (8 bits)	H03 (8 bits)	H03 (8 bits)	HEB (8 bits)	H00 (8 bits)	H03 (8 bits)	H77 (8 bits)	H2B (8 bits)

Normal response (Response message)

Slave Address	Function	Byte Count	Data						CRC Check	
H11 (8 Bits)	H03 (8 Bits)	H06 (8 Bits)	H17 (8 Bits)	H70 (8 Bits)	H0B (8 Bits)	HB8 (8 Bits)	H03 (8 Bits)	HE8 (8 Bits)	H2C (8 Bits)	HE6 (8 Bits)

Read value:
Register 41004 (Pr. 4): H1770 (60.00Hz)
Register 41005 (Pr. 5): H0BB8 (30.00Hz)
Register 41006 (Pr. 6): H03E8 (10.00Hz)

△

- Write multiple holding register data (H06 or 06)
  You can write the description of system environment variables and inverter parameters assigned to the holding register area. (Refer to the register list on page 6-264.)

Query message

❶ Slave Address	❷ Function	❸ Register Address		❹ Preset Data		CRC Check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

❶ Slave Address	❷ Function	❸ Register Address		❹ Preset Data		CRC Check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Message		Description
❶	Slave Address	Set the address to which the message will be sent. Setting of address 0 enables broadcast communication.
❷	Function	Set H06.
❸	Register Address	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.
❹	Preset Data	Set the data that will be written to the holding register. The written data is fixed to 2 bytes.

Tab. 6-71: *Description of the query message*

The normal response data ❶ to ❹ (including CRC check) of the normal response are the same as those of the query message. No response is made for broadcast communication.

Example ▽

To write 60Hz (H1770) to 40014 (running frequency RAM) at slave address 5 (H05).

Query message

Slave Address	Function	Register Address		Preset Data		CRC Check	
H05 (8 bits)	H06 (8 bits)	H00 (8 bits)	H0D (8 bits)	H17 (8 bits)	H70 (8 bits)	H17 (8 bits)	H99 (8 bits)

Normal Response (Response message):
Same data as the query message.

△

NOTE

For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the inverter processing time has elapsed after the previous query.

- Function diagnosis (H08 or 08)
  A communication check can be made since the query message sent is returned unchanged as a response message (function of subfunction code H00). Subfunction code H00 (Return Query Data).

Query message

❶ Slave Address	❷ Function	❸ Subfunction		❹ Data		CRC Check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

❶ Slave Address	❷ Function	❸ Subfunction		❹ Data		CRC Check	
(8 bits)	H08 (8 bits)	H00 (8 bits)	H00 (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Message		Description
❶	Slave Address	Set the address to which the message will be sent. Broadcast communication cannot be made (0 is invalid)
❷	Function	Set H08.
❸	Subfunction	Set H0000.
❹	Data	Any data can be set if it is 2 bytes long. The setting range is H0000 to HFFFF.

Tab. 6-72: *Description of the query message*

The normal response data ❶ to ❹ (including CRC check) of the normal response are the same as those of the query message.

NOTE

For broadcast communication, no response is returned in reply to a query. Therefore, the next query must be made when the inverter processing time has elapsed after the previous query.

- Write multiple holding register data (H10 or 16)
  You can write data to multiple holding registers.

Query message

❶ Slave Address	❷ Function	❸ Starting Address		❹ No. of Registers		❺ Byte Count	❻ Data			CRC Check	
(8 Bits)	H10 (8 Bits)	H (8 Bits)	L (8 Bits)	H (8 Bits)	L (8 Bits)	L (8 Bits)	H (8 Bits)	L (8 Bits)	... n × 2 × 8 Bits	L (8 Bits)	H (8 Bits)

Normal response (Response message)

❶ Slave Address	❷ Function	❸ Starting Address		❹ No. of Registers		CRC Check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Message		Description
❶	Slave Address	Set the address to which the message will be sent. Setting of address 0 enables broadcast communication.
❷	Function	Set H10.
❸	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.
❹	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.
❺	Byte Count	The setting range is H02 to HFA (0 to 250). Set twice greater than the value specified at ❹.
❻	Data	Set the data specified by the number specified at ❹. 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 ...

Tab. 6-73: *Description of the query message*

The normal response data ❶ to ❹ (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 Registers		Byte Count	Data				CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H04 (8 bits)	H00 (8 bits)	H05 (8 bits)	H00 (8 bits)	H0A (8 bits)	H86 (8 bits)	H3D (8 bits)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Registers		Byte Count	CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H04 (8 bits)	H22 (8 bits)	H61 (8 bits)

△

- Read holding register access log (H46 or 70)
  A response can be made to a query made by the function code H03, 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

❶ Slave Address	❷ Function	CRC Check	
(8 bits)	H46 (8 bits)	L (8 bits)	H (8 bits)

Normal response (Response message)

❶ Slave Address	❷ Function	❸ Starting Address		❹ No. of Points		CRC Check	
(8 bits)	H46 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

Message		Description
❶	Slave Address	Set the address to which the message will be sent. Broadcast communication cannot be made (0 is invalid)
❷	Function	Set H46.

Tab. 6-74: *Description of the query message*

Message		Description
❸	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.
❹	No. of Points	The number of holding registers that succeeded in access is returned.

Tab. 6-75: *Description of normal response*

Example ▽

To read the successful register starting address and successful count from the slave address 25 (H19).

Query message

Slave Address	Function	CRC Check	
H19 (8 bits)	H46 (8 bits)	H8B (8 bits)	HD2 (8 bits)

Normal response (Response message)

Slave Address	Function	Starting Address		No. of Points		CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H22 (8 bits)	H61 (8 bits)

Success of two registers at starting address 41007 (Pr. 7) is returned.

△

- **Error response**
  An error response is returned if the query message received from the master has an illegal function, address or data. No response is returned for a parity, CRC, overrun, framing or busy error.

NOTE No response message is sent in the case of broadcast communication also.

Error response (Response message)

❶ Slave Address	❷ Function	❸ Exception Code	CRC Check	
(8 bits)	H80 + Function (8 bits)	(8 bits)	L (8 bits)	H (8 bits)

Message		Description
❶	Slave address	Set the address received from the master.
❷	Function	The master-requested function code + H80 is set.
❸	Exception code	The code in the following table is set.

Tab. 6-76: *Description of response data*

Code	Error Item	Description
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)

Tab. 6-77: *Error code list*

① An error will not occur in the following cases:

- 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.
- 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.

NOTES 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.

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 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. 334).	
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.	

Tab. 6-78: *Error check item*

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	Refer to Tab. 6-80
40010	Operation mode/inverter setting ③	Read/write	Refer to Tab. 6-81
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 (E^2PROM value)	Write	

Tab. 6-79: *System environment variable*

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.

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

Tab. 6-80: *Inverter status/control input instruction*

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". (Refer to section 6.9.1.) Each assigned signal is valid or invalid depending on NET. (Refer to section 6.17.3.)

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". (Refer to section 6.9.5.)

Operation Mode	Read Value	Written Value
EXT	H0000	H0010
PU	H0001	—
EXT JOG	H0002	—
NET	H0004	H0014
PU + EXT	H0005	—

Tab. 6-81: *Operation mode/inverter setting*

The restrictions depending on the operation mode changes according to the computer link specifications.

● Real-time monitor

Refer to section 6.10.2 for details of the monitor description.

Register	Description	Unit	Register	Description	Unit
40201	Output frequency/ Speed	0.01Hz/1 ④	40215	Input terminal status ①	—
40202	Output current	0.01A/0.1A ③	40216	Output terminal status ②	—
40203	Output voltage	0.1V	40217	Load meter	0.1%
40205	Frequency setting value/ Speed setting	0.01Hz/1 ④	40220	Cumulative energizing time	1h
40206	Running speed	1r/min	40223	Actual operation time	1h
40208	Converter output voltage	0.1V	40224	Motor load factor	0.1%
40209	Regenerative brake duty	0.1%	40225	Cumulative power	01kWh
40210	Electronic thermal relay function load factor	0.1%	40250	Power saving effect	Variable
40211	Output current peak value	0.01A/0.1A ③	40251	Cumulative saving power	Variable
40212	Converter output voltage peak value	0.1V	40252	PID set point	0.1%
40213	Input power	0.01kW/0.1kW ③	40253	PID measurement value	0.1%
40214	Output power	0.01kW/0.1kW ③	40254	PID deviation value	0.1%

Tab. 6-82: *Real-time monitor*

① Input terminal monitor details (remote input)

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)

④ When Pr. 37 = "1 to 9998" or Pr. 144 = "2 to 10, 102 to 110," the unit is an integral value (one increment). (Refer to page 6-122).

● Parameter

Parame-ters	Register	Parameter Name	Read/Write	Remarks
0–999	41000–41999	Refer to the parameter list (Tab. 6-1) 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	
C42 (934)	41934	PID display bias coefficient	Read/write	
C43 (934)	42124	PID display bias analog value	Read/write	The analog value (%) set to C43 (934) is read.
	43934	PID display bias analog value (terminal analog value)	Read	The analog value (%) of the current (voltage)applied to the terminal 4 is read.
C44 (935)	41935	PID display gain coefficient	Read/write	
C45 (935)	42125	PID display gain analog value	Read/write	The analog value (%) set to C45 (935) is read.
	43935	PID display gain analog value (terminal analog value)	Read	The analog value (%) of the current (voltage) applied to the terminal 4 is read.

Tab. 6-83: *Parameter*

- 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 referred 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	

Tab. 6-84: *Alarm history*

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	HE6	PID
H30	THT	HA1	OP1	HF1	E.1
H31	THM	HB0	PE	HF5	E.5
H40	FIN	HB1	PUE	HF6	E.6
H50	IPF	HB2	RET	HF7	E.7
H51	UVT	HB3	PE2	HFD	E.13
H52	ILF	HC0	CPU		

Tab. 6-85: *Alarm code list*

Pr. 343 Communication error count

You can check the cumulative number of communication errors.

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

Tab. 6-86: *Number of communication errors*

NOTE

The number of communication errors is temporarily stored into the RAM. As it is not stored into the E²PROM, performing a power supply reset or inverter reset clears the value to 0.

Output signal LF "alarm 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".

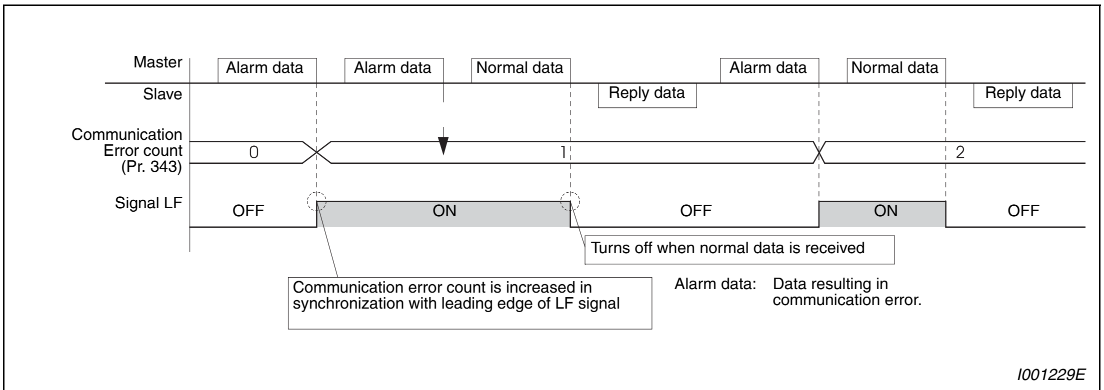


Fig. 6-155: *Output of the LF signal*

NOTE

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.

Signal loss detection (Pr. 539)

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"

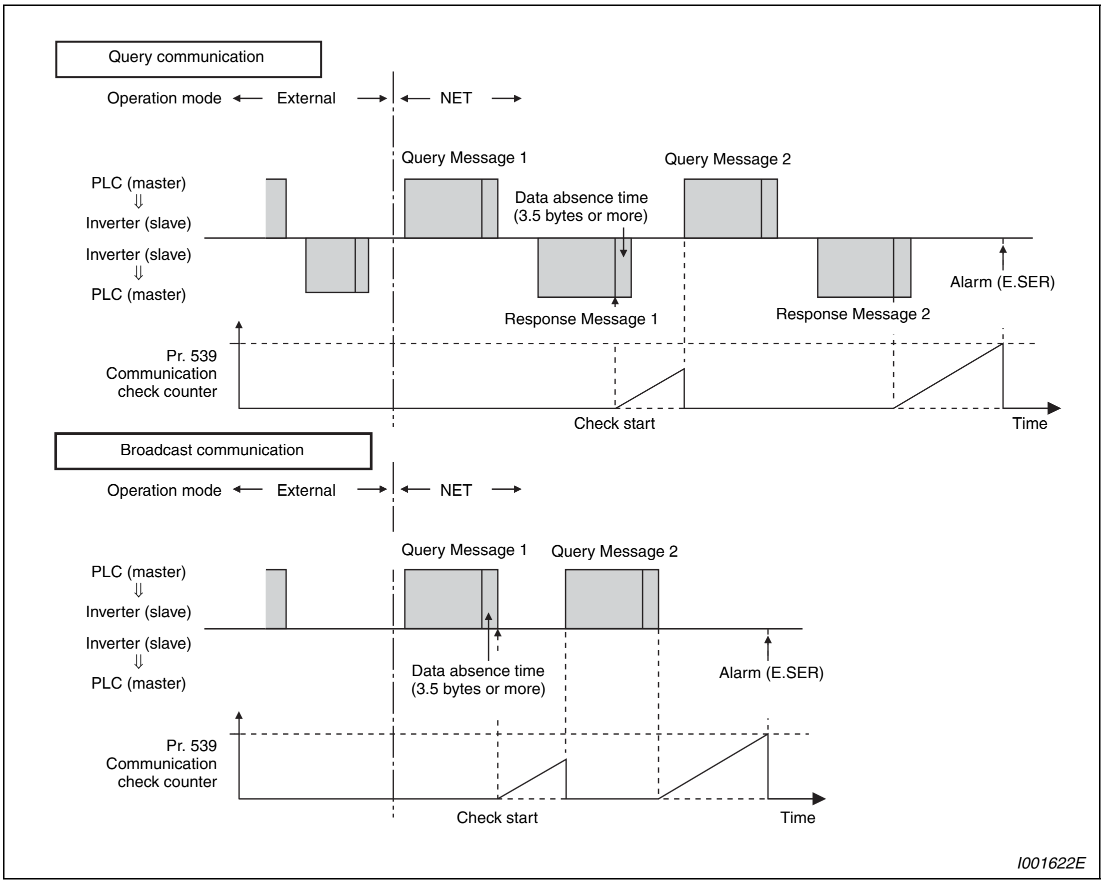


Fig. 6-156: *Signal loss detection*

6.19 Special operation

Purpose	Parameters that must be set		Refer to Section
Perform process control such as pump and air volume.	PID control	Pr. 127–Pr. 134, Pr. 241, Pr. 553, Pr. 554, Pr. 575–Pr. 577, C42 (Pr. 934) –C45 (Pr. 935)	6.19.1
Pump function by multiple motors	Advanced PID function	Pr. 554, Pr. 575–Pr. 591	6.19.3
Traverse function	Traverse function	Pr. 592–Pr. 597	6.19.4
Switch between the inverter operation and commercial power-supply operation to operate.	Commercial power supply-inverter switchover function	Pr. 135–Pr. 139, Pr. 159	6.19.2
Avoid over voltage alarm due to regeneration by automatic adjustment of output frequency	Regeneration avoidance function	Pr. 882–Pr. 886	6.19.5

6.19.1 PID control (Pr. 127 to Pr. 134, Pr. 241, Pr. 553, Pr. 554, Pr. 575 to Pr. 577, C42 (Pr. 934) to C45 (Pr. 935))

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.

Pr. No.	Name	Initial Value	Setting Range	Description	
127	PID control automatic switchover frequency	9999	0–400Hz	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, 110 ②	PID reverse action	Output signal of an external PID controller: terminal 1 ④
			11, 111 ②	PID forward action	
			20, 120 ②	PID reverse action	Measured value (terminal 4 ⑤) Set point (terminal 2 ④ or Pr. 133)
			21, 121 ②	PID forward action	
			50 ②	PID reverse action	Deviation value signal input (LONWORKS, CC-Link communication)
			51 ②	PID forward action	
			60 ②	PID reverse action	Measured value, set point input (LONWORKS, CC-Link communication)
			61 ②	PID forward action	
129	PID proportional band ①	100%	0.1–1000%	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	PID integral time ①	1s	0.1–3600s	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	0–100% ③	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	0–100% ③	Set the lower limit value. If the measured value falls below the setting range, the FDN signal is output. The maximum input (20mA/5V/10V) of the measured value (terminal 4) is equivalent to 100%.	
			9999	No function	
133	PID action set point ①	9999	0–100% ③	Used to set the set point for PID control.	
			9999	Terminal 2 input is the set point.	
134	PID differential time ①	9999	0.01–10.00s	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.	

Parameters referred to		Refer to Section
59	Remote function selection	6.5.4
73	Analog input selection	6.15.1
79	Operation mode selection	6.17.1
178–189	Input terminal function selection	6.9.1
190–196	Output terminal function selection	6.9.5
C2 (Pr. 902) – C7 (Pr. 905)	Frequency setting voltage (current) bias/gain	6.15.4

Pr. No.	Name	Initial Value	Setting Range	Description	
241	Analog input display unit switchover ①	0	0	Displayed in %	Select the unit of analog input display.
			1	Displayed in V/mA	
553	PID deviation limit	9999	0–100.0% ③	Y48 signal is output when the absolute value of deviation amount exceeds the deviation limit value.	
			9999	No function	
554	PID signal operation selection	0	0–3, 10–13	Select the operation to be performed at the detection of upper, lower, and deviation limit for the measured value input. The operation for PID output suspension function can be selected.	
575	Output interruption detection time	1s	0–3600s	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	0–400Hz	Set the frequency at which the output interruption processing is performed.	
577	Output interruption release level	1000%	900–1100%	Set the level (Pr. 577 minus 1000%) to release the PID output interruption function.	
C42 (934)	PID display bias coefficient ⑥	9999	0–500.00	Set the coefficient on bias (minimum) side of terminal 4 input.	
			9999	Displayed in %.	
C43 (934)	PID display bias analog value ⑥	20%	0–300.0%	Set the converted % on bias (minimum) side current /voltage of terminal 4 input.	
C44 (935)	PID display gain coefficient ⑥	9999	0–500.00	Set the coefficient on gain (maximum) side of the terminal 4 input.	
			9999	Displayed in %.	
C45 (935)	PID display gain analog value ⑥	100%	0–300.0%	Set the converted % on gain (maximum) side of current/voltage of terminal 4 input.	

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① The above parameters allow its setting to be changed during operation in any operation mode even if "0" (initial value) is set in Pr. 77 Parameter write selection.

② PID control is available without turning X14 signal ON when Pr.128 = "50, 51, 60, 61, 110, 111, 120, 120".

③ Setting values of Pr.131 to Pr.133, Pr. 553, Pr. 577 are without unit when "9999" is set to both of C42 (Pr. 934) and C44 (Pr. 935). (The values set to Pr. 553 and Pr. 577 indicate deviation range whether the unit is % or is not indicated.)

④ Input specification for the terminals are determined by Pr. 73 "Analog input selection".

⑤ Input specification for the terminal is determined by Pr. 267 "Terminal 4 input selection".

⑥ The parameter number in parentheses is the one for use with the parameter unit (FR-PU04/ FR-PU07).

PID control basic configuration

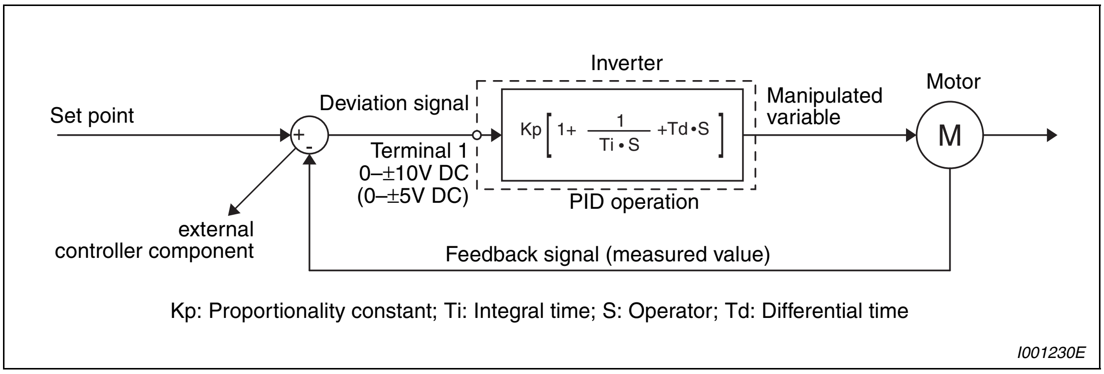


Fig. 6-157: *System configuration when Pr. 128 = 10, 11, 110, 111 (using an external (PID) controller)*

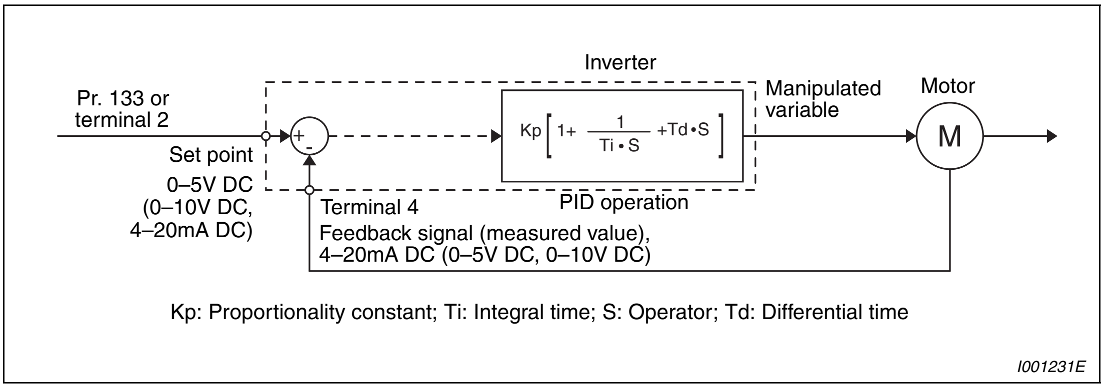


Fig. 6-158: *System configuration when Pr. 128 = 20, 21, 120, 121 (set/feedback value at the inverter)*

PI action overview

A combination of P action (P) and I action (I) for providing a manipulated variable in response to deviation and changes with time.

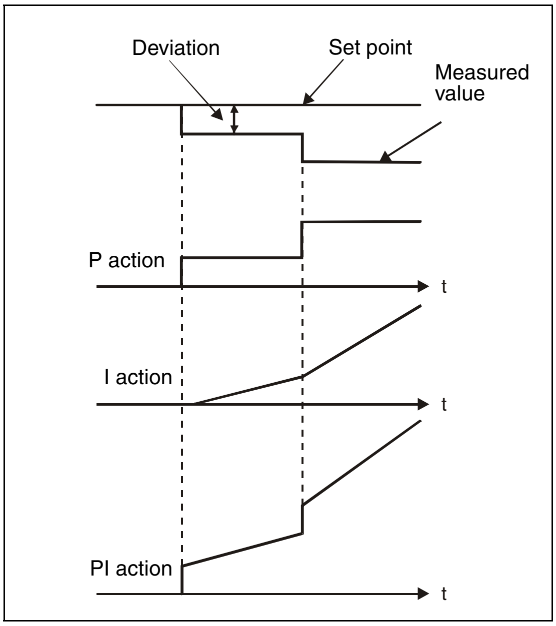
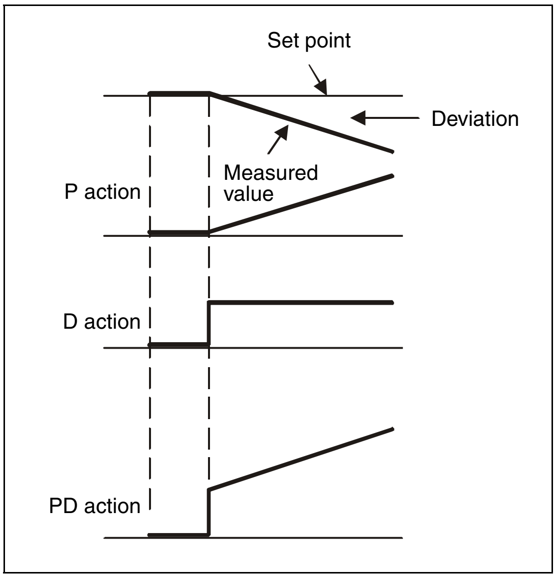


Fig. 6-159:
Operation example for stepped changes of measured value

I000045C

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.

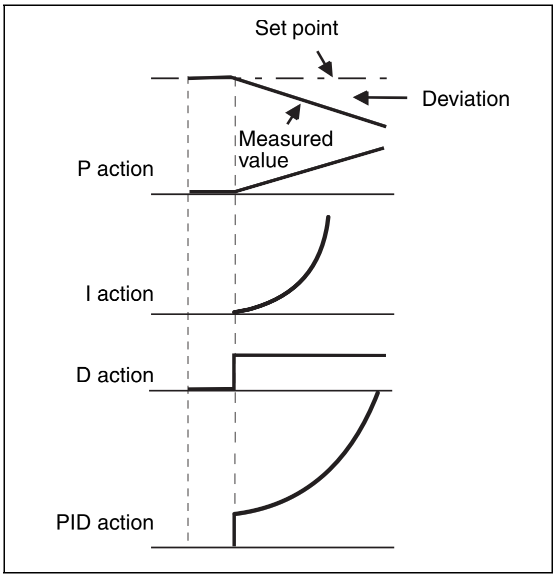


I000046C

Fig. 6-160:
Operation example for proportional changes of measured value

PID action

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



I001233E

Fig. 6-161:
Operation example for proportional changes of measured value

Reverse action

Increases the manipulated variable fi (output frequency) if deviation X = (set point – measured value) is positive, and decreases the manipulated variable if deviation is negative.

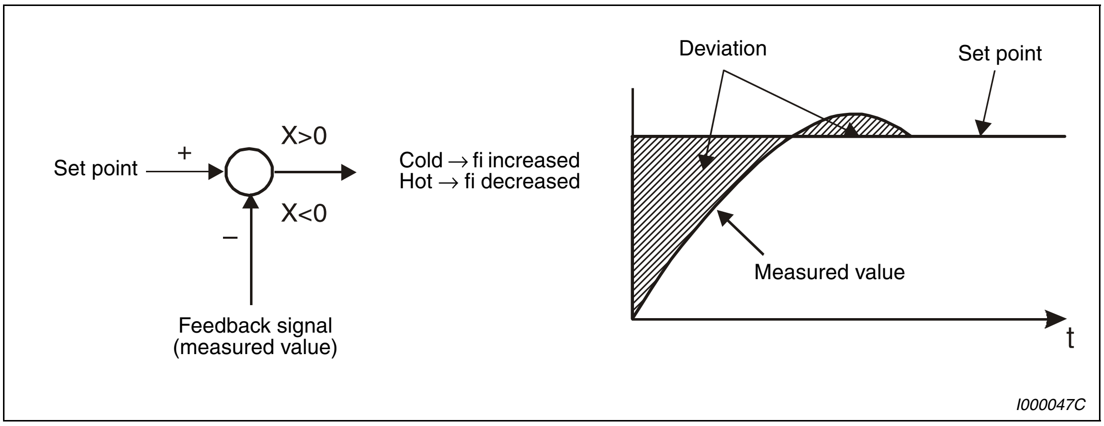


Fig. 6-162: *Heater*

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.

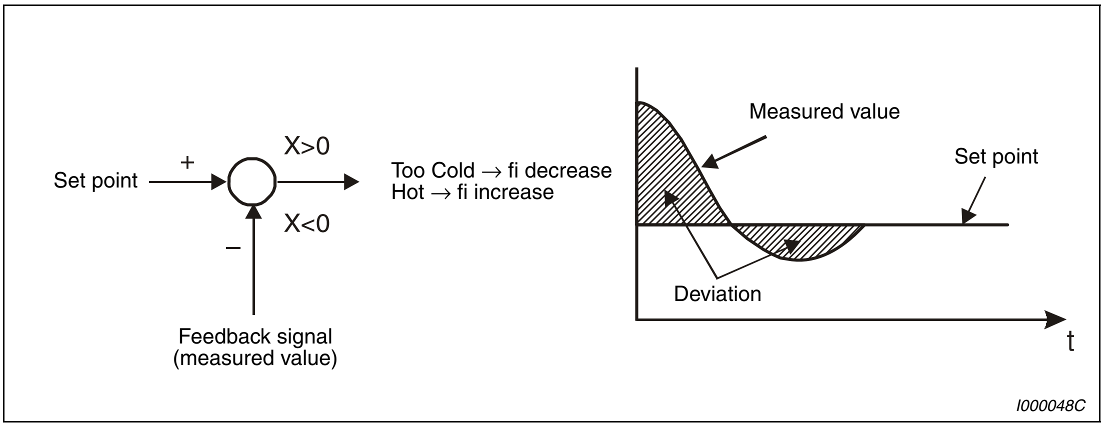


Fig. 6-163: *Cooling*

Relationships between deviation and manipulated variable (output frequency).

	Deviation	
	Positive	**Negative**
Reverse action	↗	↘
Forward action	↘	↗

Tab. 6-87: *Relationships between deviation and manipulated variable*

Connection diagram

The following graphic shows a typical application:

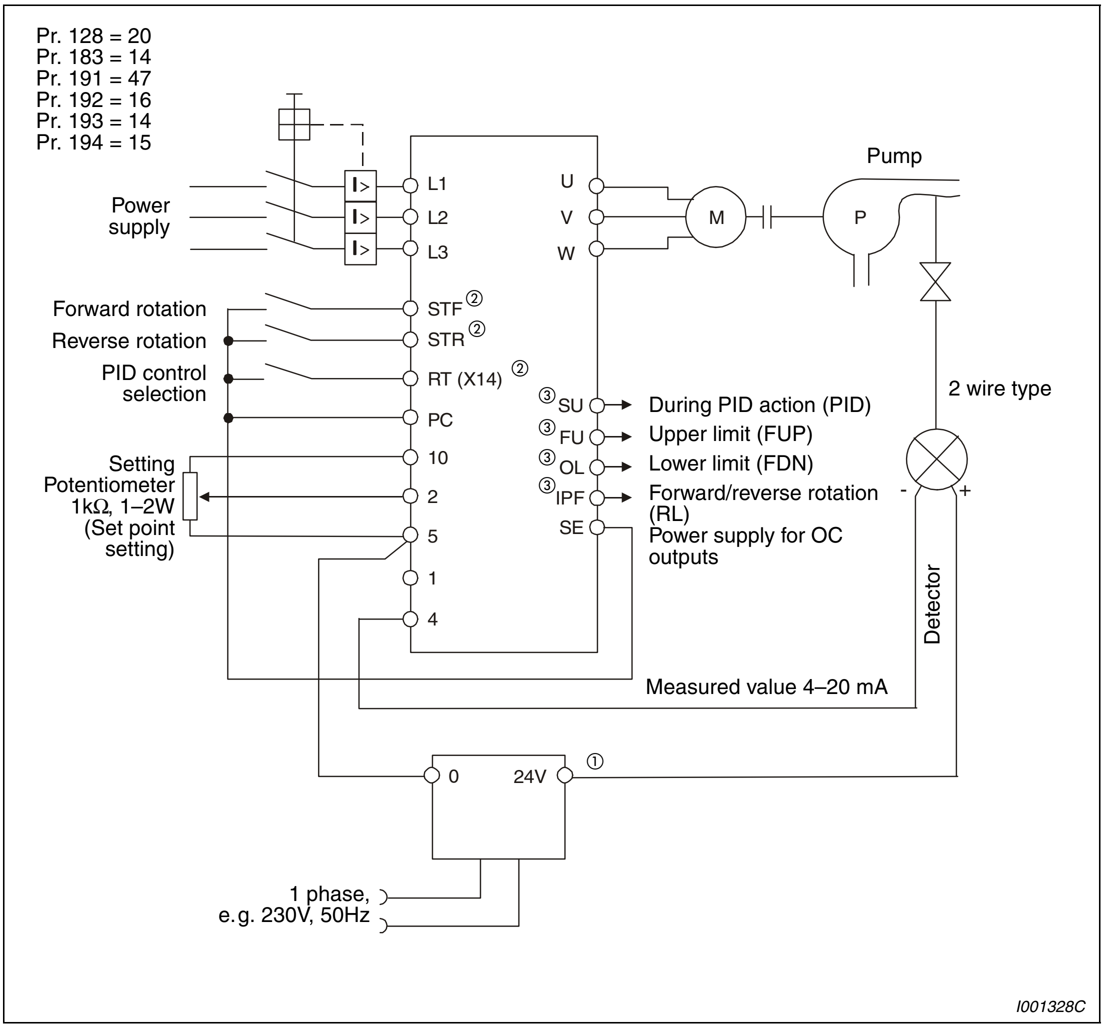


Fig. 6-164: *Connection diagram in source logic*

① The power supply must be selected in accordance with the power specifications of the detector used.

② The used input signal terminal changes depending on the Pr. 178 to Pr. 189 "Input terminal selection" setting.

③ The used output signal terminal changes depending on the Pr. 190 to Pr. 196 "Output terminal selection" setting.

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 when Pr. 128 = "50, 51, 60, 61, 110, 111, 120, 121".)

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, 21, 120 or 121" in Pr. 128.

When entering the calculated deviation signal of an external (PID) controller , enter it across terminals 1-5. At this time, set "10, 11, 110, 111" in Pr. 128.

	Signal	Terminal used	Function	Description	Parameter Setting
Input	X14	Depending on Pr. 179– Pr. 189	PID control selection	Turn ON X14 to perform PID control.	Set "14" to any of Pr. 178 to Pr. 189.
	X64		PID forward/ reverse action switchover	By turning ON X64, forward action can be selected for PID reverse action (Pr. 128 = 10, 20, 110, 120), and reverse action for forward action (Pr. 128 = 11, 21, 111, 121).	Set "64" to any of Pr. 178 to Pr. 189.
	X72		PID integral value reset	ON: Integral and differential values are reset OFF: Normal processing	Set "72" to any of Pr. 178 to Pr. 189.
	2	2	Set point input	Enter the set point for PID control.	Pr. 128 = 20, 21, 120, 121 Pr. 133 = 9999
				0–5V................ 0–100%	Pr. 73 = 1 [1], 3, 5, 11, 13, 15
				0–10V.............. 0–100%	Pr. 73 = 0, 2, 4, 10, 12, 14
				0/4–20mA........ 0–100%	Pr. 73 = 6, 7, 16, 17
	PU	—	Set point input	Set the set value (Pr. 133) from the operation panel or parameter unit.	Pr. 128 = 20, 21, 120, 121 Pr. 133 = 0–100% [4]
	1	1	Deviation signal input	Input the deviation signal calculated externally.	Pr. 128 = 10 [1], 11, 110, 111
				–5V–+5V.............. –100%–+100%	Pr. 73 = 2, 3, 5, 7, 12, 13, 15, 17
				–10V–+10V .... –100%–+100%	Pr. 73 = 0, 1 [1], 4, 6, 10, 11, 14, 16
	4	4	Measured value input	Input the signal from the detector (measured value signal).	Pr. 128 = 20, 21, 120, 121
				0/4–20mA........ 0–100%	Pr. 267 = 0 [1]
				0–5V................ 0–100%	Pr. 267 = 1
				0–10V.............. 0–100%	Pr. 267 = 2
	Communication [2]	—	Deviation value input	Input the deviation value from LONWORKS, CC-Link communication.	Pr. 128 = 50, 11
			Set value, measured value input	Input the set value and measured value from LONWORKS , CC-Link communication	Pr. 128 = 60, 61

Tab. 6-88: *I/O signals and parameter settings (1)*

	Signal	Terminal used	Function	Description	Parameter Setting
Output	FUP	Depending on Pr. 190– 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, 120, 121 Pr. 131 ≠ 9999 Set "15" or "115" to any of Pr. 190–Pr. 196 .③
	FDN		Lower limit output	Output when the measured value signal falls below the lower limit (Pr.132).	Pr. 128 = 20, 21, 60, 61, 120, 121 Pr. 132 ≠ 9999 Set "14" or "114" to any of Pr. 190–Pr. 196. ③
	RL		Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).	Set "15" or "115" to any of Pr. 190–Pr. 196. ③
	PID		During PID control activated	Turns on during PID control.	Set "47" or "147" to any of Pr. 190–Pr. 196. ③
	SLEEP		PID output interruption (SLEEP)	Turns on when the PID output interruption function is performed.	Pr. 575 ≠ 9999 Set "70" or "170" to any of Pr. 190–Pr. 196. ③
	Y48		PID deviation limit	Output when the absolute value of deviation exceeds the limit value.	Pr. 553 ≠ 9999 Set "48" or "148" to any of Pr. 190–Pr. 196. ③
	SE	SE	Output terminal common	Common terminal for terminals FUP, FDN, RL, PID, SLEEP and Y48	

Tab. 6-88: *I/O signals and parameter settings (2)*

① The half-tone screened areas indicate the parameter initial values.

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 section 6.9.5 for details.)

④ If Pr. 133 is used for the set point signal (setting ≠ 9999) any additional set point signal applied to terminals 2-5 will be ignored.

NOTE

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.

PID control automatic switchover control (Pr. 127)

For a fast system start-up 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.

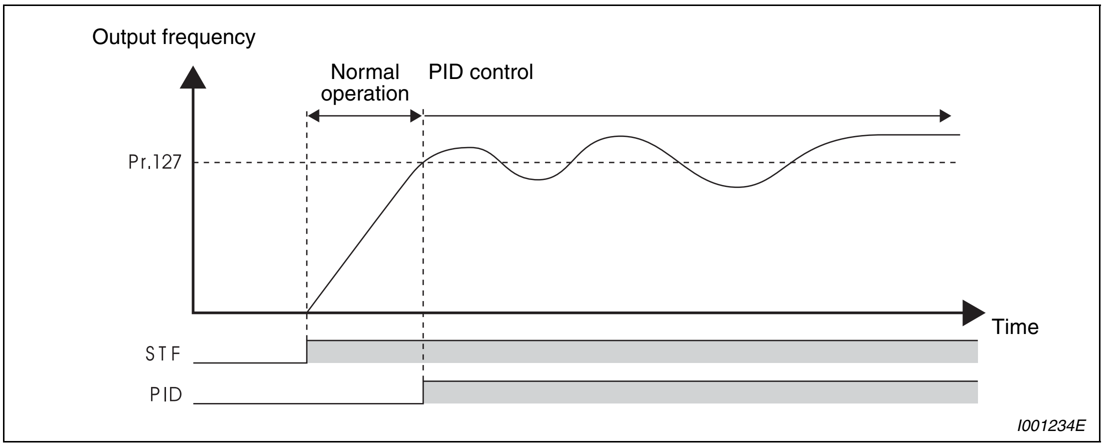


Fig. 6-165: *Automatic switchover to PID control*

Selecting operation to be performed at the output of Upper limit signal, Lower limit signal, and PID deviation limit signal (FUP signal, FDN signal, Y48 signal, Pr. 554)

You can select the operation to be performed at the detection of upper, lower and deviation limit for the measured value input. With Pr. 554 PID signal operation selection, signal output or signal output + alarm stop (E.PID) can be selected for each of upper limit output signal (FUP signal), lower limit output signal (FDN signal), and PID deviation limit signal (Y48 signal).

Pr. 554 Setting	FUP Signal, FDN Signal	Y48 Signal ①	SLEEP Function
0 (initial value)	Only signal output	Only signal output	Inverter coasts to a stop at the start of SLEEP operation
1	Signal output + stop by fault (E.PID)		
2	Only signal output	Signal output + stop by fault (E.PID)	
3	Signal output + stop by fault (E.PID)		
10	Only signal output	Only signal output	Inverter decelerates to a stop at the start of SLEEP operation
11	Signal output + stop by fault (E.PID)		
12	Only signal output	Signal output + stop by fault (E.PID)	
13	Signal output + stop by fault (E.PID)		

① When the settings for Pr.131 PID upper limit, Pr.132 PID lower limit, and Pr.553 PID deviation limit, which corresponds with FUP, FDN, and Y48 signals, are "9999" (no function), the signal is not output, or the alarm stop is not performed.

PID output suspension function (SLEEP-Signal, Pr. 554, 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". (At this time, if "0 to 3" is set to Pr. 554 PID signal operation selection, output is shut off (the inverter coasts to stop) when SLEEP operation starts. If "10 to 13" is set, the inverter decelerates to a stop in the deceleration time set in Pr. 8 when SLEEP operation starts.)

This function can reduce energy consumption in the low-efficiency, low-speed range.

Pr. 554 Setting	FUP Signal, FDN Signal	Y48 Signal ①	SLEEP Function
0 (initial value)	Only signal output	Only signal output	Inverter coasts to a stop at the start of SLEEP operation
1	Signal output + stop by fault (E.PID)		
2	Only signal output	Signal output + stop by fault (E.PID)	
3	Signal output + stop by fault (E.PID)		
10	Only signal output	Only signal output	Inverter decelerates to a stop at the start of SLEEP operation
11	Signal output + stop by fault (E.PID)		
12	Only signal output	Signal output + stop by fault (E.PID)	
13	Signal output + stop by fault (E.PID)		

When the deviation (= set value – measured value) reaches the PID output shutoff cancel level (Pr. 577 setting – 1000%) while the PID output interruption function is on, the PID output interruption function is canceled and PID control operation is resumed automatically.

While the PID output interruption function is on, the PID output interruption signal (SLEEP) is output. At this time, the inverter running signal (RUN) is off and the PID control operating signal (PID) is on.

For the terminal used for the SLEEP signal output, assign the function by setting "70" (positive logic) or "170" (negative logic) in Pr. 190 to Pr. 196 (output terminal function selection).

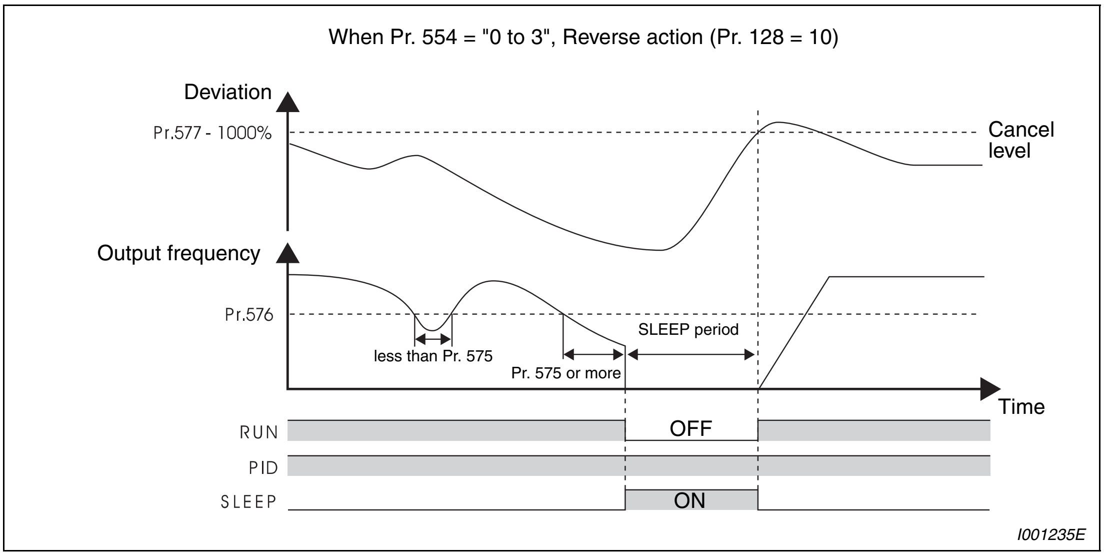
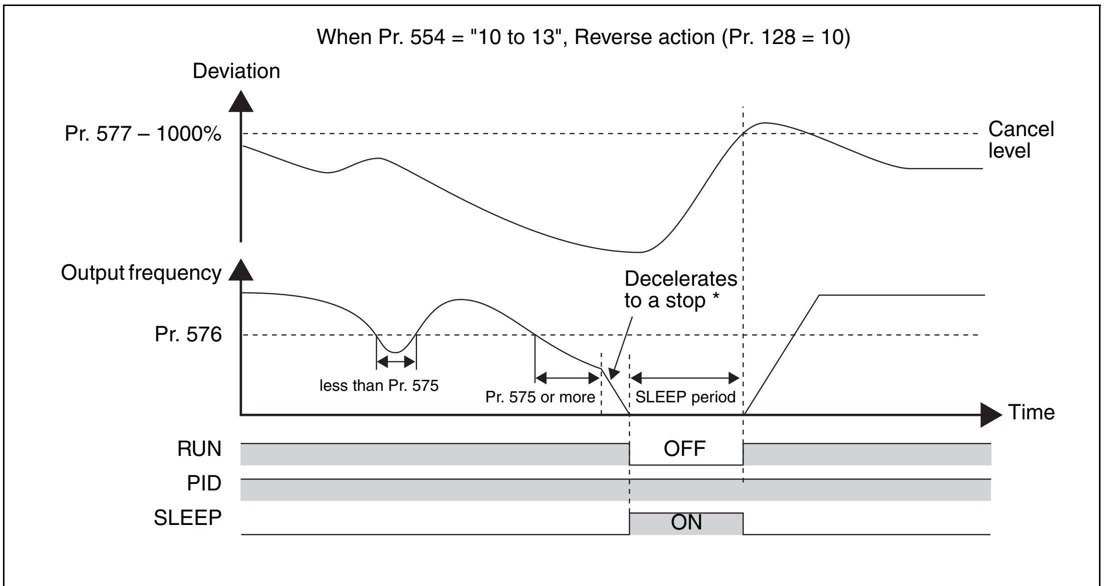


Fig. 6-166: *Output interruption (SLEEP function) when Pr. 554 = "0 to 3"*



* When the output rises to the output interruption cancel level during deceleration to a stop, output interruption gets cancelled, and the inverter accelerates again to continue PID control. Pr. 576 "Output interruption detection level" is invalid during deceleration.

I002108E

Fig. 6-167: *Output interruption (SLEEP function) when Pr. 554 = "10 to 13"*

PID monitor function

The PID control set value, meaured 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 to Pr. 52 "DU/PU main display data selection", Pr. 54 "CA terminal function selection", and Pr. 158 "AM terminal function selection".

Parameter	Monitor Description	Minimum Increments ①	Terminal CA, AM Full Scale ①	Remarks
52	PID set point	0.1%	100%/ C42 (Pr. 934) or C44 (Pr. 935)	For using an external PID controller (Pr. 128 = 10, 11, 110, 111), the monitor value is always displayed as "0".
53	PID measurement value			
54	PID deviation value	0.1%	—	Value cannot be output from the terminals AM and CA. The PID deviation value of 0% is displayed as 1000.

Tab. 6-89: *PID monitor function*

① When neither of C42 (Pr. 934) nor C44 (Pr. 935) setting is "9999", minimum increment changes from % to no unit, and the full scale value for terminal CA/AM changes from 100% to the larger value between C42 (Pr. 934) PID display bias coefficient and C44 (Pr. 935) PID display gain coefficient. (The smaller value between C42 (Pr. 934) and C44 (Pr. 935) becomes the minimum value.)

Adjustment procedure

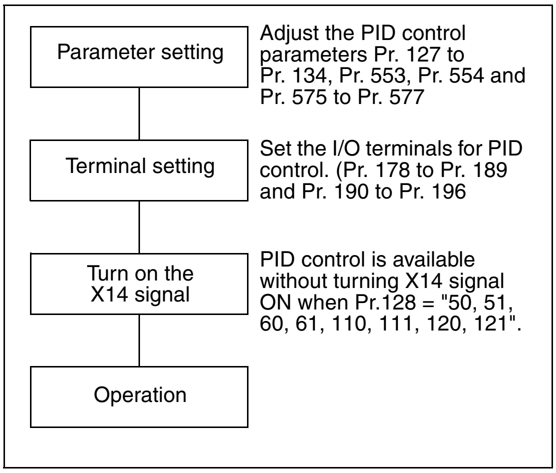


Fig. 6-168:
Adjustment procedure

Calibration example

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).

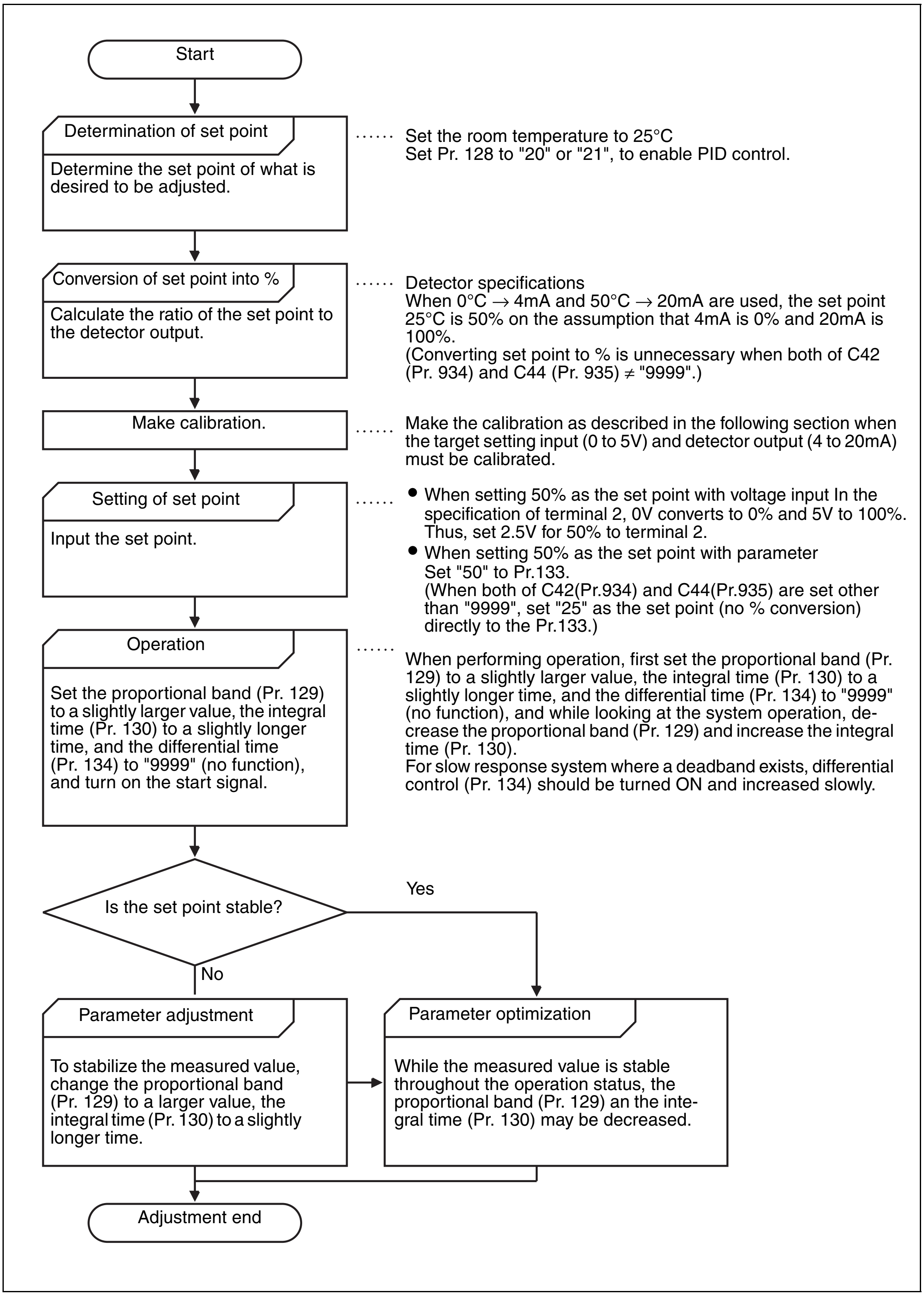


Fig. 6-169: *Calibration example*

△

Set point input calibration

- Setting with terminal 2 input

① Apply the input voltage of 0% set point setting (e.g. 0V) across terminals 2-5.

② Enter in C2 (Pr. 902) the frequency which should be output by the inverter at the deviation of 0% (e.g. 0Hz).

③ In C3 (Pr. 902), set the voltage value at 0%.

④ Apply the voltage of 100% set point (e.g. 5V) 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%.

- Setting with Pr. 133

When both or one of C42 (Pr. 934) and C44 (Pr. 935) is "9999".
For the set point, set a % converted value in the range of 0 to 100%.

When both of C42 (Pr. 934) and C44 (Pr. 935) ≠ "9999".
For the set point, set PID coefficient, which corresponds with 0 to 100%.

Process value input calibration

- When both or one of C42 (Pr. 934) and C44 (Pr. 935) is "9999"

① Apply the input current of 0% detector setting (e.g. 4mA) across terminals 4-5.

② Make calibration of the process value bias (%) using C6 (Pr. 904).

③ Apply the input current of 100% detector setting (e.g. 20mA) across terminals 4-5.

④ Make calibration of the process value gain (%) using C7 (Pr. 905).

- When both of C42 (Pr. 934) and C44 (Pr. 935) ≠ "9999"

① Apply the input current of 0% measured value (e.g. 4mA) across terminals 4 and 5.

② Set PID display value at 0% measured value (example: 15(°C)) to C42 (Pr. 934) , and calibrate C43 (Pr. 934).

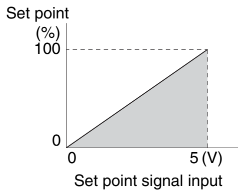
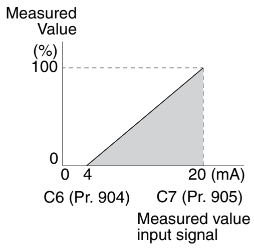
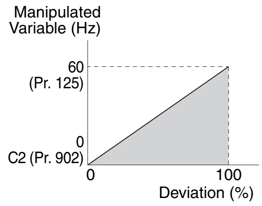
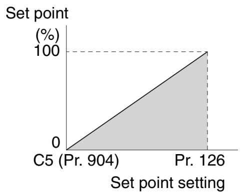
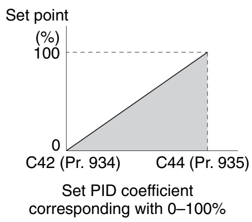
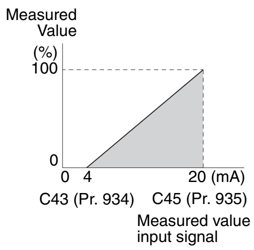
③ Apply the input current of 100% measured value (e.g. 20mA) across terminals 4 and 5.

④ Set PID display value at 100% measured value (example: 35(°C)) to C44 (Pr. 935), and calibrate C45 (Pr. 935).

NOTE

The frequency set in C5 (Pr. 904) and Pr. 126 should be the same as set in C2 (Pr. 902) and Pr. 125.

The results of the above calibration are as shown below:

<table>
<tr><th>Pr. 133 Setting</th><th>Pr. 934
Pr. 935
Setting</th><th>Set Point Setting</th><th>Measured Value (Terminal 4)</th><th>Manipulated Variable</th></tr>
<tr><td>9999</td><td>—</td><td>(Terminal 2)

I002109E</td><td rowspan="2">
I002110E</td><td rowspan="3">
I002109E</td></tr>
<tr><td rowspan="2">Other than 9999</td><td>Both or one is 9999</td><td>(Pr. 133)

I002109E</td></tr>
<tr><td>Other than 9999</td><td>(Pr. 133)

I002109E</td><td>
I002110E</td></tr>
</table>

Tab. 6-90: *Results of calibration*

NOTES

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 = 9999 (analog variable) or Pr. 79 = 6 (switchover mode).

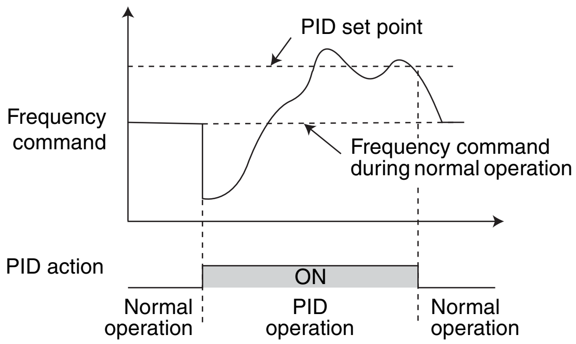
When the Pr. 128 setting is "20, 21, 120 or 121", note that the input across inverter terminals 1-5 is added to the set value across terminals 2-5.

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.

When the control is switched to PID control during normal operation, the frequency command value calculated by PID operation using 0Hz as standard is used without the frequency during the operation.



Operation when control is switched to PID control during normal operation

Bias and gain for PID displayed values [C42 (Pr. 934) to C45 (Pr. 935)]

When both of C42 (Pr.934) and C44 (Pr.935) ≠ "9999", bias/gain calibration is available for analog value of set point, measured value, deviation value to perform PID control.

① Bias/gain calibration for PID displayed value [C42 (Pr. 934) to C45 (Pr. 935)]

"Bias"/"gain" function can adjust the relation between PID displayed coefficient and measured value input signal. Examples of measured value input signals are 0 to 5V DC, 0 to 10V DC, or 4 to 20mA DC, and they are externally input.

Set PID display bias coefficient for terminal 4 input with C42 (Pr. 934). (Initial value is the coefficient for 4mA.)

Set PID display gain coefficient for 20mA of the frequency command current (4 to 20mA) with C44 (Pr. 935).

When both of C42 (Pr. 934) and C44 (Pr. 935) ≠ "9999" and Pr. 133 is set as the set point, the setting of C42 (Pr. 934) is treated as 0%, and C44 (Pr. 935) as 100%.

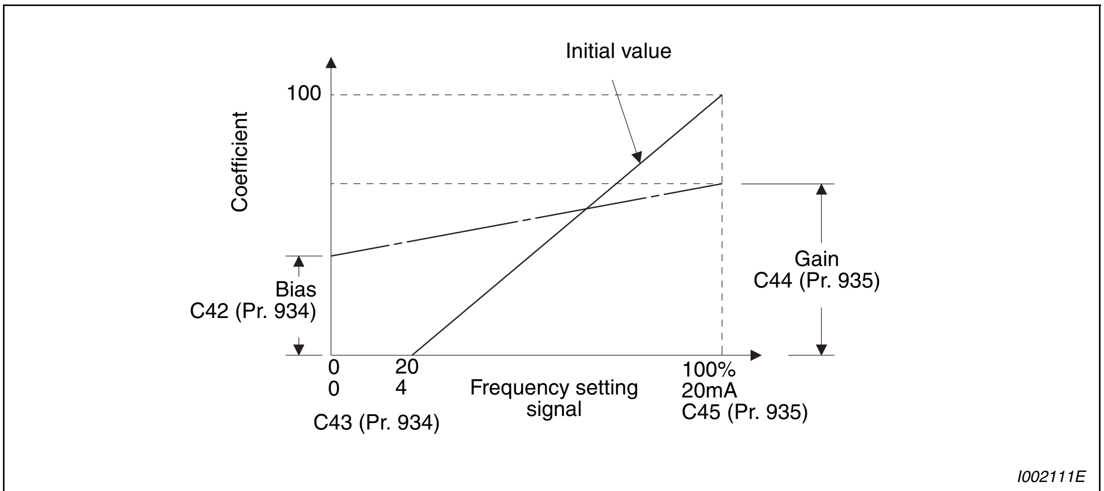


Fig. 6-170: *Bias and gain for PID displayed values*

Three methods of bias/gain adjustment for PID displayed values are the following.

(a) Method to adjust any point by application of voltage (current) across the terminals 4 and 5.
(b) Method to adjust any point without application of voltage (current) across terminals 4 and 5.
(c) Method to adjust only the frequency without adjusting the voltage (current).
For the detail of (a) to (c), refer to section 6.15.4.
Make adjustment by assuming C7 (Pr. 905) as C45 (Pr. 935), and Pr. 126 as C44 (Pr. 935).

NOTE

When the voltage/current input specifications are changed with voltage/current input switch and using Pr. 73 and Pr. 267, be sure to make calibration.

② Analog input display unit changing (Pr. 241)

You can change the analog input display unit (%/V, mA) for analog input bias/gain calibration.

Depending on the terminal input specification set to Pr. 73, Pr. 267, and voltage/current input switch the display units of C3 (Pr. 902), C4 (Pr. 903), C43 (Pr. 934), C45 (Pr. 935) change as shown below.

Analog Command (Terminal 4) (according to Pr. 73, Pr. 267 and Voltage/Current Input Switch)	Pr. 241 = 0 (initial value)	Pr. 241 = 1
0–5V input	0 to 5V → 0 to 100% is displayed.	0 to 5V → 0 to 5V is displayed.
0–10V input	0 to 10V → 0 to 100% is displayed.	0 to 10V → 0 to 10V is displayed.
0/4–20mA	0 to 20mA → 0 to 100% is displayed.	0 to 20mA → 0 to 20mA is displayed.

Tab. 6-91: *Units when displaying the set value*

6.19.2 Commercial power supply-inverter switchover function (Pr. 135 to Pr. 139, Pr. 159)

The complicated sequence circuit for commercial power supply-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.

Pr. No.	Name	Initial Value	Setting Range	Description
135	Commercial power-supply switchover sequence output terminal selection	0	0	With commercial power-supply switchover sequence
			1	Without commercial power-supply switchover sequence
136	MC switchover interlock time	1s	0–100s	Set the operation interlock time of MC2 and MC3.
137	Start waiting time	0.5s	0–100s	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	Commercial power-supply operation switchover selection at an alarm	0	0	Inverter output is stopped (motor coast) at inverter fault.
			1	Operation is automatically switched to the commercial power-supply operation at inverter fault. (Not switched when an external thermal error occurs)
139	Automatic switchover frequency between inverter and commercial power-supply operation	9999	0–60Hz	Set the frequency to switch the inverter operation to the commercial power-supply 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 commercial power supply operation.
			9999	Without automatic switchover
159	Automatic switchover ON range between commercial power-supply and inverter operation	9999	0–10Hz	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 commercial power-supply operation, the inverter automatically switches operation to the inverter operation and operates at the frequency of frequency command. When the inverter start command (STF/STR) is turned off, operation is switched to the 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 the inverter operation to commercial power-supply inverter operation, operation is switched to the inverter operation and the motor decelerates to stop.

Parameters referred to		Refer to Section
11	DC injection brake operation time	6.8.1
57	Restart coasting time	6.11.1
58	Restart cushion time	6.11.1
79	Operation mode selection	6.17.1
178–189	Input terminal function selection	6.9.1
190–196	Output terminal function selection	6.9.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

When the motor is operated at 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 commercial power supply 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 commercial power supply switchover 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.

Connecting the magnetic contactors to the inverter

Parameter setting for source logic:
Pr. 185 = 7, Pr. 192 = 17, Pr. 193 = 18, Pr. 194 = 19

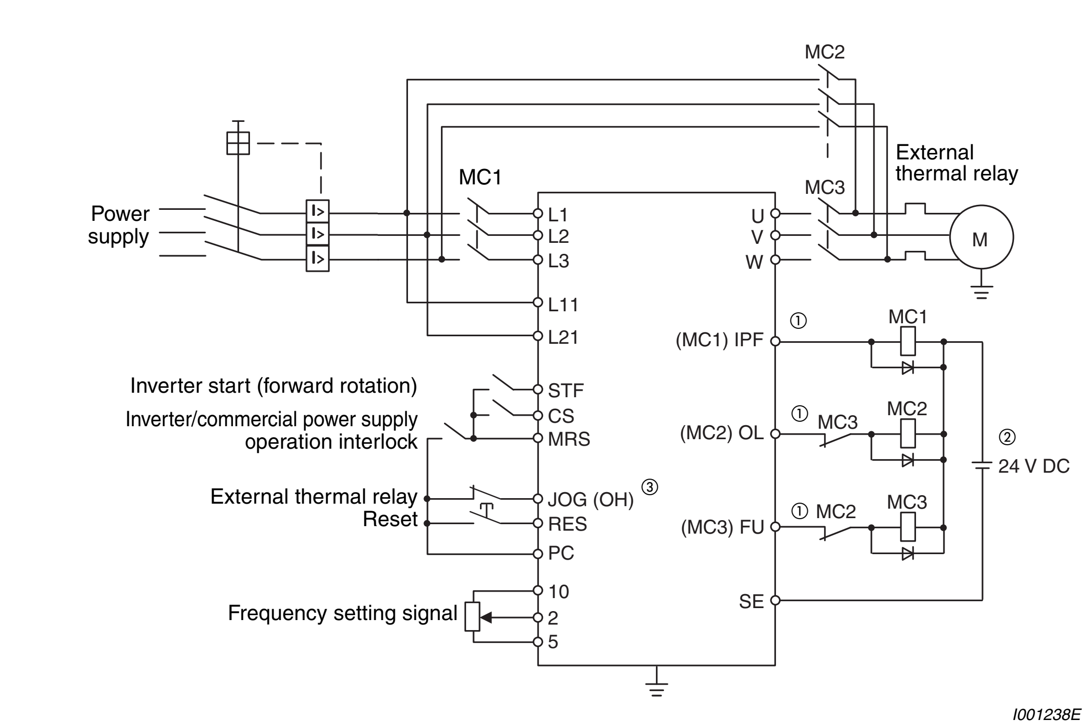


Fig. 6-171: *Connecting the magnetic contactors*

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

Tab. 6-92: *Output terminal capacity*

② When connecting a DC power supply, insert a protective diode. When connecting an AC power supply, connect arelay 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".

NOTES

Use the commercial power supply switchover 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. The inverter will be damaged if main supply voltage is connected to the output.

- Operations of magnetic contactors MC1, MC2 and MC3

Magnetic Contactor	Installation Place	Commercial Power Supply Operation	During Inverter Operation	At an Inverter Alarm Occurrence
MC1	Between power supply and inverter input	ON	ON	OFF (ON by reset)
MC2	Between power supply and motor	ON	OFF	OFF (Can be selected using Pr. 138, always OFF when external thermal relay is on)
MC3	Between inverter output and motor	OFF	ON	OFF

Tab. 6-93: *Operations of magnetic contactors*

- The input signals are as indicated below.

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

Tab. 6-94: *I/O signals*

① Unless the MRS signal is turned on, neither commercial power supply 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
—: Inverter operation .... MC2 is off and MC3 is on
Commercial power supply 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 inverter output side magnetic contactor MC2
MC3	19	Control signal output of commercial power supply operation magnetic contactor MC3

Tab. 6-95: *Output signals*

Commercial power supply-inverter switchover operation sequence

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

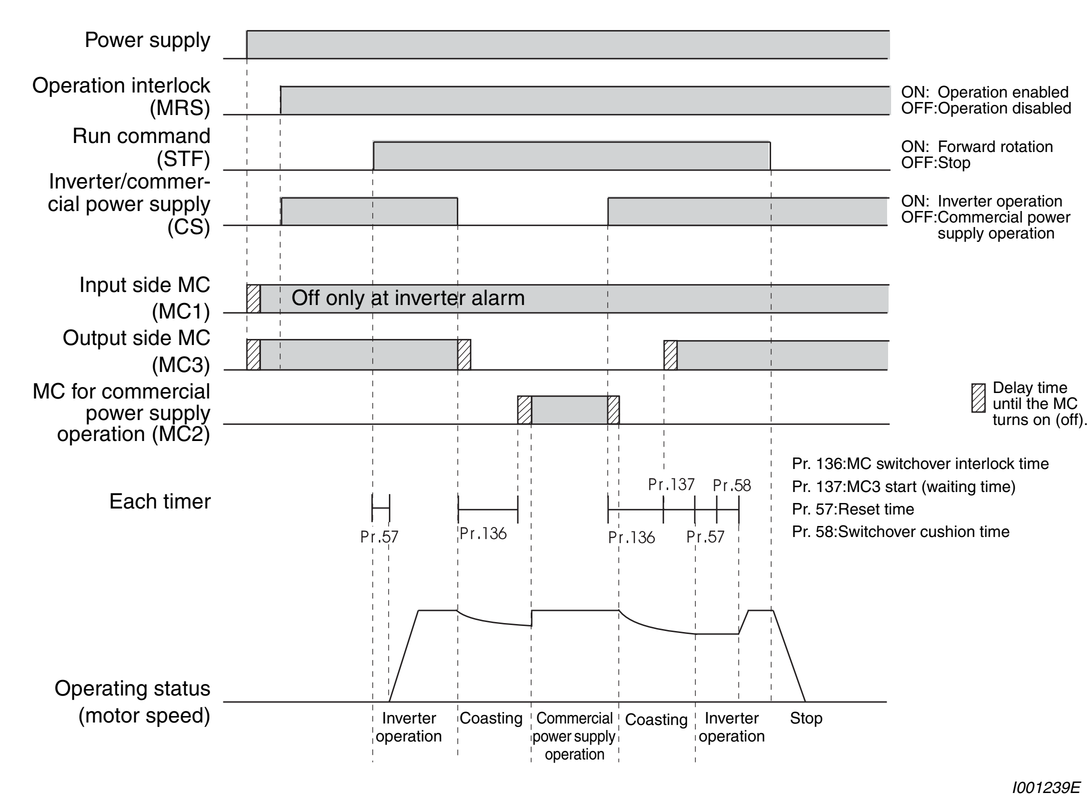


Fig. 6-172: *Signal timing when there is no automatic switchover sequence*

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

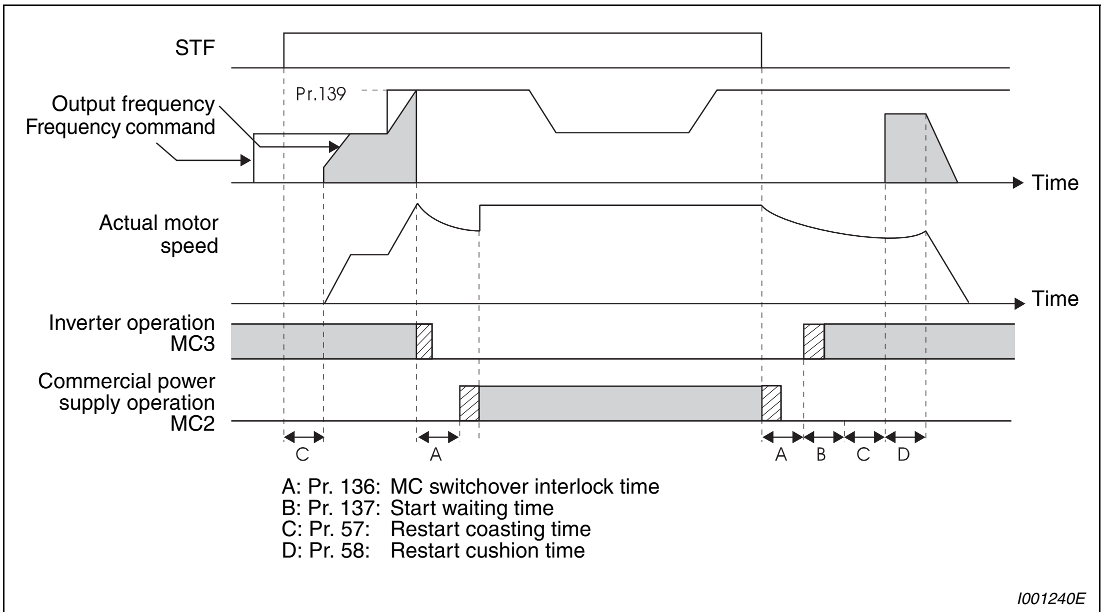


Fig. 6-173: *Signal timing when there is automatic switchover sequence*

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

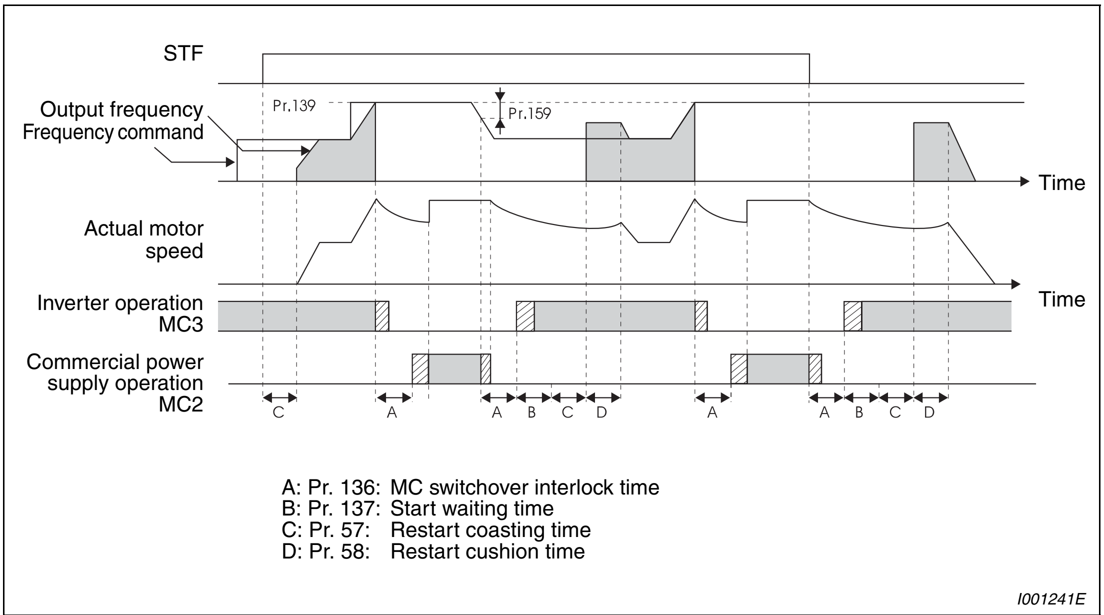


Fig. 6-174: *Signal timing when there is automatic switchover sequence*

Operation procedure

① Turn the power supply on.

② Set the parameters.
Pr. 135 = 1 (Commercial power supply operation enabled.)
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 commercial power supply operation is switched to inverter operation.)

③ Start inverter operation.

④ The switchover to commercial power supply operation is performed by a command or when the switchover frequency is reached.

⑤ When the Stop command is applied the system switches to inverter operation and the motor is decelerated under control.

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) (refer to note 2)
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	

Fig. 6-175: *Signals after parameter setting*

NOTES

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 commercial power supply-inverter switchover sequence function is not executed.

The commercial power supply-inverter switchover 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 commercial power supply 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), commercial power supply operation is performed.

When the CS signal is turned off, the motor switches to commercial power supply 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 commercial power supply-inverter switchover 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 commercial power supply-inverter switchover 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.

6.19.3 Advanced PID function (pump function) (Pr. 554, 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.

Pr. No.	Name	Initial Value	Setting Range	Description
554	PID signal operation selection	0	0–3, 10–13	Select the operation to be performed at the detection of upper, lower, and deviation limit for the measured value input. The operation for PID output suspension function can be selected.
575	Output interruption detection time	1s	0–3600s	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	0–400Hz	Set the frequency at which the output interruption processing is performed.
577	Output interruption release level	1000%	900–1100%	Level at PID output interruption function is canceled. Set (Pr. 577 – 1000%)
578	Auxiliary motor operation selection	0	0	No auxiliary motor operation
			1–3	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	0–100s	You can set the time until MC switchover interlock time when Pr. 579 = 2 or 3 is set.
581	Start waiting time	1s	0–100s	You can set the time from when the MC is switched until it starts when Pr. 579 = 2 or 3. Set this time a little longer than the MC switching time.
582	Auxiliary motor connection-time deceleration time	1s	0–3600/360s ①	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	0–3600/360s ①	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	50Hz	0–400Hz	Set the frequency to connect an auxiliary motor.
585	Auxiliary motor 2 starting frequency	50Hz	0–400Hz	
586	Auxiliary motor 3 starting frequency	50Hz	0–400Hz	
587	Auxiliary motor 1 stopping frequency	0Hz	0–400Hz	Set the frequency to open an auxiliary motor.
588	Auxiliary motor 2 stopping frequency	0Hz	0–400Hz	
589	Auxiliary motor 3 stopping frequency	0Hz	0–400Hz	
590	Auxiliary motor start detection time	5s	0–3600s	You can set the delay time until the auxiliary motor is started.
591	Auxiliary motor stop detection time	5s	0–3600s	You can set the delay time until the auxiliary motor is stopped.

Parameters referred to		Refer to Section
20	Acceleration/deceleration reference frequency	6.6.1
21	Acceleration/deceleration time increments	6.6.1
127–134 C42–C45	PID control	6.19.1
178–189	Input terminal function selection	6.9.1
190–196	Output terminal function selection	6.9.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

① Depends on the Pr. 21 Acceleration/deceleration time increments setting. The initial value for the setting range is "0 to 3600s" and the setting increments is "0.1s".

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	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 a 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.

Tab. 6-96: *Switching methods of the auxiliary motors*

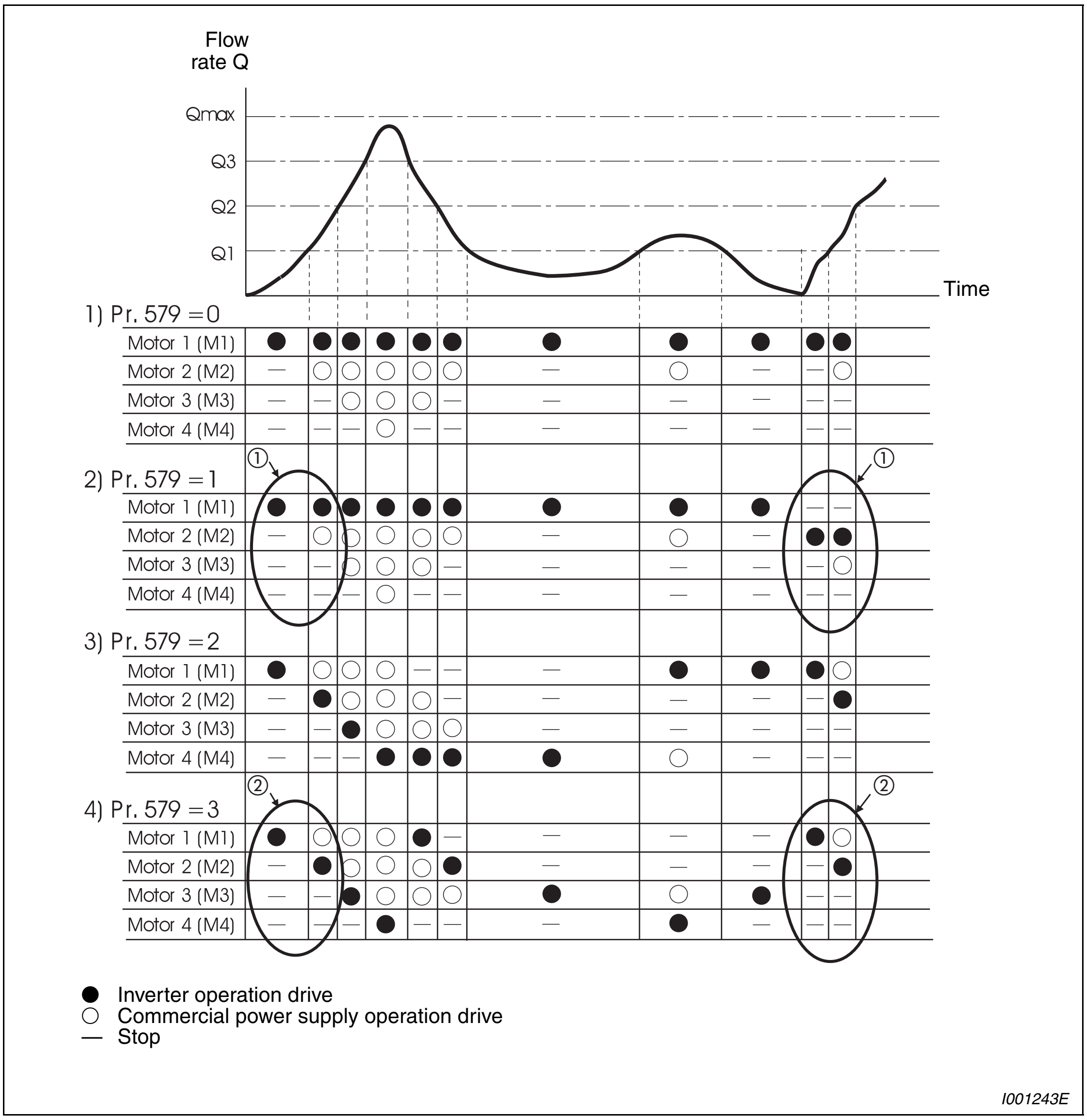


Fig. 6-176: *Flow control by auxiliary motors*

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).

NOTES

The starting order of motors to be driven returns to the initial status at an inverter reset. (Pr. 579 = 1 or 2 or 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.

System configuration

Basic system (Pr. 579 = 0)

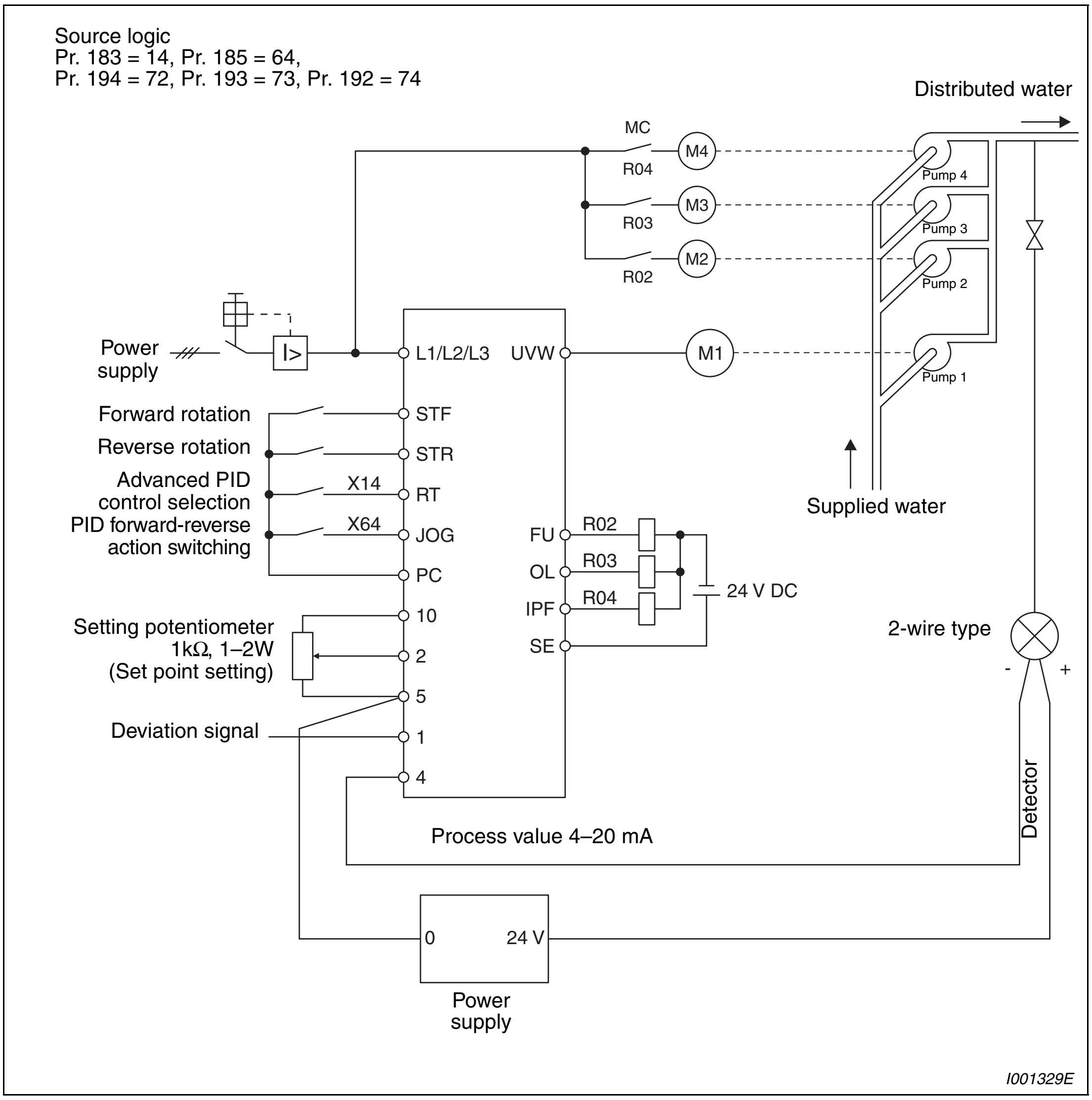


***Fig. 6-177:** Advanced PID control (basic system)*

Alternative system (Pr. 579 = 1), direct system (Pr. 579 = 2) and alternative-direct system (Pr. 579 = 3)

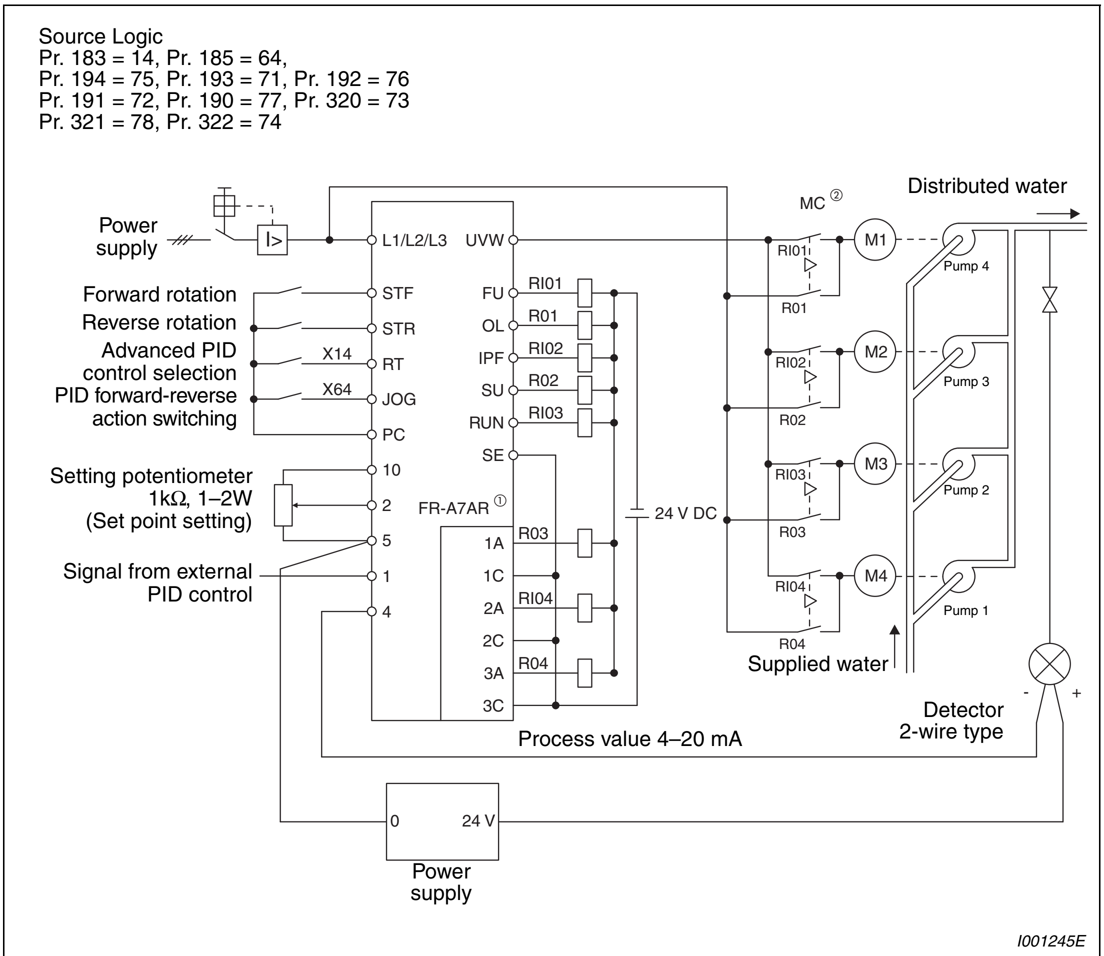


Fig. 6-178: *Advanced PID control (alternative system, direct system, alternative-direct system)*

① When driving three or more motors, use the plug-in option (FR-A7AR).

② Always provide mechanical interlocks for the MC.

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, C42 to C45 settings. (Refer to section 6.19.1.)

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 source logic is available for output terminals.)

Signal	Output Terminal Function Selection Setting		Function
	Source logic	Sink logic	
SLEEP	70	170 ①	During PID output interruption (SLEEP state)
R01	71	— ②	Commercial-power supply side motor 1 connection
R02	72	— ②	Commercial-power supply side motor 2 connection
R03	73	— ②	Commercial-power supply side motor 3 connection
R04	74	— ②	Commercial-power supply side motor 4 connection
RI01	75	— ②	Inverter side motor 1 connection
RI02	76	— ②	Inverter side motor 2 connection
RI03	77	— ②	Inverter side motor 3 connection
RI04	78	— ②	Inverter side motor 4 connection
SE	—	— ②	Output terminal common

Tab. 6-97: *I/O signals*

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 Sink logic can not be set.

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).

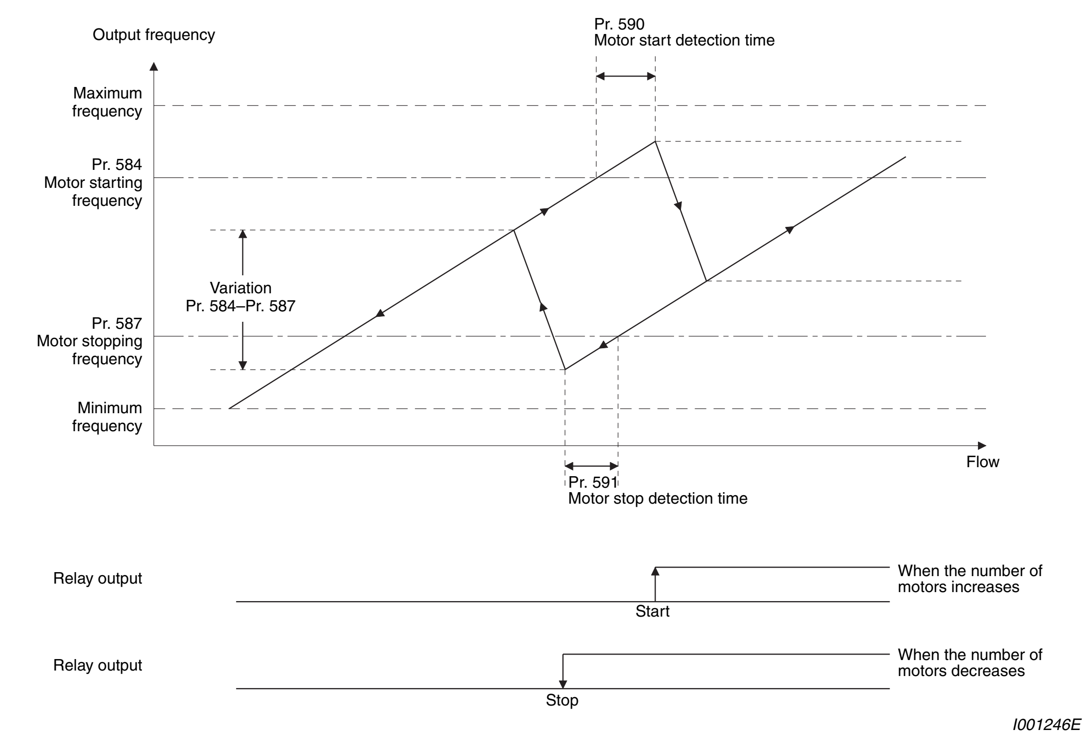


***Fig. 6-179:** Switchover timing at a start (stop) of an auxiliary motor 1*

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).

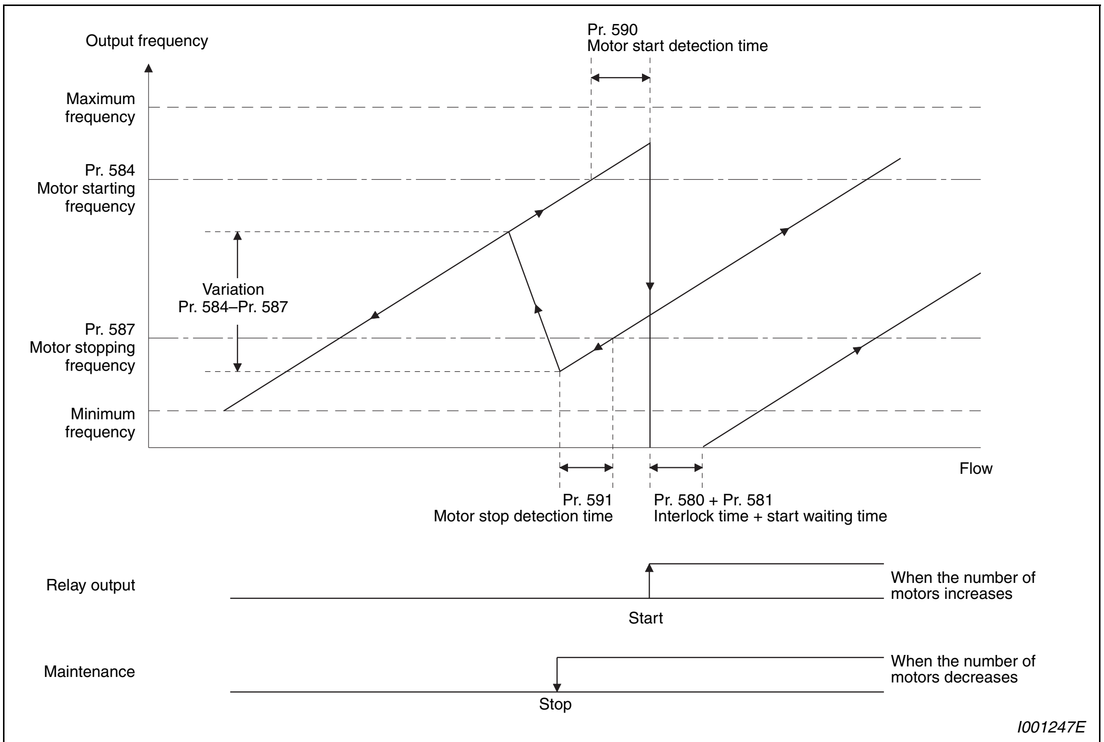


***Fig. 6-180:** Switchover timing at a start (stop) of an auxiliary motor 1*

NOTE

The control of the magnetic contactors by the frequency inverter is described on pages 6-306 ff.

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

Set a switching time of MC (e.g. time until RI01 turns on after RI01 turns off) in Pr. 580 "MC switching interlock time" in the direct system (Pr. 579 = 2 or 3). You can set the time from MC switch-over to a start (time from when RI01turns off and RI02 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 RI01 turns off and RI02 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.

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.

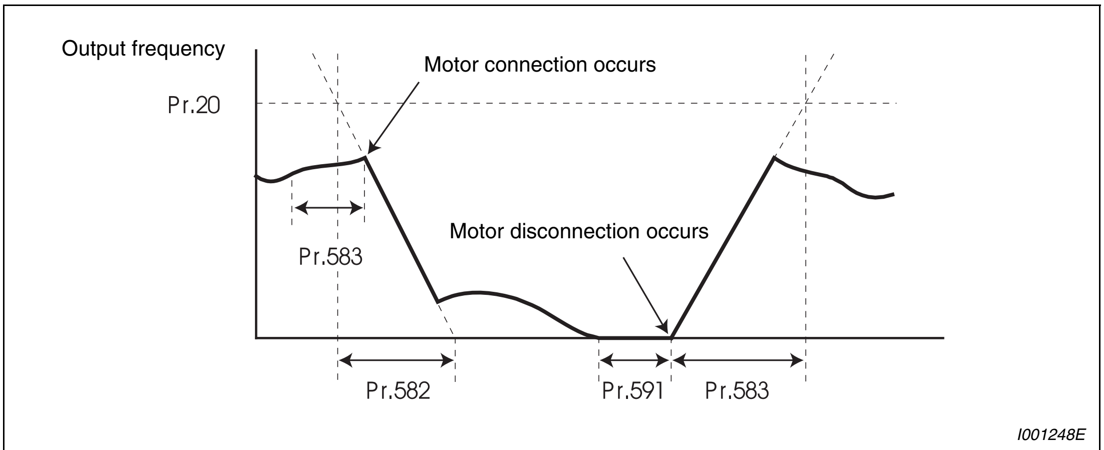


Fig. 6-181: *Deceleration/acceleration time*

NOTE

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.)

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 there is no additional commercial-power supply motor running. When starting the second commercial-power supply motor when one commercial-power supply motor is running, set Pr. 585 "Auxiliary motor 2 starting frequency".

Stop 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".

PID output interruption function (SLEEP function) (SLEEP signal, Pr. 554, 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. (At this time, if "0 to 3" is set to Pr.554 PID signal operation selection, output is shut off (the inverter coasts to stop) when SLEEP operation starts. If "10 to 13" is set, the inverter decelerates to a stop in the deceleration time set in Pr.8 when SLEEP operation starts.)

This function can reduce energy consumption in the low-efficiency, low-speed range.

Pr. 554 Setting	FUP Signal, FDN Signal	Y48 Signal ①	SLEEP Function
0 (initial value)	Only signal output	Only signal output	Inverter coasts to a stop at the start of SLEEP operation
1	Signal output + stop by fault (E.PID)		
2	Only signal output	Signal output + stop by fault (E.PID)	
3	Signal output + stop by fault (E.PID)		
10	Only signal output	Only signal output	Inverter decelerates to a stop at the start of SLEEP operation
11	Signal output + stop by fault (E.PID)		
12	Only signal output	Signal output + stop by fault (E.PID)	
13	Signal output + stop by fault (E.PID)		

When the deviation (= set point – measured value) reaches PID output interruption release 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.

For the terminal used for the SLEEP signal output, assign the function by setting "70" (positive logic) or "170" (negative logic) in Pr. 190 to Pr. 196 (output terminal function selection).

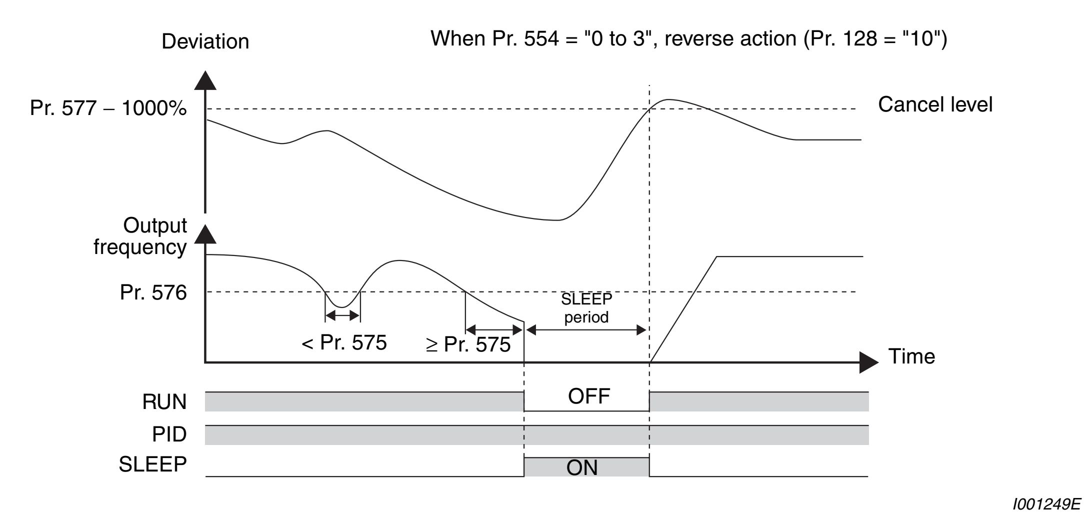
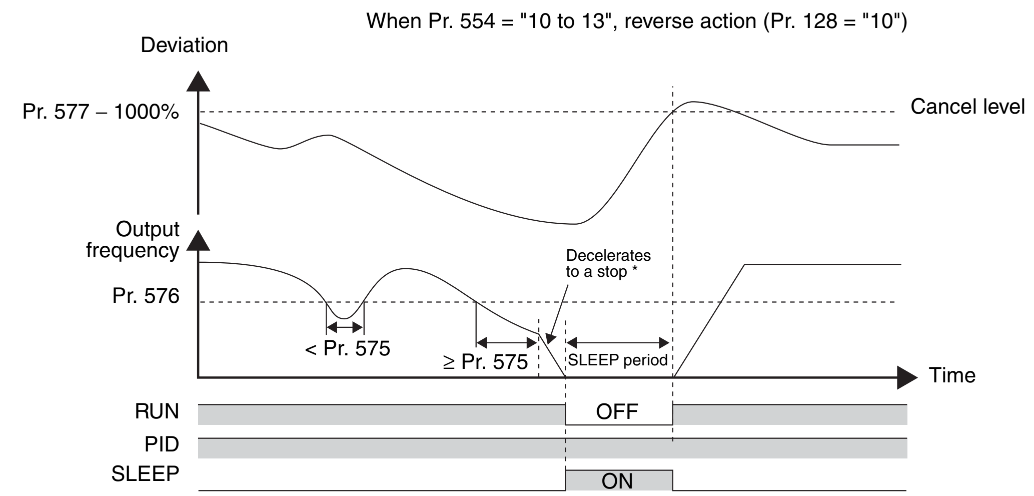


Fig. 6-182: *PID output interruption at reverse action (Pr. 554 = 0 to 3, Pr. 128 = 10)*



* When the output rises to the output interruption cancel level during deceleration to a stop, output interruption gets cancelled, and the inverter accelerates again to continue PID control. Pr. 576 Output interruption detection level is invalid during deceleration.

I002112E

Fig. 6-183: *PID output interruption at reverse action (Pr. 554 = 10 to 13, Pr. 128 = 10)*

Transient characteristic

Pr. 579 = 0 (When using four motors in the basic system)

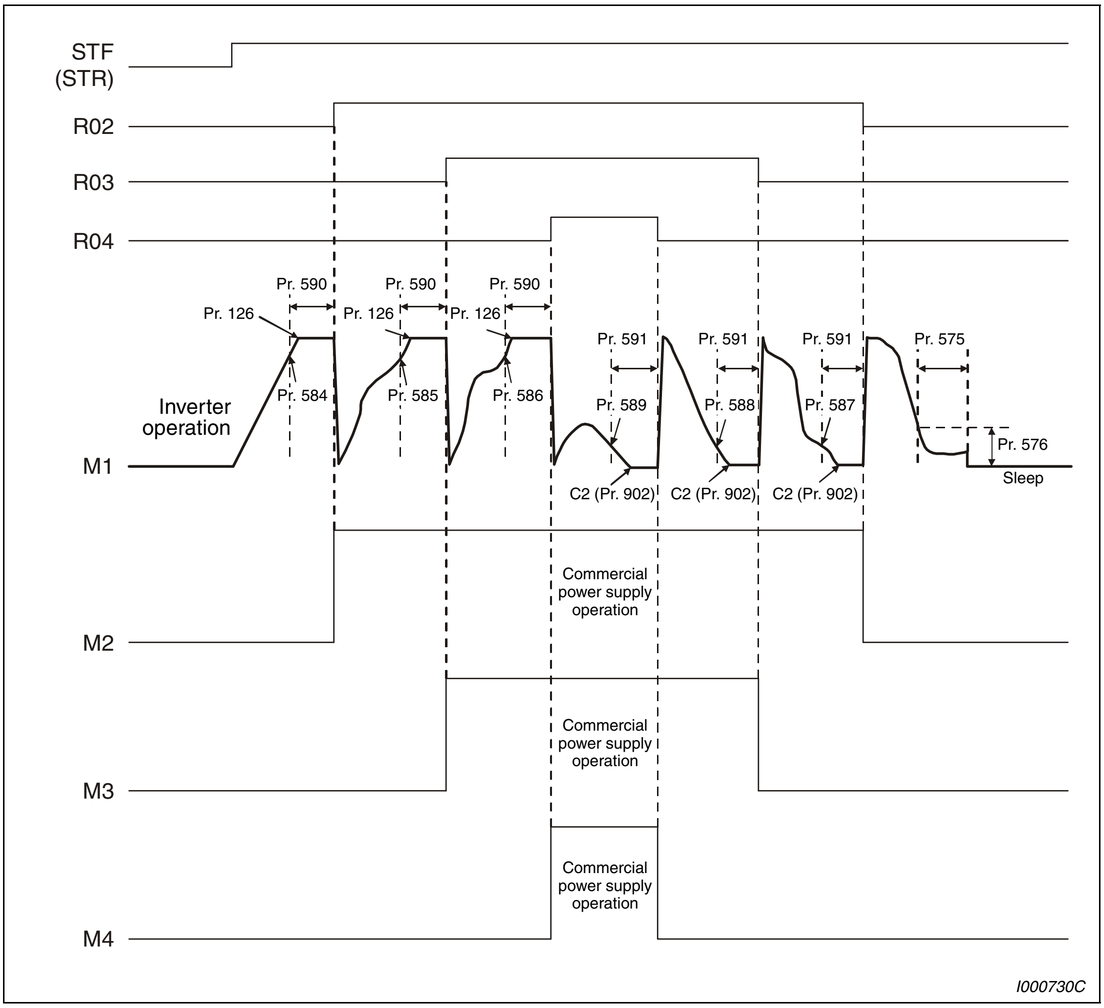


Fig. 6-184: *Transient characteristic in the basic system*

NOTE

The curved sections of the output frequency graphs for the motor under frequency inverter control are shown to illustrate PID control in response to process requirements.

Pr. 579 = 1 (When using two motors in the alternative system)

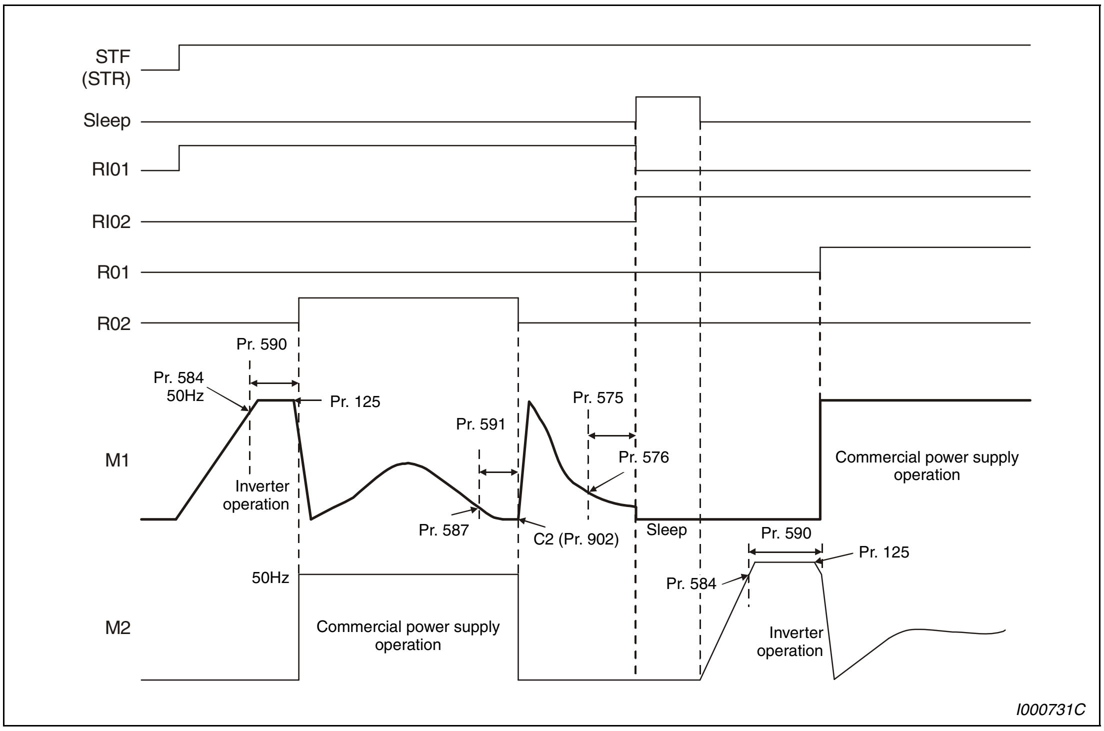


Fig. 6-185: *Transient characteristic in the alternative system*

NOTE

The curved sections of the output frequency graphs for the motor under frequency inverter control are shown to illustrate PID control in response to process requirements.

Pr. 579 = 2 (When using two motors in the direct system)

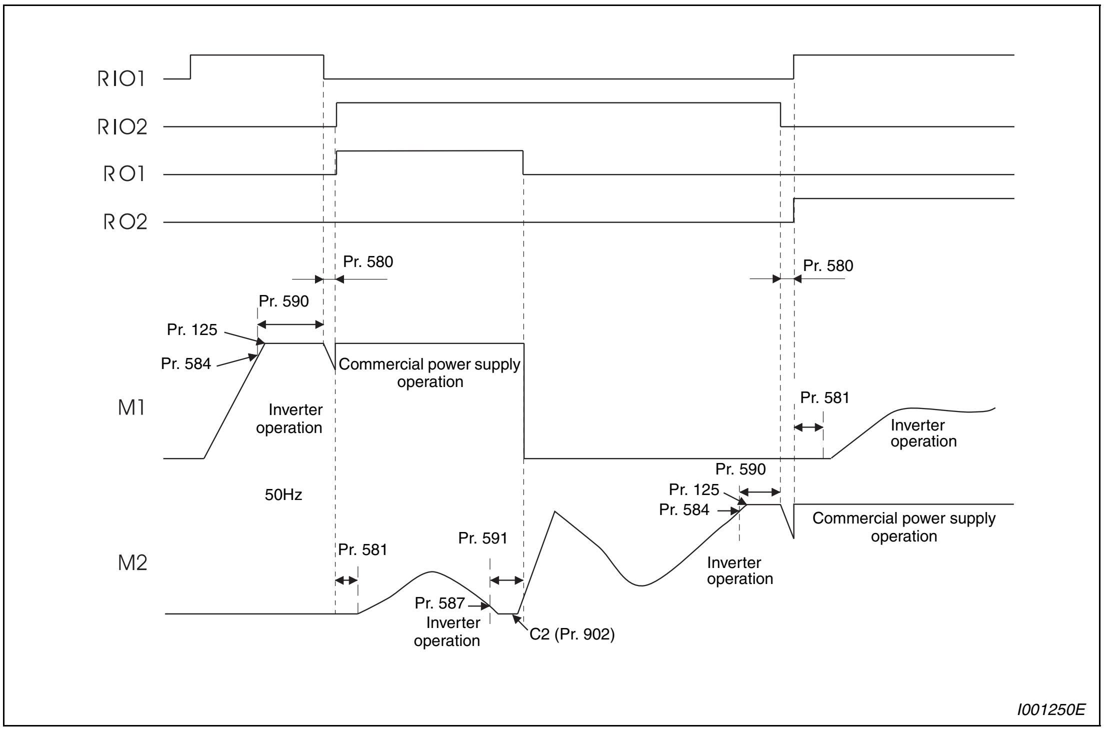


Fig. 6-186: *Transient characteristic in the direct system*

NOTES

When a start signal is turned off while running, MC (R01 to R04) turns off and the inverter decelerates.

When an error occurs while running, MC (R01 to R04) turns off and the inverter output is shut off.

The curved sections of the output frequency graphs for the motor under frequency inverter control are shown to illustrate PID control in response to process requirements.

Pr. 579 = 3 (When using two motors in the alternative-direct system)

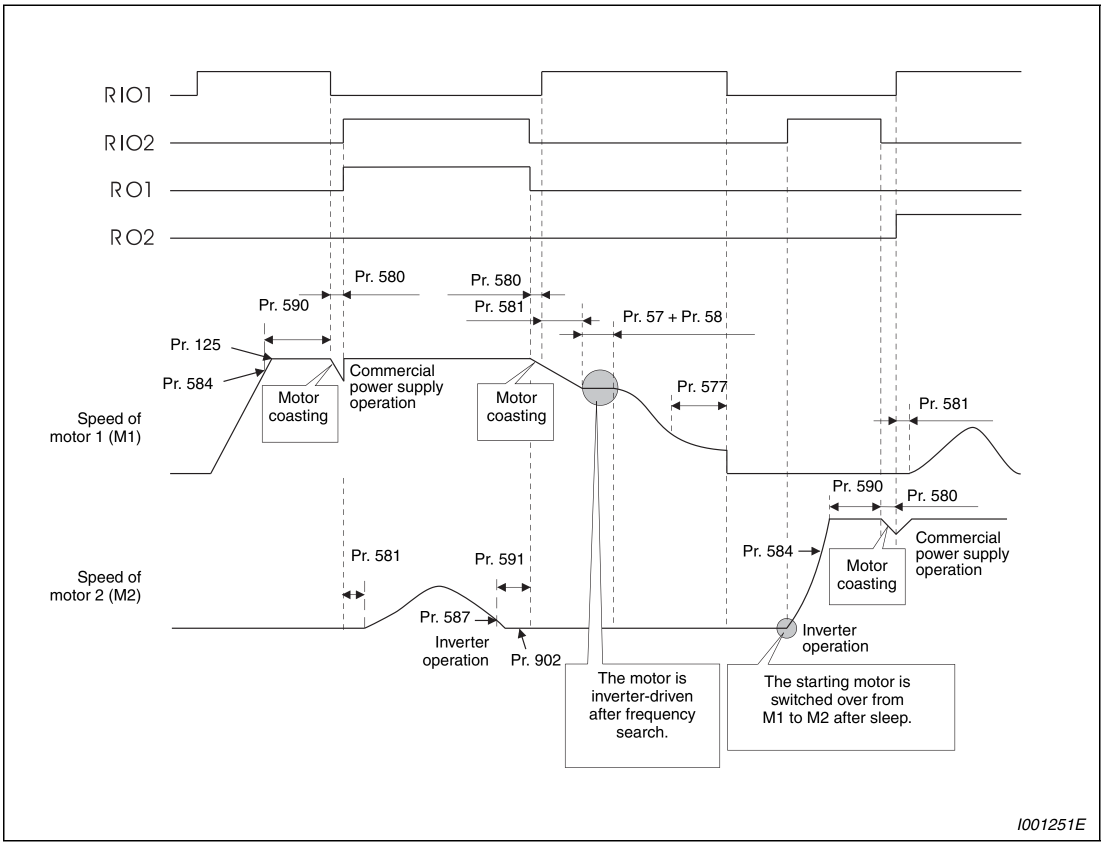


Fig. 6-187: *Transient characteristic in the alternative-direct system*

NOTES

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 (R01 to R04) 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 inverter 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 a stop independently of the Pr. 579 setting, operation by the advanced PID control is performed again at the point when the signal is turned on.

The curved sections of the output frequency graphs for the motor under frequency inverter control are shown to illustrate PID control in response to process requirements.

6.19.4 Traverse function (Pr. 592 to Pr. 597)

Traverse operation which varies the amplitude of the frequency in a constant cycle can be performed. This function of the is designed specifically for use in yarn-winding applications in the textile industry.

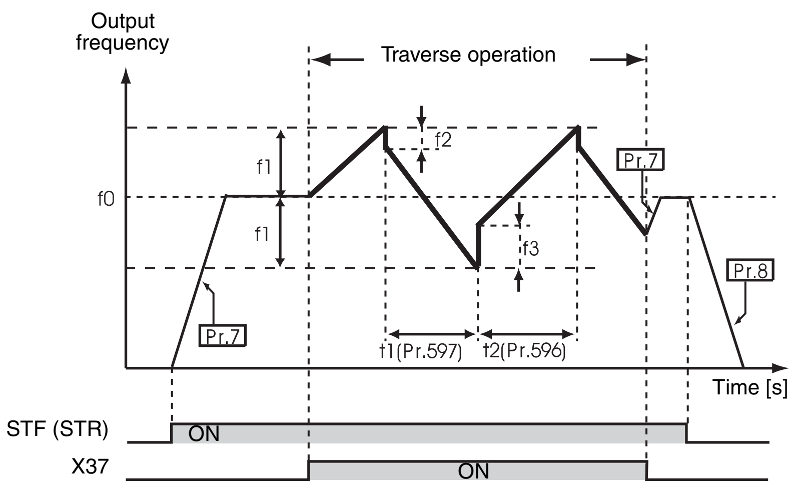
Pr. No.	Name	Initial Value	Setting Range	Description
592	Traverse function selection	0	0	Traverse function invalid
			1	Traverse function is valid only in the external operation mode
			2	Traverse function is valid independently of operation mode
593	Maximum amplitude amount	10%	0–25%	Amplitude amount during traverse operation
594	Amplitude compensation amount during deceleration	10%	0–50%	Compensation amount at the time of amplitude inversion (acceleration → deceleration)
595	Amplitude compensation amount during acceleration	10%	0–50%	Compensation amount during amplitude inversion operation (deceleration → acceleration)
596	Amplitude acceleration time	5s	0.1–3600s	Acceleration time during traverse operation
597	Amplitude deceleration time	5s	0.1–3600s	Deceleration time during traverse operation

Parameters referred to		Refer to Section
1	Maximum frequency	6.3.1
2	Minimum frequency	6.3.1
7	Acceleration time	6.6.1
8	Deceleration time	6.6.1
29	Acceleration/deceleration pattern selection	6.6.3
178–189	Input terminal function selection	6.9.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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. 597)
t2: time from deceleration during traverse operation (time from (f0 – f1) to (f0 + f1) (Pr. 596)

I001252E

Fig. 6-188: *Traverse function*

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".

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.

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.)

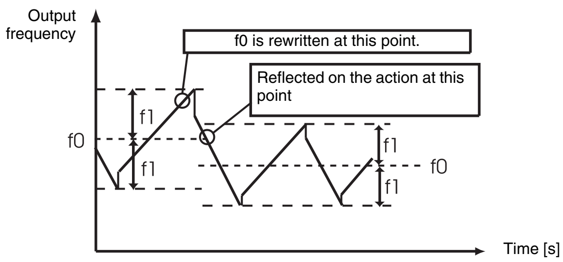
After having decelerated to f0 – f1, compensation of f3 (f1 × Pr. 595) is made and the frequency again accelerates to f0 + f1.

If the X37 signal is turned off 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).

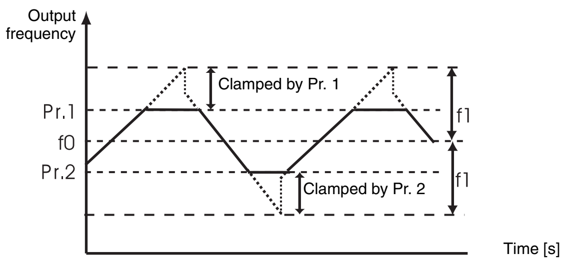
NOTES

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.

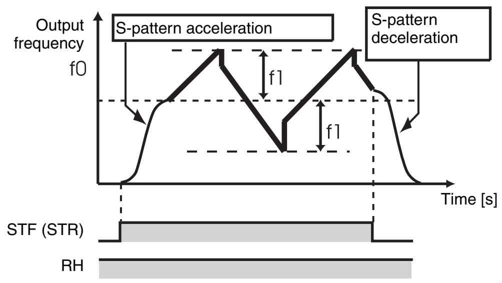


When the output frequency exceeds Pr. 1 "Maximum frequency" or Pr. 2 "Minimum frequency", the output frequency is clamped at maximum/minimum frequency while the set pattern exceeds the maximum/minimum frequency.

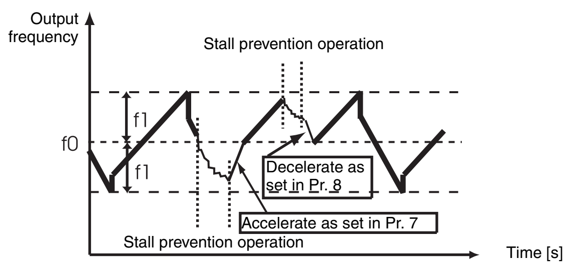


NOTE

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 stoped 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.



When the value of amplitude inversion compensation amount (Pr. 594, Pr. 595) is too large, pattern operation as set is not performed due to over voltage 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.

6.19.5 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.

Pr. No.	Name	Initial Value	Setting Range	Description
882	Regeneration avoidance operation selection	0	0	Regeneration avoidance function invalid
			1	Regeneration avoidance function valid
883	Regeneration avoidance operation level	760V DC/ 785V DC *	300–800V	Set the bus voltage level at which regeneration avoidance operates. When the bus voltage level is set to low, over voltage error will be less apt to occur. However, the actual deceleration time increases. The set value must be higher than the power supply voltage $\times \sqrt{2}$. ** The initial value differs according to the inverter capacity. (01160 or less/0180 or more)*
884	Regeneration avoidance at deceleration detection sensitivity	0	0	Regeneration avoidance by bus voltage change ratio is invalid
			1–5	Set sensitivity to detect the bus voltage change 1 (low) $\rightarrow$ 5 (high)
885	Regeneration avoidance compensation frequency limit value	6Hz	0–10Hz	Set the limit value of frequency which rises at activation of regeneration avoidance function.
			9999	Frequency limit invalid
886	Regeneration avoidance voltage gain	100%	0–200%	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.

Parameters referred to		Refer to Section
1	Maximum frequency	6.3.1
8	Deceleration time	6.6.1
22	Stall prevention operation level	6.2.4

The above parameters can be set when Pr. 160 "User group read selection" = 0.

What is regeneration avoidance function? (Pr. 882, Pr. 883)

When the regeneration status is serious, the DC bus voltage rises and an over voltage 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 function is performed during any of acceleration, constant speed and deceleration.

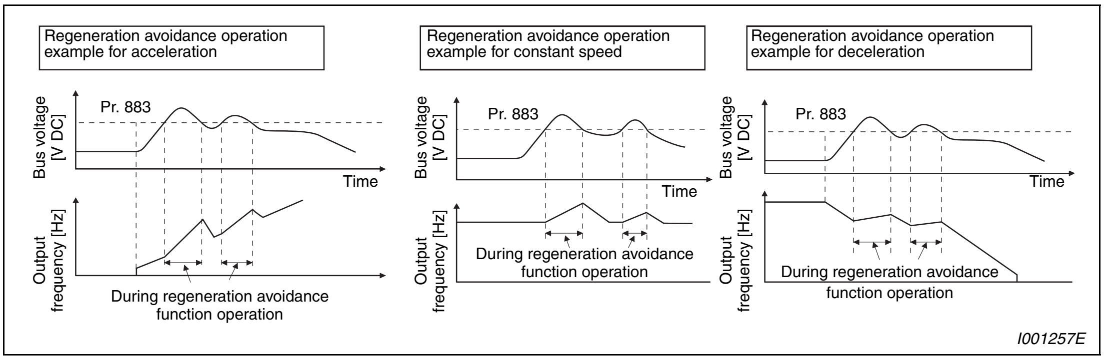


Fig. 6-189: *Regeneration avoidance function*

NOTES

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 440V AC, the bus voltage is about 622V DC). 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 over voltage stall (oL) stops the output frequency during deceleration, the regeneration avoidance function is always on and increases the frequency according to the regeneration amount.

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.

NOTE

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.

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.

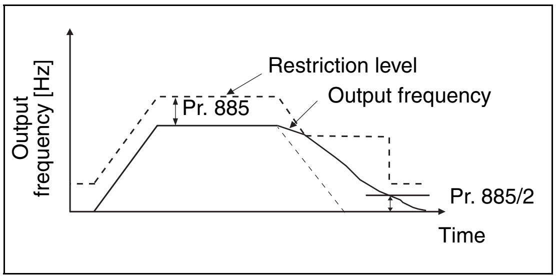


Fig. 6-190:
Limit the output frequency

I001260E

Regeneration avoidance function adjustment (Pr. 886)

If the frequency becomes instable during regeneration avoidance operation, decrease the setting of Pr. 886 "Regeneration avoidance voltage gain". Reversely, if sudden regeneration causes an over voltage alarm, increase the setting.

When the load inertia of the motor is large, decrease the Pr. 886 setting.

NOTES

When regeneration avoidance operation is performed, "oL" (over voltage stall) is displayed and the OL signal is output.

When regeneration avoidance operation is performed, stall prevention is also activated at the same time.

The regeneration avoidance function cannot shorten the actual deceleration time taken to stop the motor. The actual deceleration time depends on the regeneration capability. When shortening the deceleration time, consider using the regeneration unit (FR-BU, MT-BU5, FR-CV, FR-HC, MT-HC).

When using the regeneration unit (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 (over voltage stall). Pr. 157 "OL signal output timer" also becomes the target of (over voltage stall).

6.20 Useful functions

Purpose	Parameters that must be set		Refer to Section
Increase cooling fan life	Cooling fan operation selection	Pr. 244	6.20.1
To determine the maintenance time of parts.	Inverter part life display	Pr. 255–Pr. 259	6.20.2
	Maintenance output function	Pr. 503–Pr. 504	6.20.3
	Current average value monitor signal	Pr. 555–Pr. 557	6.20.4
Freely available parameter	Free parameter	Pr. 888–Pr. 889	6.20.5

6.20.1 Cooling fan operation selection (Pr. 244)

You can control the operation of the cooling fan (00083 or more) built in the inverter.

Pr. No.	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 of the heatsink.

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5

The above parameter can be set when Pr. 160 "User group read selection" = 0.

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" (source logic) or "125" (sink logic) to any of Pr. 190 to Pr.196 "Output terminal function selection", and for the LF signal, set "98" (source logic) or "198" (sink logic).

NOTE

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.

6.20.2 Display of the life of the inverter parts (Pr. 255 to Pr. 259)

Degrees of deterioration of main circuit capacitor, control circuit capacitor or inrush current limit circuit and cooling fan 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 shown on page 6-319 is not performed.

Pr. No.	Name	Initial Value	Setting Range	Description
255	Life alarm status display	0	(0–15)	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%	(0–100%)	Display the deterioration degree of the inrush current limit circuit. Reading only
257	Control circuit capacitor life display	100%	(0–100%)	Display the deterioration degree of the control circuit capacitor. Reading only
258	Main circuit capacitor life display	100%	(0–100%)	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 (refer to the following pages). When the Pr. 259 value is "3" after powering on again, the measuring is completed. Read the deterioration degree in Pr. 258.

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

Life alarm display and signal output (Y90 signal, Pr. 255)

Whether any of the control circuit capacitor, main circuit capacitor, cooling fan and inrush current limit circuit has reached the life alarm output level or not can be checked by Pr. 255 "Life alarm status display" and life alarm signal (Y90).

① Read the setting of parameter 255.

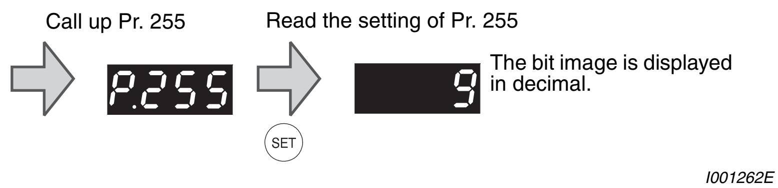


Fig. 6-191: *Read parameter 255*

② When the life alarm output level is reached, the bits are set as follows.

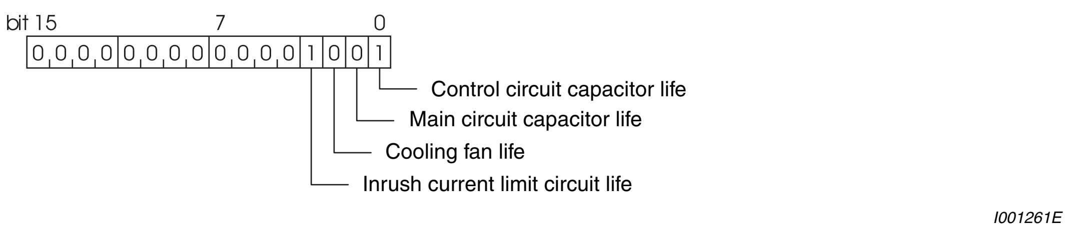


Fig. 6-192: *Bits of parameter 255*

Pr. 255 (decimal)	Bits (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	—	—	—	—

Tab. 6-98: *Displaying the end of service life by bits*

✔: End of the service life is reached
—: End of the service life is not reached

The life alarm signal (Y90) turns on when any of the control board 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" (source logic) or "190" (sink logic) to any of Pr. 190 to Pr.196 "Output terminal function selection".

NOTES

The digital output option (FR-A7AY) allows the control circuit capacitor life signal (Y86), main circuit capacitor life signal (Y87), cooling fan life signal (Y88) and inrush current limit circuit life signal (Y89) to be output individually.

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.

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.

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 energizing time and temperature of the inverter's heatsink, 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.

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. Please also provide a separate mains power supply for the inverter's control circuit (terminals L11 and L21).

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 ❸, ❼, ❽, ❾ below)	
9	Measurement error (see ❹, ❺, ❻ below)	

Tab. 6-99: *Parameter 259*

The life of the main circuit capacitor can not be measured in the following conditions:

❶ The FR-HC, MT-HC, FR-CV, FR-BU, MT-BU5 or BU is connected.

❷ Terminals R1/L11, S1/L21 or DC power supply is connected to the terminal P/+ and N/–.

❸ Switch power on again during measuring.

❹ The motor is not connected to the inverter.

❺ The motor is running. (The motor is coasting.)

❻ The motor capacity is two ranks (or more) smaller as compared to the inverter capacity.

❼ The inverter is at an alarm stop or an alarm occurred while power is off.

❽ The inverter output is shut off with the MRS signal.

❾ 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)

Cooling fan life display

The cooling fan speed of 40% or less is detected and "FN" is displayed on the operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07). As an alarm display, Pr. 255 bit 2 is turned on and also an alarm is output to the Y90 signal.

NOTE

When the inverter is mounted with two or more cooling fans, the life of even one cooling fan is diagnosed.

6.20.3 Maintenance timer alarm (Pr. 503, Pr. 504)

When the cumulative energizing 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.

Pr. No.	Name	Initial Value	Setting Range	Description
503	Maintenance timer	0	0 (1–9998)	Display the cumulative energizing time of the inverter in 100h increments. Reading only Writing the setting of "0" clears the cumulative energizing time.
504	Maintenance timer alarm output set time	9999	0–9998	Set the time taken until when the maintenance timer alarm output signal (Y95) is output.
			9999	No function

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5

The above parameters can be set when Pr. 160 "User group read selection" = 0.

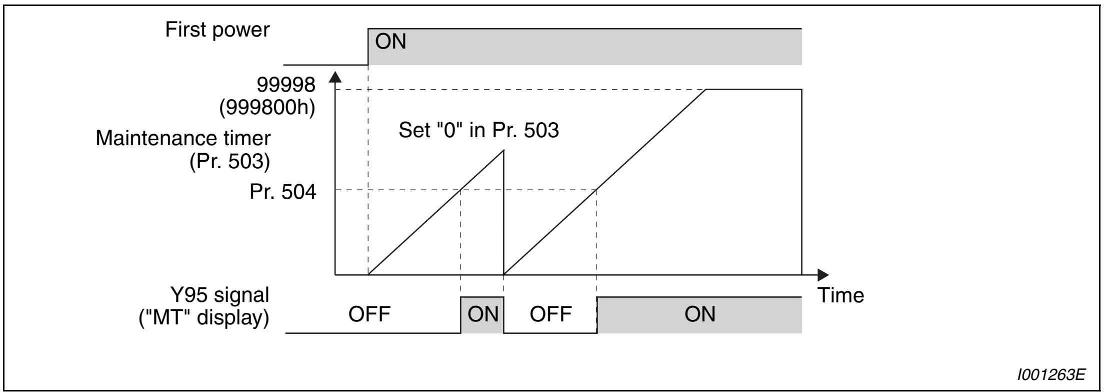


Fig. 6-193: *Maintenance timer*

The cumulative energizing time of the inverter is stored into the E^2PROM 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" (source logic) or "195" (sink logic) to any of Pr. 190 to Pr. 196 "Output terminal function selection".

NOTES

The cumulative energizing time is counted every hour. The energizing 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.

6.20.4 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.

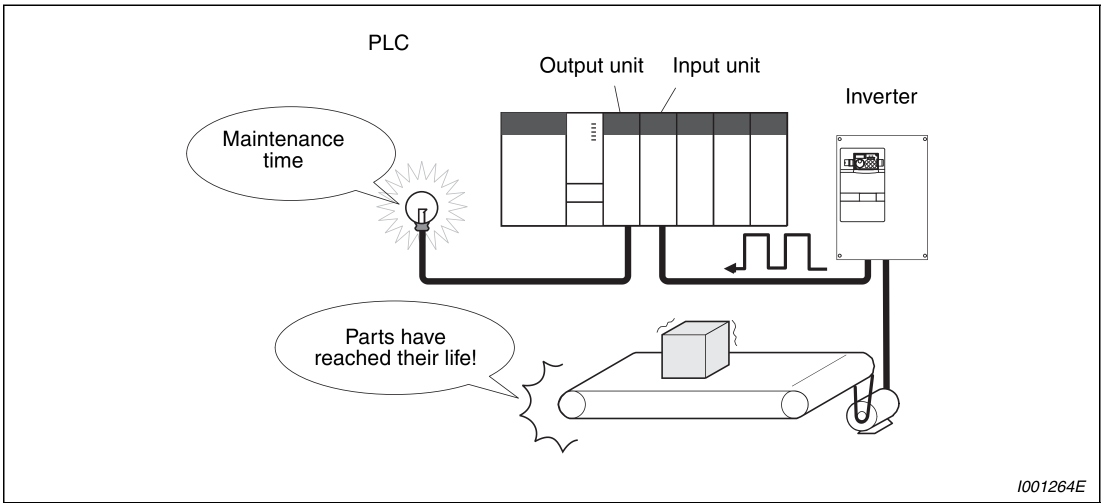


Fig. 6-194: *Monitoring the maintenance timer and current average value*

Pr. No.	Name	Initial Value	Setting Range	Description
555	Current average time	1s	0.1–1.0s	Set the time taken to average the current during start bit output (1s).
556	Data output mask time	0s	0.0–20.0s	Set the time for not obtaining (mask) transient state data.
557	Current average value monitor signal output reference current	Rated inverter current	0–500/ 0–3600A ①	Set the reference (100%) for outputting the signal of the current average value.

Parameters referred to		Refer to Section
190–196	Output terminal function selection	6.9.5
503	Maintenance timer	6.20.3
57	Restart coasting time	6.11.1

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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

① The setting depends on capacities. (01160 or less/01800 or more)

The pulse output of the current average value monitor signal (Y93) is shown below.

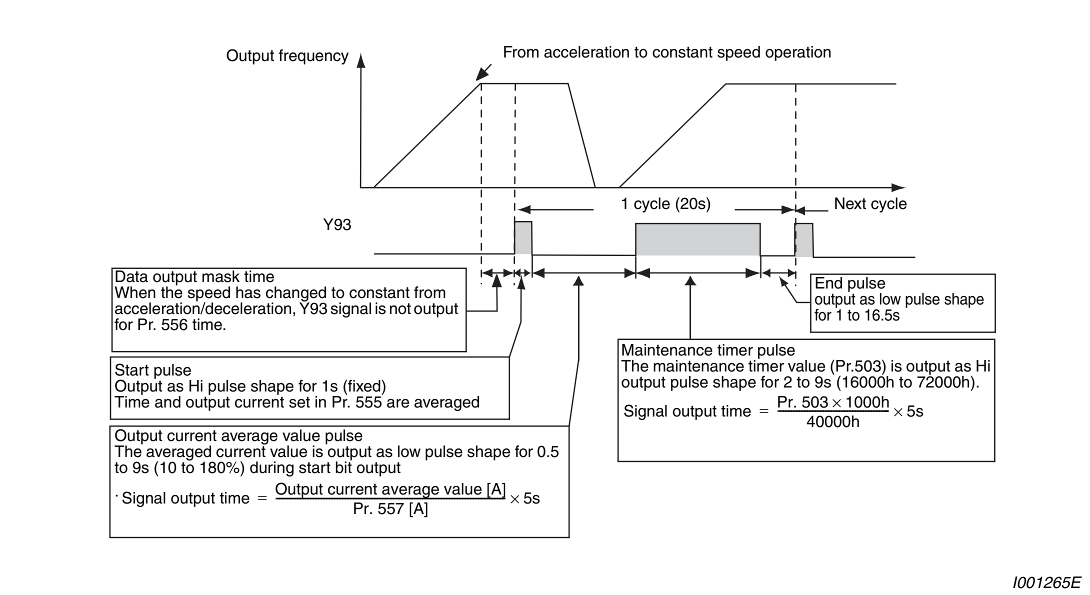


Fig. 6-195: *Output of the pulse signal Y93*

For the terminal used for the Y93 signal output, assign the function by setting "93" (source logic) or "193" (sink 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".)

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.

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.

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 of the low pulse after a fixed start pulse of 1s from the following calculation.

$$\frac{\text{Output current average value}}{\text{Pr. 557}} \times 5\text{s (output current average value 100 \%/5s)}$$

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 it exceeds 180%.

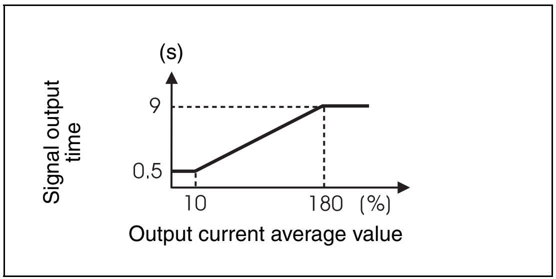


Fig. 6-196:
Signal output time for the current average value

I001266E

Example ▽

When Pr. 557 = 10A and the average value of output current is 15A, the current average value monitor signal is output as low pulse shape for 7.5s.

$$\text{Signal output time} = \frac{15\text{A}}{10\text{A}} \times 5\text{s} = 7.5\text{s}$$

△

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.

$$\frac{\text{Pr. 503}}{40000\text{h}} \times 5\text{s (Maintenance timer value 100\%/5s)}$$

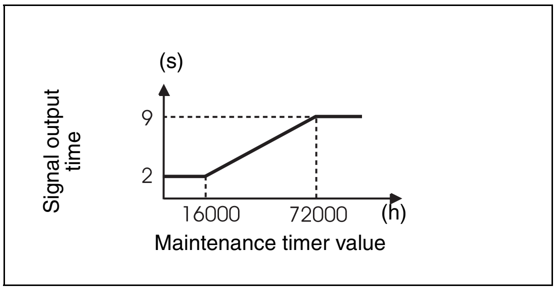


Fig. 6-197:
Signal output time for the maintenance output value

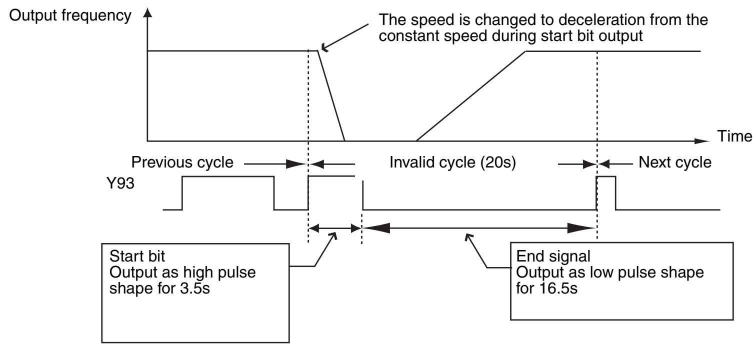
I001267E

Note that the output time range is 2 to 9s, and it is 2s when Pr. 503 is less than16000h and 9s when it exceeds 72000h.

NOTES

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:

- When the motor is in the acceleration/deceleration state on completion of the 1 cycle signal output.
- When 1-cycle signal output was ended during restart operation with the setting of automatic restart after instantaneous power failure (Pr. 57 ≠ 9999).
- 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.

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.

6.20.5 Free parameters (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.

Pr. No.	Name	Initial Value	Setting Range	Description
888	Free parameter 1	9999	0–9999	Desired values can be input. Data is held even if the inverter power is turned off.
889	Free parameter 2	9999	0–9999	

Parameters referred to	Refer to Section
—	

The above parameters can be set when Pr. 160 "User group read selection" = 0.

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".

NOTE Pr. 888 and Pr. 889 do not influence the inverter operation.

6.21 Setting for the parameter unit, operation panel

Purpose	Parameters that must be set		Refer to Section
Switch the display language of the parameter unit	PU display language selection	Pr. 145	6.21.1
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	6.21.2
Control of the parameter unit, operation panel buzzer	PU buzzer control	Pr. 990	6.21.3
Adjust the LCD contrast of the parameter unit	PU contrast adjustment	Pr. 991	6.21.4

6.21.1 PU display language selection (Pr. 145)

By using parameter 145 you can select the display language for the parameter unit FR-PU04/ FR-PU07.

Pr. No.	Name	Initial Value	Setting Value	Description
145	PU display language selection	1	0	Japanese
			1	English
			2	German
			3	French
			4	Spanish
			5	Italian
			6	Swedish
			7	Finnish

Parameters referred to	Refer to Section
—	

The above parameter can be set when Pr. 160 "User group read selection" = 0.

6.21.2 Operation panel frequency setting/key lock operation selection (Pr. 161)

The setting dial of the operation panel (FR-DU07) can be used like a potentiometer to perform operation. The key operation of the operation panel can be disabled.

Pr. No.	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 These setting must be confirmed by pressing the MODE key for about 2 s.
			11	Setting dial volume mode	

Parameters referred to	Refer to Section
—	

The above parameter can be set when Pr. 160 "User group read selection" = 0.

NOTES

You can find a detailed description of the operation panel with examples in section 4.3 "Operation Panel FR-DU07".

When the setting dial and key operation is made invalid, "HOLD" appears on the operation panel while pressing a key.

The STOP/RESET key is valid even in the operation lock status.

6.21.3 Buzzer control (Pr. 990)

You can make the buzzer "beep" when you press a key of the operation panel (FR-DU07) and parameter unit (FR-PU04/FR-PU07).

Pr. No.	Name	Initial Value	Setting Range	Description
990	PU buzzer control	1	0	Without buzzer
			1	With buzzer

Parameters referred to	Refer to Section
—	

The above parameter can be set when Pr. 160 "User group read selection" = 0.

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

6.21.4 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. You should press the WRITE key to store the PU contrast setting.

Pr. No.	Name	Initial Value	Setting Range	Description
991	PU contrast adjustment	58	0–63	0: Light ↓ 63: Dark

Parameters referred to	Refer to Section
—	

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.

7 Troubleshooting

When an alarm 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 the 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 a protective function of the inverter is activated, the power output of the inverter is blocked (motor is coasting). The inverter cannot start up again unless an automatic restart has been configured or the inverter is reset. Please observe carefully the warnings contained below in the configuration of an automatic restart or the execution of a reset.
- If protective functions were activated (i. e. the inverter switched off with an error message) follow the instructions for error correction provided in the manual for the inverter. Especially in the case of short circuits or earth contacts in the inverter output and mains overvoltages the cause of the fault must be determined prior to switching on again as a recurrence of such faults at short intervals can lead to premature aging of components or even the complete breakdown of the device. After the cause of the fault has been found and corrected the inverter can be reset and operations continue.

7.1 List of alarm display

Operation Panel Indication			Name	Refer to Page
Error message	HOLd	HOLD	Operation panel lock	7-4
	Er 1 to Er 4	Er1 to Er4	Parameter write error	7-4
	rE 1 to rE 4	rE1 to rE4	Copy operation error	7-5
	Err.	Err.	Error	7-6
Warnings	OL	OL	Stall prevention (overcurrent)	7-7
	oL	oL	Stall prevention (overvoltage)	7-7
	rb	RB	Regenerative brake prealarm	7-8
	E.THT	TH	Electronic thermal relay function prealarm	7-8
	PS	PS	PU Stop	7-8
	MT	MT	Maintenance signal output	7-8
	CP	CP	Parameter copy	7-9
Minor fault	Fn	FN	Fan fault	7-9
Major failures	E.OC 1	E.OC1	Overcurrent shut-off during acceleration	7-9
	E.OC 2	E.OC2	Overcurrent shut-off during constant speed	7-10
	E.OC 3	E.OC3	Overcurrent shut-off during deceleration or stop	7-10
	E.Ou 1	E.OV1	Regenerative overvoltage shut-off during acceleration	7-10
	E.Ou2	E.OV2	Regenerative overvoltage shut-off during constant speed	7-10
	E.Ou 3	E.OV3	Regenerative overvoltage shut-off during deceleration or stop	7-11
	E.THT	E.THT	Inverter overload shut-off (electronic thermal relay function)	7-11
	E.THM	E.THM	Motor overload shut-off (electronic thermal relay function)	7-11
	E.FI n	E.FIN	Fin overheat	7-12
	E.I PF	E.IPF	Instantaneous power failure protection	7-12
	E. bE	E.BE	Brake transistor alarm detection/ internal circuit error	7-12
	E.UuT	E.UVT	Undervoltage protection	7-13
	E.I LF	E.ILF ①	Input phase loss	7-13
	E.OLT	E.OLT	Stall prevention	7-13

Tab. 7-1: *List of alarm display (1)*

Operation Panel Indication			Name	Refer to Page
Major failures	E. GF	E.GF	Output side earth (ground) fault overcurrent protection	7-13
	E. LF	E.LF	Output phase loss	7-14
	E.OHT	E.OHT	External thermal relay operation	7-14
	E.PTC	E.PTC ①	PTC thermistor operation	7-14
	E.OPT	E.OPT	Error related to the connection of a (external) option	7-14
	E.OP1	E.OP1	Error of the internal (extension slot) installed option (e.g. communication error)	7-15
	E. 1	E. 1	Error of the internal (extension slot) installed option (e.g. connection or contact fault respectively)	7-15
	E. PE	E.PE	Parameter storage device alarm	7-15
	E.PUE	E.PUE	PU disconnection	7-16
	E.r.E.T	E.RET	Retry count excess	7-16
	E.PE2	E.PE2 ①	Parameter storage device alarm	7-15
	E. 5	E. 5	CPU fault	7-16
	E. 6	E. 6		
	E. 7	E. 7		
	E.CPU	E.CPU		
	E.CTE	E.CTE	Operation panel power supply short circuit RS-485 terminal power supply short circuit	7-17
	E.P24	E.P24	24V DC power output short circuit	7-17
	E.CdO	E.CDO ①	Output current detection value exceeded	7-17
	E.IOH	E.IOH ①	Inrush resistor overheat	7-17
	E.SEr	E.SER ①	Communication error (inverter)	7-18
	E.AIE	E.AIE ①	Analog input error	7-18
	E.PId	E.PID ①	PID signal fault	7-18
	E. 13	E.13	Internal circuit error	7-18

Tab. 7-1: *List of alarm display (2)*

① If when employing the parameter unit FR-PU04/FR-PU07 one of the errors "E.ILF, E.PTC, E.PE2, E.CDO, E.IOH, E.SER, E.AIE, E.PID" occurs, then "Fault 14" will be displayed.

7.2 Causes and corrective actions

Error Message

A message regarding operational troubles is displayed. Output is not shutoff.

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 section 4.3.3.)	
Check point	—	
Corrective action	Press the MODE key 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 section 6.16.2.) 2) Check the settings of Pr. 31 to 36 (frequency jump). (Refer to section 6.3.2.) 3) Check the settings of Pr. 100 to Pr. 109 (Adjustable 5 points V/F). (Refer to section 6.4.3.) 4) Check the connection of the PU and inverter.	

Operation Panel Indication	Er2	Er2
Name	Write error during operation	
Description	When parameter write was performed during operation with a value other than "2" (writing is enabled independently of operation 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 section 6.16.2.) 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.	
Corrective action	Check the settings of C3, C4, C6 and C7 (calibration functions). (Refer to section 6.15.4.)	

Operation Panel Indication	**Er4**	
Name	Mode designation error	
Description	• You attempted to make parameter setting in the NET operation mode when Pr. 77 is not "2". • If a parameter write was performed when the command source is not at the operation panel (FRDU07).	
Check point	1) Check that operation mode is "PU operation mode". 2) Check the Pr. 77 setting. (Refer to section 6.16.2.) 3) Check the Pr. 551 setting.	
Corrective action	1) After setting the operation mode to the "PU operation mode", make parameter setting. (Refer to section 6.16.2.) 2) After setting "2" in Pr. 72, make parameter setting. 3) Set Pr. 551 = "2 (initial setting)". (Refer to section 6.17.3)	

Operation Panel Indication	**rE1**	
Name	Parameter read error	
Description	An error occurred in the E²PROM on the operation panel side during parameter copy reading.	
Check point	—	
Corrective action	• Make parameter copy again. (Refer to section 5.10). • Check for an operation panel (FR-DU07) failure. Please contact your sales representative.	

Operation Panel Indication	**rE2**	
Name	Parameter write error	
Description	1) You attempted to perform parameter copy write during operation. 2) An error occurred in the E²PROM 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 section 5.10.) 2) Check for an operation panel (FR-DU07) failure. Please contact your sales representative.	

Operation Panel Indication	**rE3**	
Name	Parameter verification error	
Description	1) Data on the operation panel side and inverter side are different. 2) An error occurred in the E²PROM 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 the SET key to continue verification. Make parameter verification again. (Refer to section 5.10.2). 2) Check for an operation panel (FR-DU07) failure. Please contact your sales representative.	

Operation Panel Indication	**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.**	
Name	Error	
Description	1) The RES signal is on. 2) The PU and inverter cannot make normal communication (contact fault of the connector). 3) When the voltage drops in the inverter's input side. 3) When the control circuit power (R1/L11, S1/L21) and the main circuit power 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. 3) Check the voltage on the inverter's input side.	

Warnings

When the protective function is activated, the output is not shut off.

Operation Panel Indication	OL	OL	FR-PU04 FR-PU07	OL
Name	Stall prevention (overcurrent)			
Description	During acceleration	If a current of more than 110% ① of the rated inverter current flows in the motor, this function stops the increase in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 110% ①, this function increases the frequency again.		
	During constant-speed operation	If a current of more than 110% ① of the rated inverter current flows in the motor, this function lowers the frequency until the overload current reduces to prevent overcurrent shut-off. When the overload current has reduced below 110% ①, this function increases the frequency up to the set value.		
	During deceleration	If a current of more than 110% ① of the rated inverter current flows in the motor, this function stops the decrease in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 110% ①, this function decreases the frequency again.		
Check point	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. 6) Check that the Pr. 22 Stall prevention operation level is appropriate.			
Corrective action	1) Increase or decrease the Pr. 0 "Torque boost setting" 1% by 1% and check the motor status. (Refer to section 6.2.1.) 2) Set a larger value in Pr. 7 "Acceleration time" and Pr. 8 "Deceleration time". (Refer to section 6.6.1.) 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.)			

① 120% when the overload capacity is 150%

Operation Panel Indication	oL	oL	FR-PU04 FR-PU07	oL
Name	Stall prevention (overcurrent)			
Description	During deceleration	● If the regenerative energy of the motor becomes excessive and exceeds the regenerative energy consumption capability, this function stops the decrease in frequency to prevent overvoltage 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 section 6.19.5.)		
Check point	● Check for sudden speed reduction. ● Regeneration avoidance function (Pr. 882 to Pr. 886) is being used? (Refer to section 6.19.5).			
Corrective action	The deceleration time may change. Increase the deceleration time using Pr. 8 "Deceleration time".			

Operation Panel Indication	PS		FR-PU04 FR-PU07	PS
Name	PU Stop			
Description	Stop with the STOP/RESET key of the PU is set in Pr. 75 "Reset selection/disconnected PU detection/PU stop selection". (For Pr. 75, refer to section 6.16.1.)			
Check point	Check for a stop made by pressing the STOP/RESET key of the operation panel.			
Corrective action	Turn the start signal off and release with PU/EXT key.			

Operation Panel Indication	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. When the setting of Pr. 70 Special regenerative brake duty is the initial value (Pr. 70 ="0"), this warning does not occur.If the regenerative brake duty reaches 100%, a regenerative overvoltage (E. OV☐) occurs. The RBP signal can be simultaneously output with the [RB] display. For the terminal used for the RBP signal output, assign the function by setting "7" (positive logic) or "107" (negative logic) in any of Pr. 190 to Pr. 196 (output terminal function selection). (Refer to section 6.9.5) 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 (Pr. 8). ● Check the Pr. 30 "Regenerative function selection" and Pr. 70 "Special regenerative brake duty" values.			

Operation Panel Indication	TH		FR-PU04 FR-PU07	TH
Name	Electronic thermal relay function prealarm			
Description	Appears if the integrating 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" (source logic) or "108" (sink logic) in any of Pr. 190 to Pr. 196 "Output terminal function selection". (Refer to section 6.9.5.)			
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 section 6.7.1.)			
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 section 6.7.1.)			

Operation Panel Indication	MT		FR-PU04	—
			FR-PU07	MT
Name	Maintenance signal output			
Description	Indicates that the cumulative energizing time of the inverter has reached a given time. When the setting of Pr. 504 Maintenance timer alarm output set time is the initial value (Pr. 504 = "9999"), this protective function does not function.			
Check point	The Pr. 503 "Maintenance timer" setting is larger than the Pr. 504 "Maintenance timer alarm output set time" setting. (Refer to section 6.20.3.)			
Corrective action	Setting "0" in Pr. 503 "Maintenance timer" erases the signal.			

Operation Panel Indication	**CP**	CP	**FR-PU04**	**—**
			FR-PU07	**CP**
Name	Parameter copy			
Description	Appears when parameters are copied between models with capacities of 01160 or less and 01800 or more.			
Check point	Resetting of parameters 9, 30, 51, 52, 54, 56, 57, 70, 72, 80, 90, 158, 190 to 196 and 893 is necessary.			
Corrective action	Set the initial value in Pr. 989 "Parameter copy alarm release".			

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 section 6.9.5.)

Operation Panel Indication	**PS**	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.			

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 Acc**
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 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 section 6.2.4.) 5) Set base voltage (rated voltage of the motor, etc.) in Pr. 19 "Base frequency voltage". (Refer to section 6.4.1.)			

Operation Panel Indication	E.OC2		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 section 6.2.4.)			

Operation Panel Indication	E.OC3		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 section 6.2.4.)			

Operation Panel Indication	E.OV1		FR-PU04 FR-PU07	OV During Acc
Name	Regenerative overvoltage shutoff 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	1) Check for too slow acceleration. (e.g. during descending acceleration with lifting load) 2) Check that the Pr. 22 Stall prevention operation level is not lower than the no load current.			
Corrective action	1) ● Decrease the acceleration time. ● Use regeneration avoidance function (Pr. 882 to Pr. 886). (Refer to section 6.19.5.) 2) Set a value larger than the no load current in Pr. 22 Stall prevention operation level.			

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	1) Check for sudden load change. 2) Check that the Pr. 22 Stall prevention operation level is not lower than the no load current.			
Corrective action	1) ● Keep load stable. ● Use regeneration avoidance function (Pr. 882 to Pr. 886). (Refer to section 6.19.5.) ● Use the brake unit or power regeneration common converter (FR-CV) as required. 2) Set a value larger than the no load current in Pr. 22 Stall prevention operation level.			

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 inertia moment of the load) ● Decrease the braking duty. ● Use the brake unit or power regeneration common converter (FR-CV) as required. ● Use regeneration avoidance function (Pr. 882 to Pr. 886). (Refer to section 6.19.5.)			

Operation Panel Indication	E.THT		FR-PU04 FR-PU07	Inv. Overload
Name	Inverter overload shut-off (electronic thermal relay function) [1]			
Description	If a current not less than 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	1) Check that acceleration/deceleration time is not too short. 2) Check that torque boost setting is not too large (small). 3) Check that load pattern selection setting is appropriate for the load pattern of the using machine. 4) Check the motor for use under overload.			
Corrective action	1) Increase acceleration/deceleration time. 2) Adjust the torque boost setting. 3) Set the load pattern selection setting according to the load pattern of the using machine. 4) Reduce the load weight.			

[1] Resetting the inverter initializes the internal thermal integrated data of the electronic thermal relay function.

[2] 120% when the overload capacity is 150%

Operation Panel Indication	E.THM		FR-PU04 FR-PU07	Motor Ovrload
Name	Motor overload shut-off (electronic thermal relay function) [1]			
Description	The electronic thermal relay function in the inverter detects motor overheat due to overload or reduced cooling capability during constant-speed operation and pre-alarm (TH display) is output when the temperature reaches 85% of the Pr. 9 "Electronic thermal O/L relay" setting and the protection circuit is activated to stop the inverter output when the temperature reaches the specified value. When running a special motor such as a multi-pole motor 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 section 6.7.2) and check that the setting of the rated motor current in Pr. 9 is correct. 3) Check that stall prevention operation setting is correct. (Refer to section 6.2.4.)			
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 section 6.2.4.)			

[1] 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" (source logic) or "126" (sink logic) in any of Pr. 190 to Pr. 196 "Output terminal function selection". (Refer to section 6.9.5.)			
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 protection			
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 section 6.11.)			
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 section 6.11.1.)			

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**		**FR-PU04** **FR-PU07**	**Under Voltage**
Name	Undervoltage protection			
Description	If the power supply voltage of the inverter reduces, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage reduces below about 300V for the 400V class, this function stops the inverter output. When a jumper is not connected across P/+-P1, the under voltage protective function is activated. When undervoltage protection is activated, the IPF signal is output. (Refer to section 6.11.)			
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**		**FR-PU04**	**Fault 14**
			FR-PU07	**Input phase loss**
Name	Input phase loss			
Description	This fault is output when function valid setting (=1) is set in Pr. 872 "Input phase loss protection selection" and one phase of the three phase power input is lost. When the setting of Pr. 872 Input phase loss protection selection is the initial value (Pr. 872 = "0"), this fault does not occur. (Refer to section 6.12.3.)			
Check point	Check for a break in the cable for the three-phase power supply input.			
Corrective action	● Wire the cables properly. ● Repair a break portion in the cable. ● Check the Pr. 872 "Input phase loss 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 section 6.2.4).			
Corrective action	Reduce the load weight.			

Operation Panel Indication	**E.GF**		**FR-PU04** **FR-PU07**	**Ground Fault**
Name	Output side earth fault overcurrent protection			
Description	This function stops the inverter output if an earth fault overcurrent flows due to an earth (ground) 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**	—
Name	Output phase loss			
Description	This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) 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 loss protection selection" setting.			

Operation Panel Indication	**E.OHT**		**FR-PU04** **FR-PU07**	**OH Fault**
Name	External thermal relay operation			
Description	If the external thermal relay provided for motor overheat protection, or the internally mounted temperature relay in the motor, etc. switches on (contacts open), the inverter output is stopped. Functions when "7" (OH signal) is set to any of Pr. 178 to Pr. 189 (input terminal function selection). When the initial value (without OH signal assigned) is set, this protective function does not function.			
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.			

Operation Panel Indication	**E.PTC**		**FR-PU04**	**Fault 14**
			FR-PU07	**PTC activated**
Name	PTC thermistor operation			
Description	Trips when the motor overheat status is detected for 10s or more by the external PTC thermistor input connected to the terminal AU. This fault functions when "63" is set in Pr. 184 AU terminal function selection and AU/PTC switchover switch is set in PTC side. When the initial value (Pr. 184 = "4") is set, this protective function does not function.			
Check point	• Check the connection between the PTC thermistor switch and thermal protector. • Check the motor for operation under overload. • Is valid setting (= 63) selected in Pr. 184 "AU terminal function selection"?			
Corrective action	Reduce the load weight.			

Operation Panel Indication	**E.OPT**		**FR-PU04** **FR-PU07**	**Option Fault**
Name	Option alarm			
Description	Appears when the AC power supply is connected to the terminal R/L1, S/L2, T/L3 accidentally when a high power factor converter is connected. Appears when the switch for the manufacturer setting of the plug-in option is changed.			
Check point	Check that the AC power supply is not connected to the terminal R/L1, S/L2, T/L3 when a high power factor converter (FR-HC, MT-HC) or power regenerative 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. • Return the switch for the manufacturer setting of the plug-in option to the initial status. (Refer to instruction manual of each option)			

Operation Panel Indication	E.OP1	E.OP 1	FR-PU04 FR-PU07	Option 1 Fault
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 break 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. Appears when the switch for the manufacturer setting of the plug-in option is changed.			
Check point	● Check that the plug-in option is plugged into the connector securely. ● Check for excess electrical noises around the inverter.			
Corrective action	● Connect the plug-in option securely. ● 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. ● Return the switch position for the manufacturer setting of the plug-in option to the initial status. (Refer to instruction manual of each option)			

Operation Panel Indication	E.PE	E. PE	FR-PU04 FR-PU07	Corrupt Memry
Name	Parameter storage device alarm (control circuit board)			
Description	A fault occurred in parameters stored (E^2PROM failure).			
Check point	Check for too many number of parameter write times.			
Corrective action	Please contact your sales representative. When performing parameter write frequently for communication purposes, set "1" in Pr. 342 to enable RAM write. Note that powering off returns the inverter to the status before RAM write.			

Operation Panel Indication	E.PE2	E.PE2	FR-PU04	Fault 14
			FR-PU07	PR storage alarm
Name	Parameter storage device alarm (main circuit board)			
Description	A fault occurred in parameters stored (E^2PROM failure).			
Check point	—			
Corrective action	Please contact your sales representative.			

Operation Panel Indication	**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", "17", "102", "103", "116" or "117" 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**		**FR-PU04** **FR-PU07**	**Retry No Over**
Name	Retry count excess			
Description	If operation cannot be resumed properly within the number of retries set, this function trips the inverter. Functions only when Pr. 67 Number of retries at fault occurrence is set. When the initial value (Pr. 67 = "0") is set, this fault does not occur.			
Check point	Find the cause of alarm occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

Operation Panel Indication	**E. 5**		**FR-PU04** **FR-PU07**	**Fault 5**
	E. 6			**Fault 6**
	E. 7			**Fault 7**
	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 RS-485 terminal is shorted, this function shuts off the power output. At this time, communication from the RS-485 terminal 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 terminal is connected correctly.			
Corrective action	1) Check the PU and cable. 2) Check the connection of the RS-485 terminal.			

Operation Panel Indication	**E.P24**	E.P24	**FR-PU04** **FR-PU07**	**E.P24**
Name	24V DC power output short circuit			
Description	When the 24V DC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch off. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel or switch power off, then on again.			
Check point	Check for a short circuit in the PC terminal output.			
Corrective action	Remedy the earth (ground) fault portion.			

Operation Panel Indication	**E.CDO**	E.Cd0	**FR-PU04**	**Fault 14**
			FR-PU07	**OC detect level**
Name	Output current detection value excess			
Description	This functions stops the inverter output when the output current exceeds the setting of Pr.150 Output current detection level, or the output current falls below the setting of Pr.152 Zero current detection level. This function is active when Pr. 167 Output current detection operation selection is set to "1, 10, 11". When the initial value (Pr. 167 = "0") is set, this fault does not occur.			
Check point	Check the settings of Pr. 150 "Output current detection level", Pr. 151 "Output current detection signal delay time", Pr. 152 Zero current detection level, Pr. 153 Zero current detection time, Pr. 166 "Output current detection signal retention time", Pr. 167 "Output current detection operation selection".			

Operation Panel Indication	**E.IOH**	E.I OH	**FR-PU04**	**Fault 14**
			FR-PU07	**Inrush overheat**
Name	Inrush current limit circuit alarm			
Description	Trips when the resistor of the inrush current limit circuit overheats. The inrush current limit circuit fault.			
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. • Check that the power supply circuit of inrush current limit circuit contactor is not damaged.			
Corrective action	1) Connect a AC reactor. 2) 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**		**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 number of retries" during RS-485 communication from the RS-485 terminal. 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 terminal properly.			

Operation Panel Indication	**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".			
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. (Refer to section 6.15.1.)			

Operation Panel Indication	**E.PID**		**FR-PU04**	**Fault 14**
			FR-PU07	**Fault**
Name	PID signal fault			
Description	If any of PID upper limit (FUP), PID lower limit (FDN), and PID deviation limit (Y48) turns ON during PID control, inverter shuts off the output. This function is active under the following parameter settings: Pr.554 PID signal operation selection ≠ "0,10", Pr. 131 PID upper limit ≠ "9999", Pr. 132 PID lower limit ≠ "9999", and Pr. 553 PID deviation limit ≠ "9999". This protective function is not active in the initial setting (Pr. 554 = "0", Pr. 131 = "9999", Pr. 132 = "9999", Pr. 553 = "9999").			
Check point	Check if the measured PID value is greater than the upper limit (Pr. 131) or smaller than the lower limit (Pr. 132). Check if the absolute PID deviation value is greater than the limit value (Pr. 553).			
Corrective action	Make correct settings for Pr. 131 PID upper limit, Pr. 132 PID lower limit, Pr. 553 PID deviation limit. (Refer to section 6.19.1)			

Operation Panel Indication	**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.			

NOTES

If protective functions of "E.ILF, E.PTC, E.PE2, E.CDO, E.IOH, E.SER, E.AIE, E.PID" 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.

7.3 Reset method of protective function

Eliminate the cause of the error befor you reset the inverter. 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. It takes about 1s for reset.

The inverter can be reset by performing any of the following operations:

- Using the operation panel, press the STOP/RESET key to reset the inverter.
  (Enabled only when the inverter protective function is activated (major fault). (Refer to page 7-9 for major fault.))

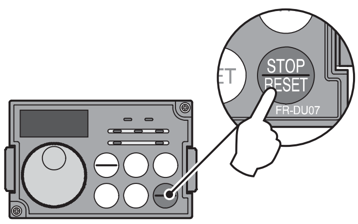


Fig. 7-1:
Resetting the inverter by using the operation panel

I001296E

- Switch OFF the power once, then switch it ON again after the indicator of the operation panel turns OFF.

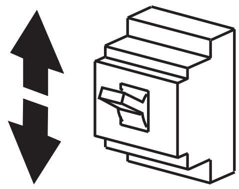


Fig. 7-2:
Resetting the inverter by switching the power supply off an on

I001297E

- Turn on the reset signal RES for more than 0.1s. (Connect the terminals RES and SD when using sink logic or terminals RES and PC as shown Fig. 7-3 when using source logic).
  (If the RES signal is kept on, "Err." appears (flickers) to indicate that the inverter is in a reset status.)

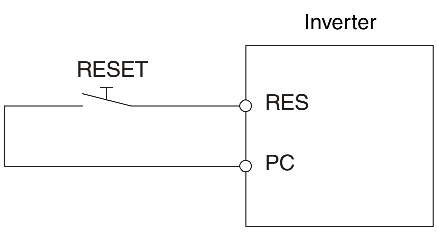


Fig. 7-3:
Resetting the inverter by sturning on the RES signal

I000249C

NOTE

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.

7.4 LED display

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel.

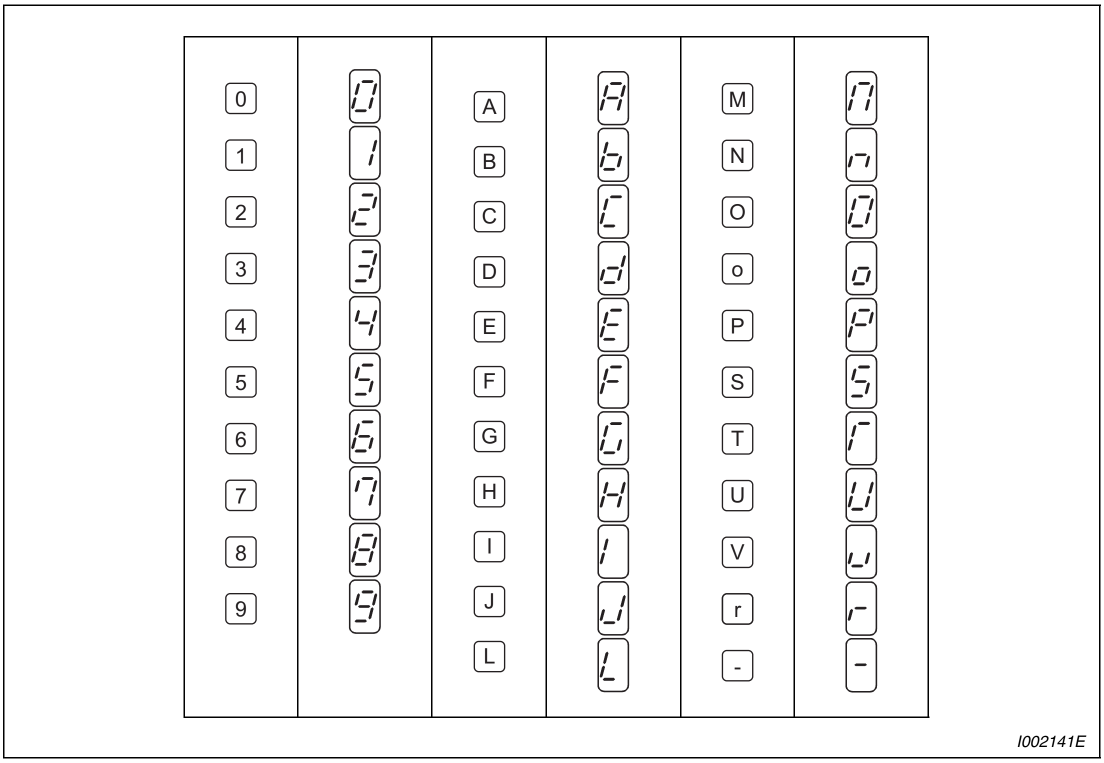


Fig. 7-4: *Correspondences between digital and actual characters (FR-DU07)*

7.5 Check and clear of the alarm history

Check for the alarm (major fault) history

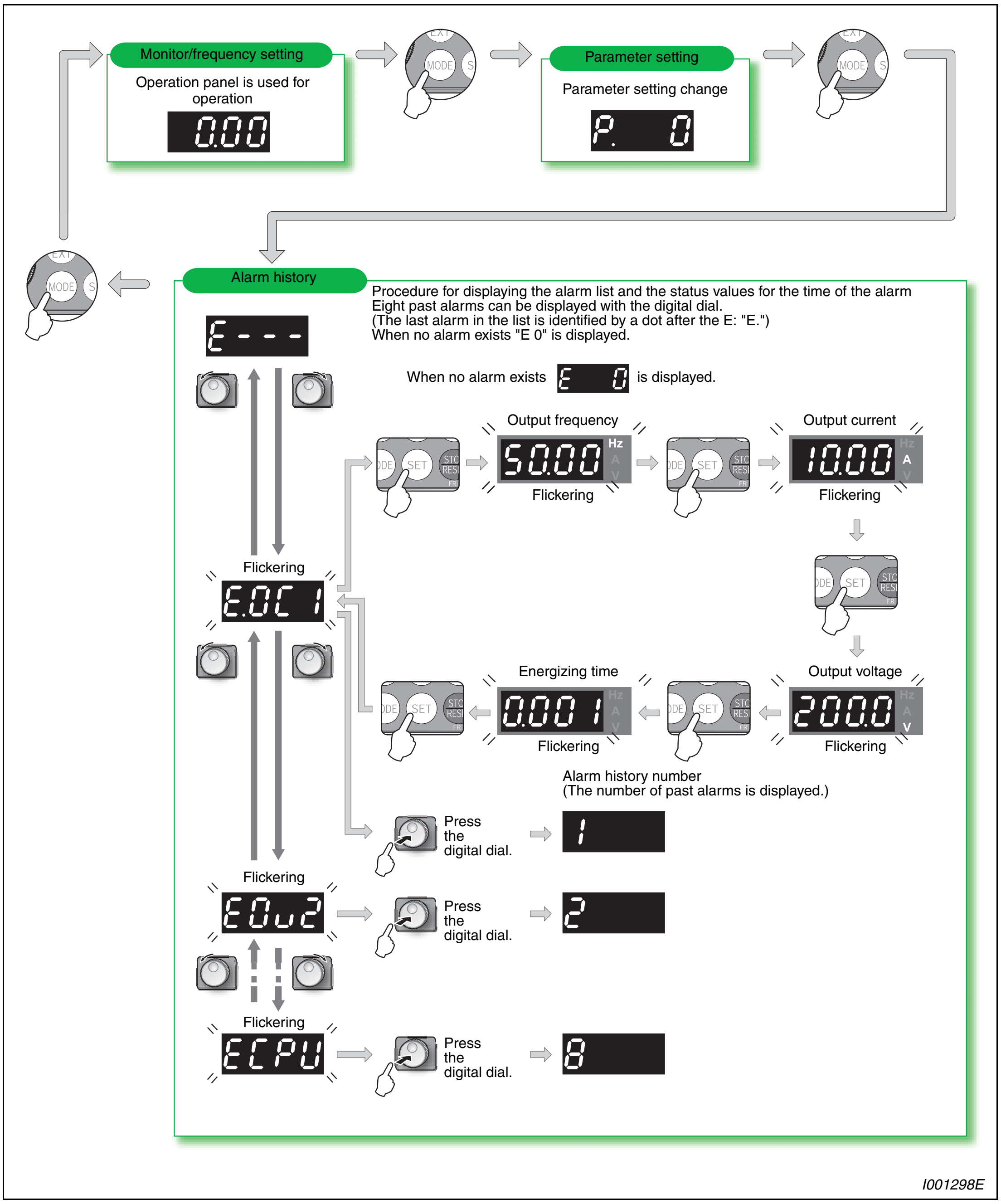


Fig. 7-5: *Displaying the alarm list and the status values for the time of the alarm*

Clearing procedure

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 the MODE key to choose the parameter setting mode.

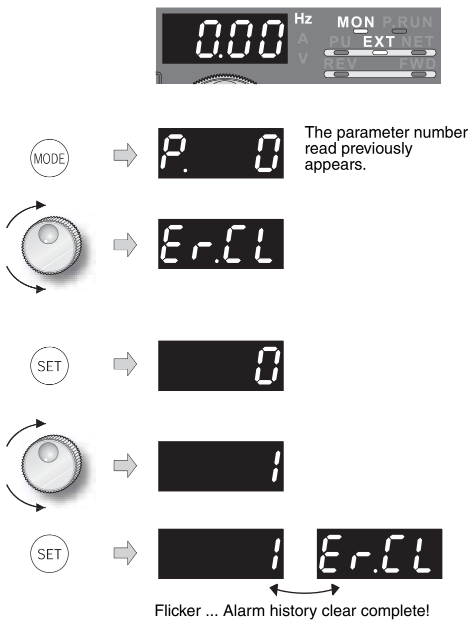
③ Turn the digital dial until Er.CL appears.

④ Press the SET key to show the currently set value.
The initial value "0" appears.

⑤ Turn the digital dial to change it to the setting value of "1".

⑥ Press the SET key to set.

Display



- By turning the digital dial, you can read another parameter.
- Press the SET key to show the setting again.
- Press the SET key twice to show the next parameter.

I001299E

Fig. 7-6: *Clearing the alarm history*

7.6 Check first when you have troubles

7.6.1 Motor does not start

Check points	Possible Cause	Countermeasures	Refer to page
Main Circuit	Appropriate power supply voltage is not applied. (Operation panel display is not provided.)	Power ON a moulded case circuit breaker (MCCB), an earth leakage circuit breaker (ELB), or a magnetic contactor (MC).	—
		Check for the decreased input voltage, input phase loss, and wiring.	
		If only the control power is ON when using a separate power source for the control circuit, turn ON the main circuit power.	3-22
	Motor is not connected properly.	Check the wiring between the inverter and the motor. If commercial power supply-inverter switchover function is active, check the wiring of the magnetic contactor connected between the inverter and the motor.	3-7
	The jumper across P/+ and P1 is disconnected (01160 or less).	Securely fit a jumper across P/+ and P1. When using a DC reactor (FR-HEL), remove the jumper across P/+ and P1, and then connect the DC reactor.	3-40
Input Signal	Start signal is not input.	Check the start command source, and input a start signal. PU operation mode: FWD/REV key External operation mode: STF/STR signal	6-206
	Both the forward and reverse rotation start signals (STF, STR) are input simultaneously.	Turn ON only one of the forward and reverse rotation start signals (STF or STR). When the STF and STR signals are turned ON simultaneously, a stop command is given.	3-15
	Frequency command is zero. (FWD or REV LED of the operation panel flickers.)	Check the frequency command source and enter a frequency command.	6-206
	AU signal is not ON when terminal 4 is used for frequency setting. (FWD or REV LED of the operation panel flickers.)	Turn ON the AU signal. Turning ON the AU signal activates terminal 4 input.	6-170
	Output stop signal (MRS) or reset signal (RES) is ON. (FWD or REV LED on the operation panel flickers.)	Turn MRS or RES signal OFF. Inverter starts the operation with a given start command and a frequency command after turning OFF MRS or RES signal. Before turning OFF, ensure the safety.	6-137, 7-19
	CS signal is OFF when automatic restart after instantaneous power failure function is selected (Pr. 57 ≠ "9999"). (FWD or REV LED on the operation panel is flickering.)	Turn ON the CS signal. Restart operation is enabled when restart after instantaneous power signal (CS) is ON.	6-137
	Jumper connector of sink - source is wrongly selected. (FWD or REV LED of the operation panel flickers.)	Check that the control logic switchover jumper connector is correctly installed. If it is not installed correctly, input signal is not recognized.	3-25
	Voltage/current input switch is not correctly set for analog input signal (0 to 5V/0 to 10V, 4 to 20mA). (FWD or REV LED of the operation panel flickers.)	Set Pr. 73, Pr. 267, and a voltage/current input switch correctly, then input an analog signal in accordance with the setting.	3-25
	The STOP/RESET key was pressed (Operation panel indication is "PS".)	During the External operation mode, check the method of restarting from a STOP/RESET key input stop from PU.	7-8
	Two-wire or three-wire type connection is wrong.	Check the connection. Connect STOP signal when three-wire type is used.	6-103

Check points	Possible Cause	Countermeasures	Refer to page
Parameter Setting	Pr. 0 "Torque boost" setting is improper when V/F control is used.	Increase Pr. 0 setting by 0.5% increments while observing the rotation of a motor. If that makes no difference, decrease the setting.	6-30
	Pr. 78 "Reverse rotation prevention selection" is set.	Check the Pr. 78 setting. Set Pr. 78 when you want to limit the motor rotation to only one direction.	6-199
	Pr. 79 "Operation mode selection" setting is wrong.	Select the operation mode which corresponds with input methods of start command and frequency command.	6-206
	Bias and gain (calibration parameter C2 to C7) settings are improper.	Check the bias and gain (calibration parameter C2 to C7) settings.	6-181
	Pr. 13 "Starting frequency" setting is greater than the running frequency.	Set running frequency higher than Pr. 13. The inverter does not start if the frequency setting signal is less than the value set in Pr. 13.	6-70
	Frequency settings of various running frequency (such as multi-speed operation) are zero. Especially, Pr. 1 "Maximum frequency" is zero.	Set the frequency command according to the application. Set Pr. 1 higher than the actual frequency used.	6-45
	Pr. 15 "Jog frequency" setting is lower than Pr. 13 "Starting frequency".	Set Pr. 15 "Jog frequency" higher than Pr. 13 "Starting frequency".	6-57
	Operation mode and a writing device do not match.	Check Pr. 79, Pr. 338, Pr. 339, Pr. 550 and Pr. 551, and select an operation mode suitable for the purpose.	6-203, 6-217
	Start signal operation selection is set by the Pr. 250 "Stop selection".	Check Pr. 250 setting and connection of STF and STR signals.	6-103
	Inverter decelerated to a stop when power failure deceleration stop function is selected.	When power is restored, ensure the safety, and turn OFF the start signal once, then turn ON again to restart. Inverter restarts when Pr. 261="2, 22".	6-145
	Automatic restart after instantaneous power failure function or power failure stop function is activated. (Performing overload operation during input phase loss may cause voltage insufficiency, and that may result in detection of power failure.)	● Set Pr. 872 Input phase loss protection selection = "1" (input phase failure protection active). ● Disable the automatic restart after instantaneous power failure function and power failure stop function. ● Reduce the load. ● Increase the acceleration time if the automatic restart after instantaneous power failure function or power failure stop function occurred during acceleration.	6-137, 6-145
Load	Load is too heavy.	Reduce the load.	—
	Shaft is locked.	Inspect the machine (motor).	—

7.6.2 Motor or machine is making abnormal acoustic noise

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 in section A.1. This may cause the motor noise to increase. But it is not a fault.

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Disturbance due to EMI when frequency command is given from analog input (terminal 1, 2, 4).	Take countermeasures against EMI.	3-41
Parameter Setting		Increase the Pr. 74 "Input filter time constant" if steady operation cannot be performed due to EMI.	6-180
Parameter Setting	No carrier frequency noises (metallic noises) are generated.	In the initial setting, Pr. 240 "Soft-PWM operation selection" is enabled to change motor noise to an unoffending complex tone. Therefore, no carrier frequency noises (metallic noises) are generated. Set Pr. 240 = "0" to disable this function.	6-167
	Resonance occurs. (output frequency)	Set Pr. 31 to Pr. 36 "Frequency jump". When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped.	6-47
	Resonance occurs. (carrier frequency)	Change Pr. 72 "PWM frequency selection" setting. Changing the PWM carrier frequency produces an effect on avoiding the resonance frequency of a mechanical system or a motor.	6-167
	Gain adjustment during PID control is insufficient.	To stabilize the measured value, change the proportional band (Pr. 129) to a larger value, the integral time (Pr. 130) to a slightly longer time, and the differential time (Pr. 134) to a slightly shorter time. Check the calibration of set point and measured value.	6-271
Others	Mechanical looseness	Adjust machine/equipment so that there is no mechanical looseness.	—
	Contact the motor manufacturer.		
Motor	Operating with output phase loss	Check the motor wiring.	—

7.6.3 Inverter generates abnormal noise

Check points	Possible Cause	Countermeasures	Refer to page
Fan	Fan cover was not correctly installed when a cooling fan was replaced.	Install a fan cover correctly.	8-11

7.6.4 Motor generates heat abnormally

Check points	Possible Cause	Countermeasures	Refer to page
Motor	Motor fan is not working (Dust is accumulated.)	Clean the motor fan. Improve the environment.	—
	Phase to phase insulation of the motor is insufficient.	Check the insulation of the motor.	—
Main Circuit	The inverter output voltage (U, V, W) are unbalanced.	Check the output voltage of the inverter. Check the insulation of the motor.	8-2
Parameter Setting	The Pr. 71 "Applied motor" setting is wrong.	Check the Pr. 71 "Applied motor" setting.	6-82
—	Motor current is large.	Refer to "7.6.11 Motor current is too large"	7-28

7.6.5 Motor rotates in the opposite direction

Check points	Possible Cause	Countermeasures	Refer to page
Main Circuit	Phase sequence of output terminals U, V and W is incorrect.	Connect phase sequence of the output cables (terminal U, V, W) to the motor correctly	3-7
Input signal	The start signals (forward rotation, reverse rotation) are connected improperly.	Check the wiring. (STF: forward rotation, STR: reverse rotation)	3-15
	The polarity of the frequency command is negative during the polarity reversible operation set by Pr. 73 "Analog input selection".	Check the polarity of the frequency command.	6-170

7.6.6 Speed greatly differs from the setting

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Frequency setting signal is incorrectly input.	Measure the input signal level.	—
	The input signal lines are affected by external EMI.	Take countermeasures against EMI such as using shielded wires for input signal lines.	3-41
Parameter Setting	Pr. 1, Pr. 2, Pr. 18, calibration parameter C2 to C7 settings are improper.	Check the settings of Pr. 1 "Maximum frequency", Pr. 2 "Minimum frequency", Pr. 18 "High speed maximum frequency".	6-45
		Check the calibration parameter C2 to C7 settings.	6-181
	Pr. 31 to Pr. 36 "Frequency jump" settings are improper.	Narrow down the range of frequency jump.	6-47
Load	Stall prevention is activated due to a heavy load.	Reduce the load weight.	—
Parameter Setting		Set Pr. 22 "Stall prevention operation level "higher according to the load. (Setting Pr. 22 too large may result in frequent overcurrent trip (E.OC□).)	6-35
Motor		Check the capacities of the inverter and the motor.	—

7.6.7 Acceleration/deceleration is not smooth

Check points	Possible Cause	Countermeasures	Refer to page
Parameter Setting	Acceleration/deceleration time is too short.	Increase acceleration/deceleration time.	6-66
	Torque boost (Pr. 0, Pr. 46) setting is improper under V/f control, so the stall prevention function is activated.	Increase/decrease Pr. 0 "Torque boost" setting value by 0.5% increments to the setting.	6-30
	The base frequency does not match the motor characteristics.	For V/f control, set Pr. 3 "Base frequency" and Pr. 47 "Second V/f (base frequency)".	6-49
	Regeneration avoidance operation is performed	If the frequency becomes unstable during regeneration avoidance operation, decrease the setting of Pr. 886 "Regeneration avoidance voltage gain".	6-313
Load	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
Parameter Setting		Set Pr. 22 "Stall prevention operation level "higher according to the load. (Setting Pr. 22 too large may result in frequent overcurrent trip (E.OC□).)	6-35
Motor		Check the capacities of the inverter and the motor.	—

7.6.8 Speed varies during operation

Check points	Possible Cause	Countermeasures	Refer to page
Load	Load varies during an operation.	Select Simple magnetic flux vector control.	6-33
Input signal	Frequency setting signal is varying.	Check the frequency reference signal.	—
	The frequency setting signal is affected by EMI.	Set filter to the analog input terminal using Pr. 74 "Input filter time constant".	6-180
		Take countermeasures against EMI, such as using shielded wires for input signal lines.	3-41
	Malfunction is occurring due to the undesirable current generated when the transistor output unit is connected.	Use terminal PC (terminal SD when source logic) as a common terminal to prevent a malfunction caused by undesirable current.	3-27
	Multi-speed command signal is chattering.	Take countermeasures to suppress chattering.	—
Parameter Setting	Fluctuation of power supply voltage is too large.	Change the Pr. 19 "Base frequency voltage" setting (about 3%) under V/f control.	6-49
	Pr. 80 "Motor capacity" setting is improper for the capacities of the inverter and the motor for Simple magnetic flux vector control.	Check the Pr. 80 "Motor capacity"setting.	6-33
	Wiring length is too long for V/f control, and a voltage drop occurs.	Adjust Pr. 0 "Torque boost" by increasing with 0.5% increments for low-speed operation.	6-30
		Change to Simple magnetic flux vector control.	6-33
	Hunting occurs by the generated vibration, for example, when structural rigidity at load side is insufficient.	Disable automatic control functions, such as energy saving operation, fast-response current limit function, regeneration avoidance function, Simple magnetic flux vector control, and stall prevention. Adjust so that the control gain decreases and the level of safety increases.	—
		Change Pr. 72 "PWM frequency selection" setting.	6-167

7.6.9 Operation mode is not changed properly

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Start signal (STF or STR) is ON.	Check that the STF and STR signals are OFF. When either is ON, the operation mode cannot be changed.	6-203
Parameter Setting	Pr. 79 setting is improper.	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. To switch to the PU operation mode, press the PU/EXT key on the operation panel (press the PU key when the parameter unit (FR-PU04/FR-PU07) is used) to switch to the PU operation mode. For other values (1 to 4, 6, 7), the operation mode is limited accordingly.	6-203
	Operation mode and a writing device do not correspond.	Check Pr. 79, Pr. 338, Pr. 339, Pr. 550 and Pr. 551, and select an operation mode suitable for the purpose.	6-203, 6-217

7.6.10 Operation panel (FR-DU07) display is not operating

Check points	Possible Cause	Countermeasures	Refer to page
Main Circuit, Control Circuit	No power input.	Input the power.	3-5
Front cover	Operation panel is not properly connected to the inverter.	Check if the inverter front cover is installed securely. The inverter cover may not fit properly when using wires whose size are 1.25mm^2 or larger, or when using many wires, and this could cause a contact fault of the operation panel.	2-2

7.6.11 Motor current is too large

Check points	Possible Cause	Countermeasures	Refer to page
Parameter Setting	Torque boost (Pr. 0, Pr. 46) setting is improper under V/f control, so the stall prevention function is activated.	Increase/decrease Pr. 0 "Torque boost" setting value by 0.5% increments to the setting.	6-30
	V/f pattern is improper when V/f control is performed. (Pr. 3, Pr. 14, Pr. 19)	Set rated frequency of the motor to Pr. 3 "Base frequency". Use Pr. 19 "Base frequency voltage" to set the base voltage (e.g. rated motor voltage).	6-49
		Change Pr. 14 "Load pattern selection" according to the load characteristic.	6-51
	Stall prevention function is activated due to a heavy load.	Reduce the load weight.	—
		Set Pr. 22 "Stall prevention operation level" higher according to the load. (Setting Pr. 22 too large may result in frequent overcurrent trip (E.OC□).)	6-35
		Check the capacities of the inverter and the motor.	—

7.6.12 Speed does not accelerate

<table>
<tr><th>Check points</th><th>Possible Cause</th><th>Countermeasures</th><th>Refer to page</th></tr>
<tr><td rowspan="3">Input signal</td><td>Start command and frequency command are chattering.</td><td>Check if the start command and the frequency command are correct.</td><td>—</td></tr>
<tr><td>The wiring length used for analog frequency command is too long, and it is causing a voltage (current) drop.</td><td>Perform analog input bias/gain calibration.</td><td>6-181</td></tr>
<tr><td>Input signal lines are affected by external EMI.</td><td>Take countermeasures against EMI, such as using shielded wires for input signal lines.</td><td>3-41</td></tr>
<tr><td rowspan="10">Parameter Setting</td><td rowspan="2">Pr. 1, Pr. 2, Pr. 18, calibration parameter C2 to C7 settings are improper.</td><td>Check the settings of Pr. 1 "Maximum frequency" and Pr. 2 "Minimum frequency". If you want to run the motor at 120Hz or higher, set Pr. 18 "High speed maximum frequency".</td><td>6-45</td></tr>
<tr><td>Check the calibration parameter C2 to C7 settings.</td><td>6-181</td></tr>
<tr><td>Torque boost (Pr. 0, Pr. 46) setting is improper under V/f control, so the stall prevention function is activated.</td><td>Increase/decrease Pr. 0 "Torque boost" setting value by 0.5% increments so that stall prevention does not occur.</td><td>6-30</td></tr>
<tr><td rowspan="2">V/f pattern is improper when V/f control is performed. (Pr. 3, Pr. 14, Pr. 19)</td><td>Set rated frequency of the motor to Pr. 3 "Base frequency". Use Pr. 19 "Base frequency voltage" to set the base voltage (e.g. rated motor voltage).</td><td>6-49</td></tr>
<tr><td>Change Pr. 14 "Load pattern selection" according to the load characteristic.</td><td>6-51</td></tr>
<tr><td rowspan="3">Stall prevention is activated due to a heavy load.</td><td>Reduce the load weight.</td><td>—</td></tr>
<tr><td>Set Pr. 22 "Stall prevention operation level" higher according to the load. (Setting Pr. 22 too large may result in frequent overcurrent trip (E.OC□).)</td><td>6-35</td></tr>
<tr><td>Check the capacities of the inverter and the motor.</td><td>—</td></tr>
<tr><td colspan="2">During PID control, output frequency is automatically controlled to make measured value = set point.</td><td>6-271</td></tr>
</table>

7.6.13 Unable to write parameter setting

Check points	Possible Cause	Countermeasures	Refer to page
Input signal	Operation is being performed (signal STF or STR is ON).	Stop the operation. When Pr. 77 = "0" (initial value), write is enabled only during a stop.	6-197
Parameter Setting	You are attempting to set the parameter in the External operation mode.	Choose the PU operation mode. Or, set Pr. 77 = "2" to enable parameter write regardless of the operation mode.	6-197
	Parameter is disabled by the Pr. 77 "Parameter write selection" setting.	Check Pr. 77 "Parameter write selection" setting.	6-197
	Key lock is activated by the Pr. 161 "Frequency setting/key lock operation selection" setting.	Check Pr. 161 "Frequency setting/key lock operation selection" setting.	6-328
	Operation mode and a writing device do not correspond.	Check Pr. 79, Pr. 338, Pr. 339, Pr. 550 and Pr. 551, and select an operation mode suitable for the purpose.	6-203, 6-217

7.6.14 Power lamp is not lit

Check points	Possible Cause	Countermeasures	Refer to page
Main Circuit, Control Circuit	Wiring or installation is improper.	Check for the wiring and the installation. Power lamp is lit when power supply is input to the control circuit (R1/L11, S1/L21).	3-7

7.7 Meters and measuring methods

NOTE For further information about measurements at the inverter refer to section 8.2.

Since voltages and currents in the primary and secondary side of the inverter include harmonics, different meters indicate different measured values.

When installing meters etc. on the inverter output side
When the inverter-to-motor wiring length is large, especially in the 400V class, large-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.

When using measuring instruments for the normal frequency range, carry out the measurements as described below.

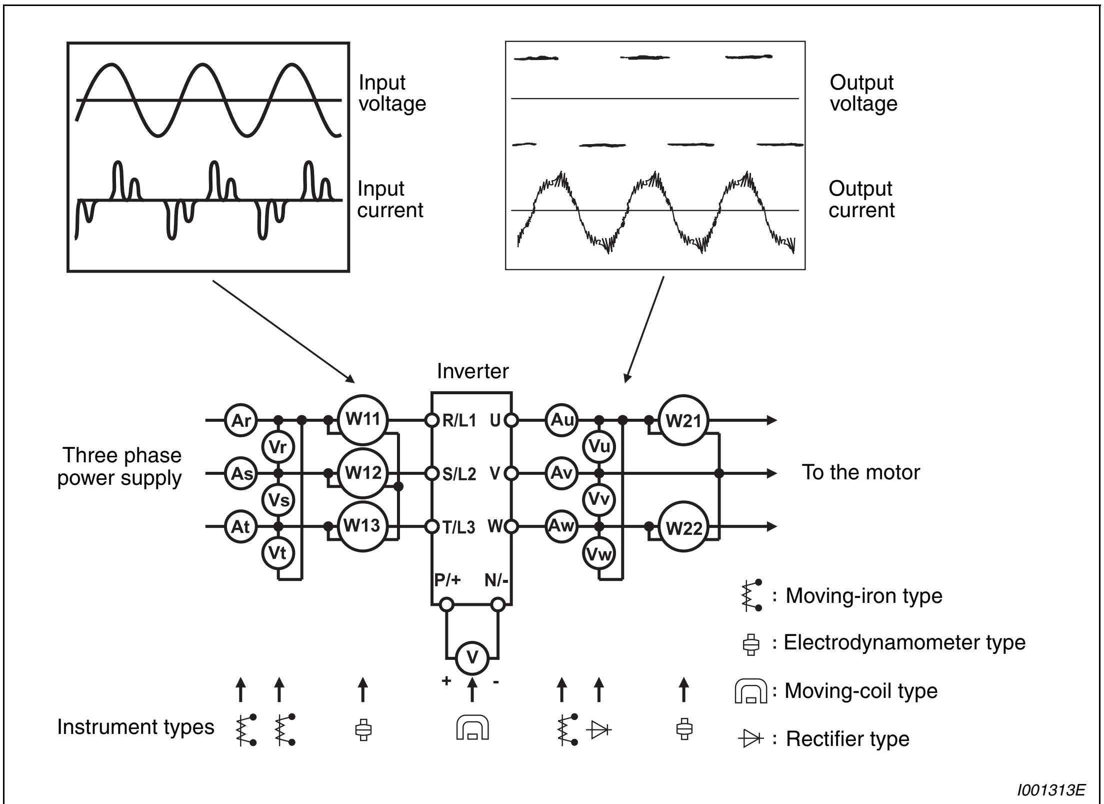


Fig. 7-7: Examples of measuring points and instruments

7.7.1 Measurement of powers

Using an electro-dynamometer type meter, measure the power in both the input and output sides of the inverter using the two- or three-wattmeter method. As the current is liable to be imbalanced especially in the input side, it is recommended to use the three-wattmeter method. Examples of measured value differences produced by different measuring meters are shown below.

An error will be produced by difference between measuring instruments, e.g. power calculation type and two- or three-wattmeter type three-phase wattmeter. When a CT is used in the current measuring side or when the meter contains a PT on the voltage measurement side, an error will also be produced due to the frequency characteristics of the CT and PT.

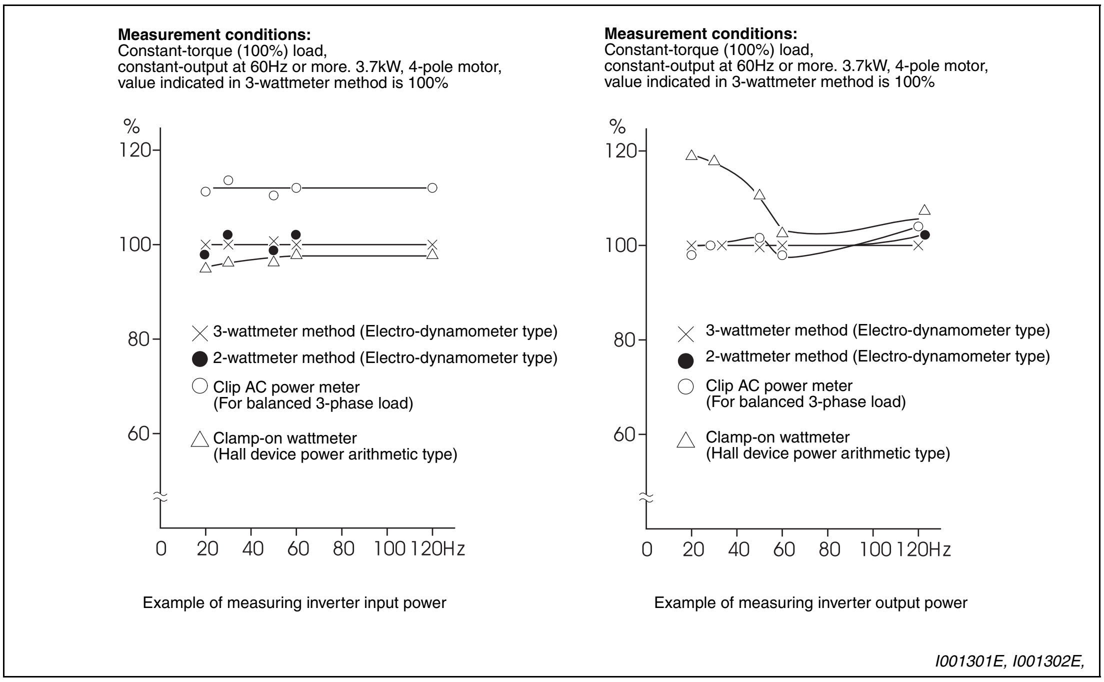


Fig. 7-8: *Differences when measuring power with different instruments*

7.7.2 Measurement of voltages and use of PT

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.

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.

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.)

7.7.3 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 loss 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 measurement value difference produced by different measuring meters is shown below.

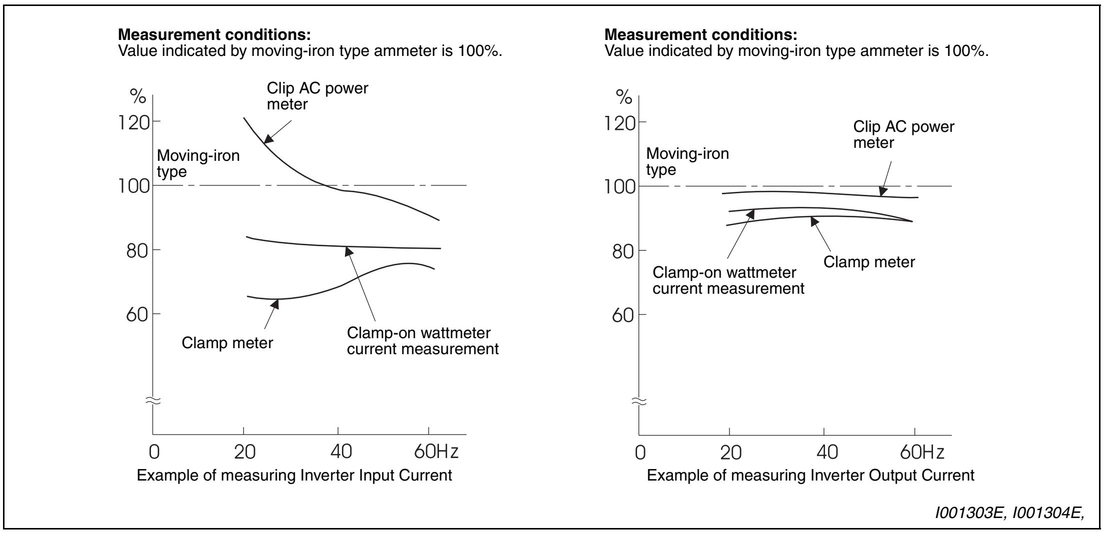


Fig. 7-9: *Differences when measuring currents with different instruments*

7.7.4 Use of CT and transducer

A CT may be used in both the input and output sides of the inverter, but the one used should have the largest possible VA ability because an error will increase if the frequency gets lower. When using a transducer, use the effective value calculation type which is immune to harmonics.

7.7.5 Measurement of inverter input power factor

Use the effective power and apparent power to calculate the inverter input power factor. A power-factor meter cannot indicate an exact value.

$$\text{Total power factor of the inverter} = \frac{\text{Effective power}}{\text{Apparent power}} = \frac{\text{3-phase input power found by 3-wattmeter method}}{\sqrt{3} \times \text{V (power supply voltage)} \times \text{I (input current effective value)}}$$

7.7.6 Measurement of converter output voltage (across terminals P/+ and N/–)

The output voltage of the converter is developed across terminals P/+ and N/– and can be measured with a moving-coil type meter (tester). Although the voltage varies according to the power supply voltage, approximately 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.

8 Maintenance and inspection

The inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to the adverse effects of the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

WARNING:
Wait for a period of well over 10 minutes after disconnecting from the power supply before performing any service work on the frequency inverter. This is necessary so that the capacitors can discharge down to a save level (< 25V) after disconnection of the mains power. The LED indictor and the CHARGE LED inside the unit must both be off.

8.1 Inspection

8.1.1 Daily inspection

Basically, check for the following faults during operation:

- Motor operation fault
- Improper installation environment
- Cooling system fault
- Unusual vibration and noise
- Unusual overheat and discoloration

8.1.2 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.
Consult us for periodic inspection.

- Check for cooling system fault . . . . Clean the air filter, etc.
- 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 3-11.)
- Check the conductors and insulating materials for corrosion and damage.
- Measure insulation resistance.
- Check and change the cooling fan and relay.

8.1.3 Daily and periodic inspection

Area of Inspection	Inspection Item	Inspection Item	Interval: Daily	Interval: Periodic ②	Method	Customers's check
General	Surrounding environment	Check the ambient temperature, humidity, dirt, corrosive gas, oil mist , etc.	✔		Improve environment	
	Overall unit	Check for unusual vibration and noise.	✔		Check alarm location and retighten	
	Power supply voltage	Check that the main circuit voltages are normal. ①	✔		Inspect the power supply	
Main circuit	General	1) Check with megger (across main circuit terminals and earth (ground) terminal).		✔	Contact the manufacturer	
		2) Check for loose screws and bolts.		✔	Retighten	
		3) Check for overheat traces on the parts.		✔	Contact the manufacturer	
		4) Check for stain		✔	Clean	
	Conductors, cables	1) Check conductors for distortion.		✔	Contact the manufacturer	
		2) Check cable sheaths for breakage		✔	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 section 8.1.4.)		✔		
	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	
	Parts check: 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 section 8.1.4.)		✔		
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	

Tab. 8-1: *Daily and periodic inspection (1)*

Area of Inspection	Inspection Item	Inspection Item	Interval		Method	Customers's check
			Daily	Periodic ②		
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	Operqation check	Check for vibration and abnormal increase in operation noise.	✔		Stop the device and contact the manufacturer.	

Tab. 8-1: *Daily and periodic inspection (2)*

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.

8.1.4 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. For the life check of the main circuit capacitor, the alarm signal (Y90) will not be output if a measuring method of is not performed. (Refer to the description below.)

The life alarm output can be used as a guideline for life judgement.

Parts	Judgement Level
Main circuit capacitor	85% of the initial capacity
Control circuit capacitor	Estimated 10% life remaining
Inrush current limit circuit	Estimated 10% life remaining (Power on: 100,000 times left)
Cooling fan	Less than 40% of the predetermined speed

Tab. 8-2: *Guideline for the alarm signal output*

Display of the life alarm

Pr. 255 "Life alarm status display" can be used to confirm that the control circuit capacitor, main circuit capacitor, cooling fan, and each parts of the inrush current limit circuit has reached the life alarm output level.

① Read the setting of parameter 255.

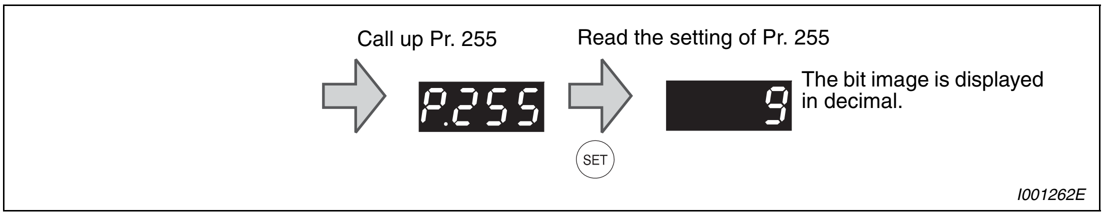


Fig. 8-1: *Read parameter 255*

② When the life alarm output level is reached, the bits are set as follows.

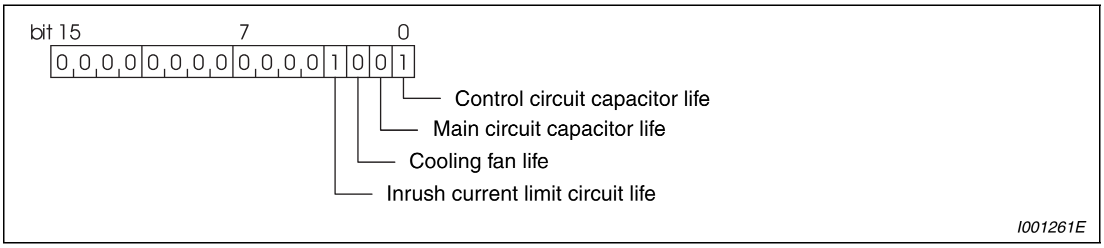


Fig. 8-2: *Bits of parameter 255*

Pr. 255 (decimal)	Bits (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	—	—	—	—

Tab. 8-3: *Displaying the end of service life by bits*

✔: End of the service life is reached
—: End of the service life is not reached

NOTE Life check of the main circuit capacitor needs to be done by Pr. 259. (Refer to the following.)

Measuring method of life of the main circuit capacitor

If the value of capacitor capacity measured before shipment is considered as 100%, Pr. 255 bit 1 is turned on when the measured value falls below 85%.

Measure the capacitor capacity according to the following procedure and check the deterioration level of the capacitor capacity.

① Check that the motor is connected and at a stop. Please also provide a separate mains power supply for the inverter's control circuit (terminals L11 and L21).

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 255, and check the deterioration degree of the main circuit capacitor.

The life of the main circuit capacitor can not be measured in the following conditions:

❶ The FR-HC, MT-HC, FR-CV, FR-BU, MT-BU5 or BU is connected.

❷ Terminals R1/L11, S1/L21 or DC power supply is connected to the terminal P/+ and N/–.

❸ Switch power on again during measuring.

❹ The motor is not connected to the inverter.

❺ The motor is running. (The motor is coasting.)

❻ The motor capacity is two ranks (or more) smaller as compared to the inverter capacity.

❼ The inverter is at an alarm stop or an alarm occurred while power is off.

❽ The inverter output is shut off with the MRS signal.

❾ 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)

NOTE

For the accurate life measuring of the main circuit capacitor, perform after more than 3h passed since the turn off of the power as it is affected by the capacitor temperature.

8.1.5 Checking the inverter and converter modules

Disconnect the external power supply cables (R/L1, S/L2, T/L3) and motor cables (U, V, W). Prepare a tester. (Use 100Ω range.)

Change the polarity of the tester alternately at the inverter terminals R/L1, S/L2, T/L3, U, V, W, P/+ and N/–, and check for continuity.

CAUTION:
Before measurement, check that the smoothing capacitor is discharged.

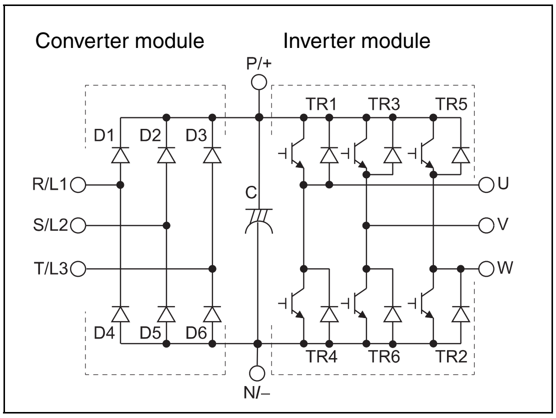


Fig. 8-3:
Module device numbers and terminals to be checked

I001305E

		Tester Polarity		Measured Value		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

Tab. 8-4: *Continuity check of the modules*

8.1.6 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.

8.1.7 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)

Tab. 8-5: *Wearing parts*

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 : 80% of the inverter rated current

NOTE For parts replacement, consult the nearest Mitsubishi FA Centre.

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.

Inverter Type		Fan Type	Units
FR-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	9LB1424S5H03	6
FR-F746	00083 to 00126	MMF-09D24TS-RP3 BKO-CA1640H03	1
	00170 to 00380		2
	00470, 00620	MMF-12D24DS-RP3 BKO-CA1619H03	2
	00770		2
	00930, 01160		2

Tab. 8-6: *Correspondence between inverters and cooling fans*

NOTE The inverters of the capacity classes 00023 to 00052 are not provided with a cooling fan.

● Removal of the fan (FR-F740-00083 to 03610)

① Push the hooks of the fan cover from above. Remove the fan cover.

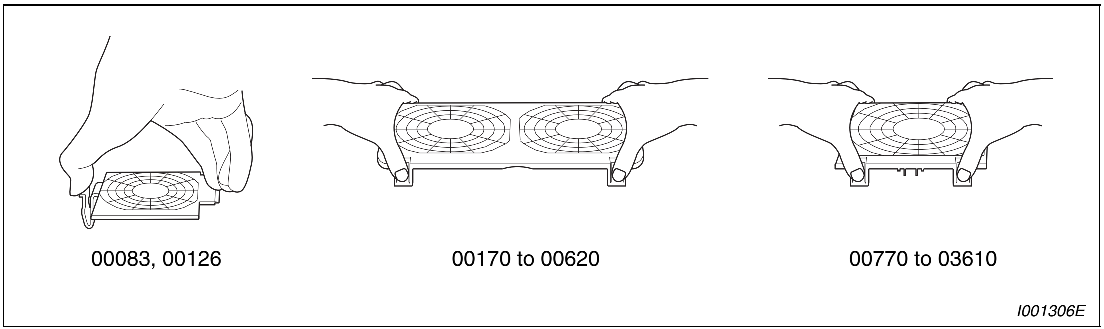


Fig. 8-4: *Removal of the fan cover*

② Disconnect the fan connector.

③ Remove the fan.

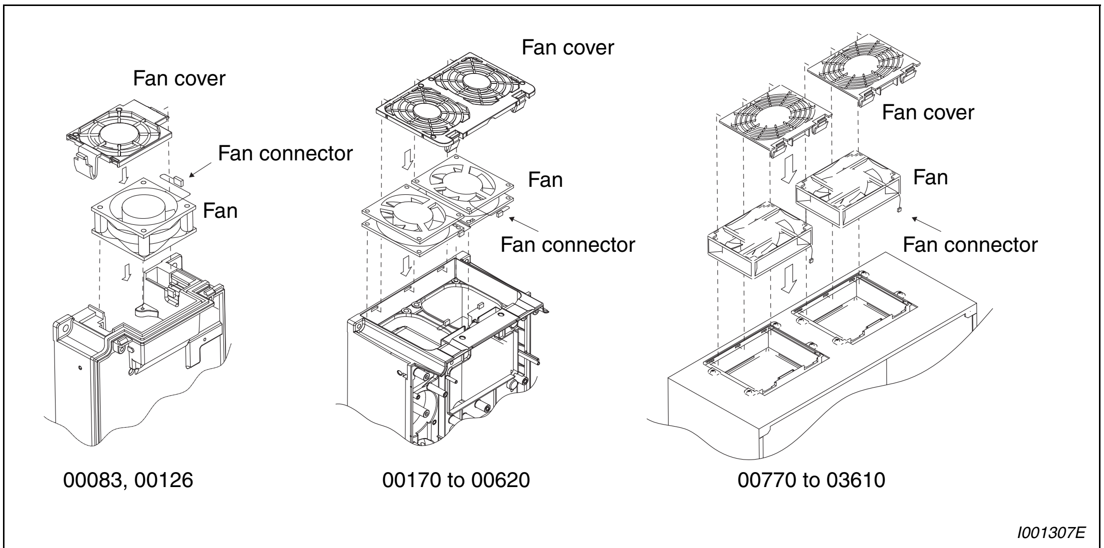


Fig. 8-5: *Removal of the fan*

NOTE The number of cooling fans differs according to the inverter capacity (refer to Tab. 8-6).

- Reinstallation of the fan (FR-F740-00083 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.

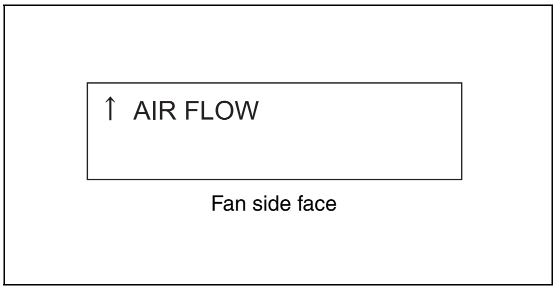


Fig. 8-6:
Orientation of the fan

I001334E

NOTE Installing the fan in the opposite air flow direction can cause the inverter life to be shorter.

② Reconnect the fan connectors. When wiring, use care to avoid the cables being caught by the fan.

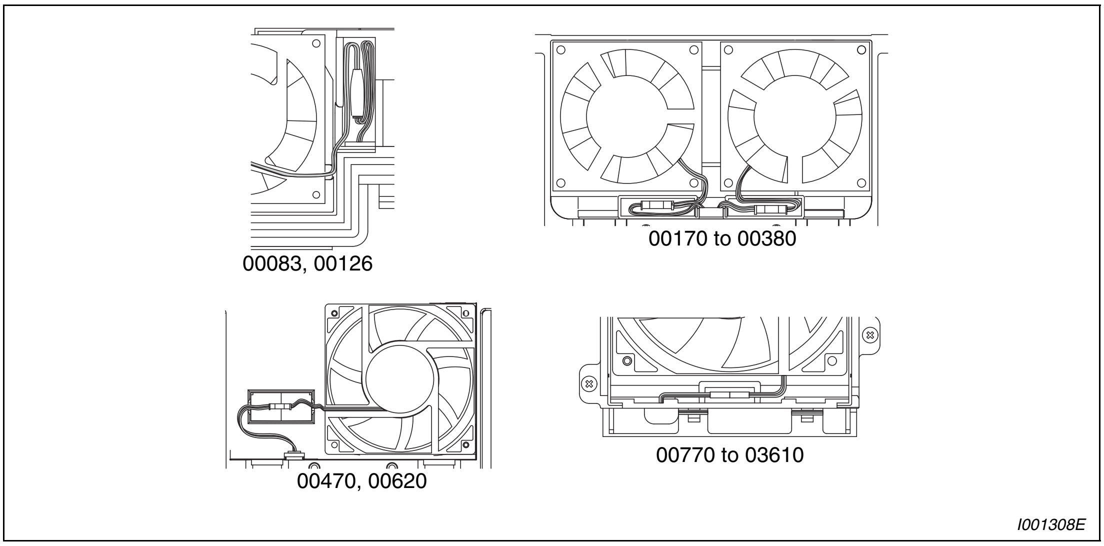


Fig. 8-7: *Connection of the fan*

③ Reinstall the fan cover. Insert hooks into the holes ❶. Insert hooks ❷ until you hear a click sound.

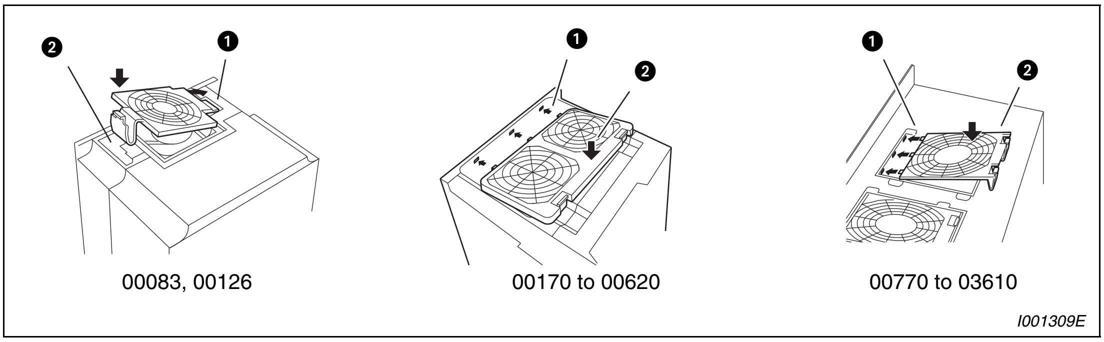


Fig. 8-8: *Reinstall the fan cover*

- Removal of the fan (FR-F740-04320 or more)

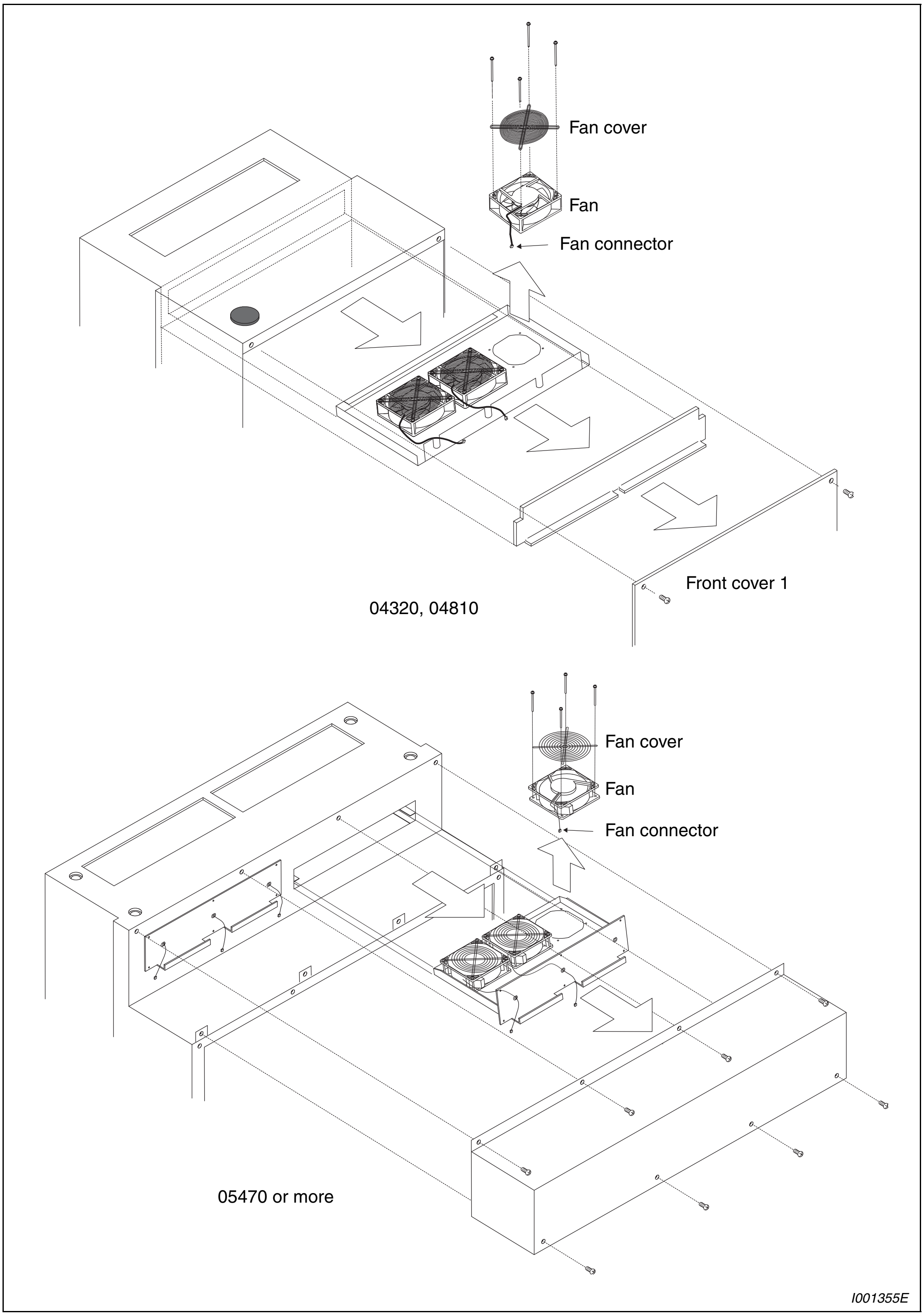


Fig. 8-9: *Removal of the fan*

NOTE The number of cooling fans differs according to the inverter capacity (refer to Tab. 8-6).

- Reinstalltion of the fan (FR-F740-04320 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.

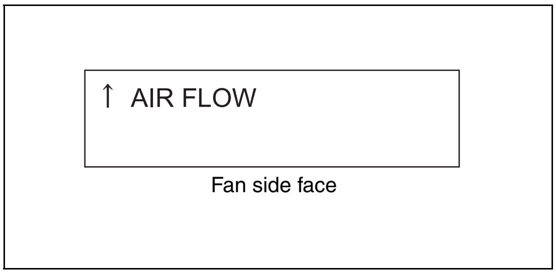


Fig. 8-10:
Orientation of the fan

I001334E

NOTE Installing the fan in the opposite air flow direction can cause the inverter life to be shorter.

② Install fans referring to Fig. 8-9.

- Removal of the fan (FR-F746-00083 to 01160)

① Remove the fixed srews to remove the fan cover.

② Remove the fan cover.

③ Remove the fan connector.

④ Remove the cooling fan.

- Reinstallation of the fan (FR-F746-00083 to 01160)

① After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.

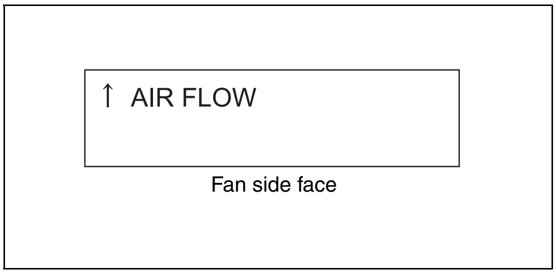


Fig. 8-11:
Orientation of the fan

I001334E

NOTE Installing the fan in the opposite air flow direction can cause the inverter life to be shorter.

② Connect the fan connection connector to return the connector to the original position. When wiring, care must be taken to avoid the cables being caught by the fan.

③ Install the fan cover.

④ Fix the fan cover with the fixing screws.

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.

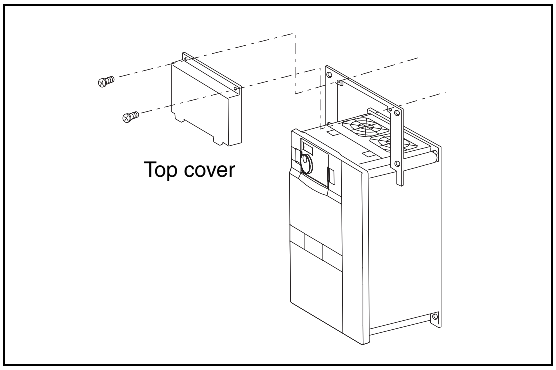


Fig. 8-12:
Replacement procedure of the cooling fan when using a heatsink protrusion attachment

I001356E

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:

- Case: Check the side and bottom faces for expansion
- Sealing plate: Check for remarkable warp and extreme crack.
- 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.

Relays

To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

8.1.8 Inverter replacement

The inverter can be replaced with the control circuit wiring kept connected. Before replacement, remove the wiring cover of the inverter.

WARNING:
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.

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.

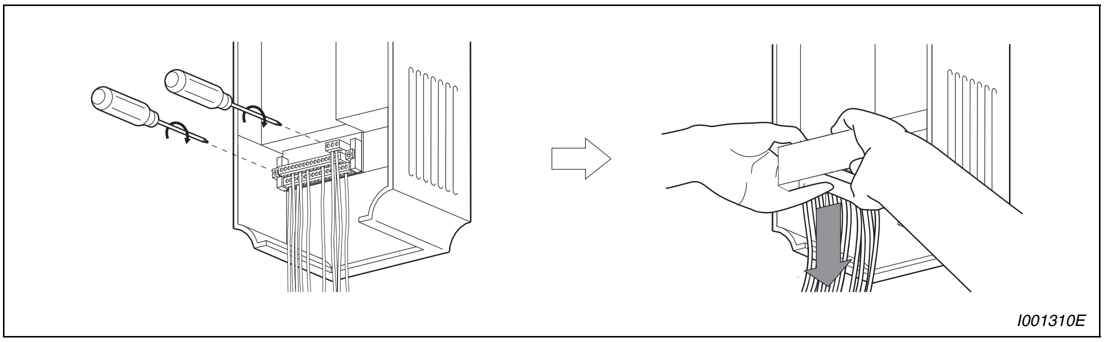


Fig. 8-13: *Removal of the terminal block*

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.

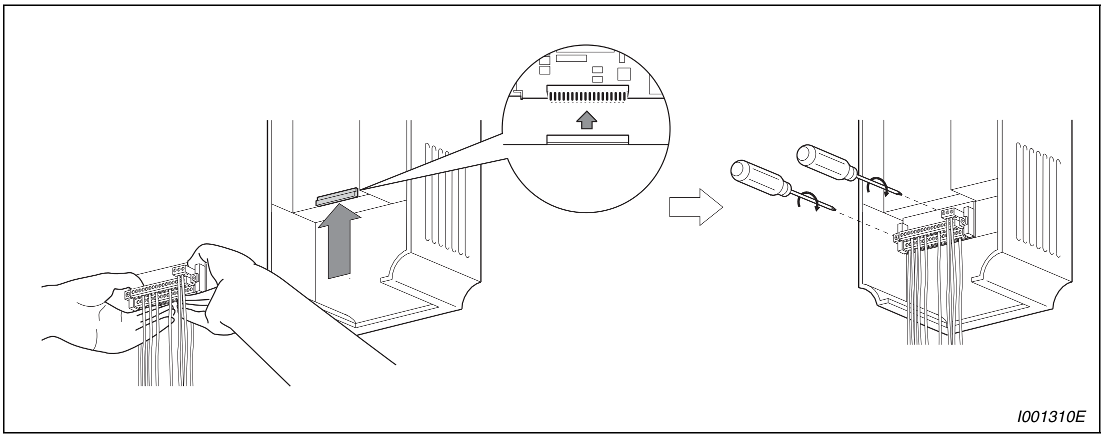


Fig. 8-14: *Reinstallation of the terminal block*

8.2 Measurements on the main circuit

This section describes the measurement of the main circuit voltages, currents, powers and insulation resistance.

8.2.1 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 500V DC megger.).

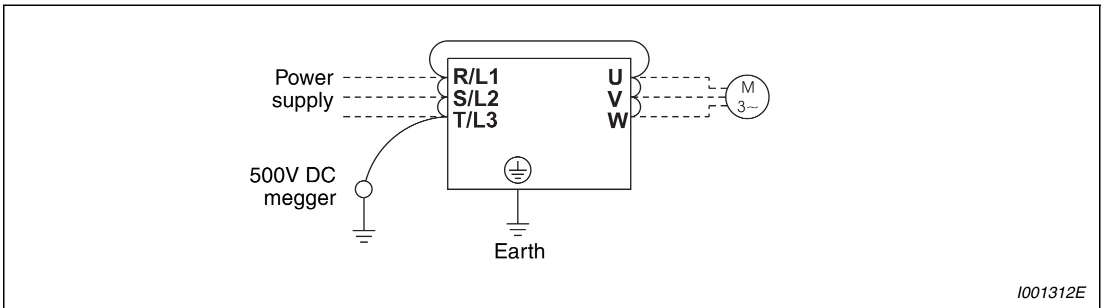


Fig. 8-15: *Insulation resistance test*

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.

NOTE

For the continuity test of the control circuit, use a tester (high resistance range) and do not use the megger or buzzer.

8.2.2 Pressure test

Do not conduct a pressure test. Deterioration may occur.

8.2.3 Measurement of voltages and currents

Since voltages and currents in the primary and secondary side of the inverter include harmonics, different meters indicate different measured values.

When installing meters etc. on the inverter output side
When the inverter-to-motor wiring length is large, especially in the 400V class, large-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.

When using measuring instruments for the normal frequency range, carry out the measurements as described below.

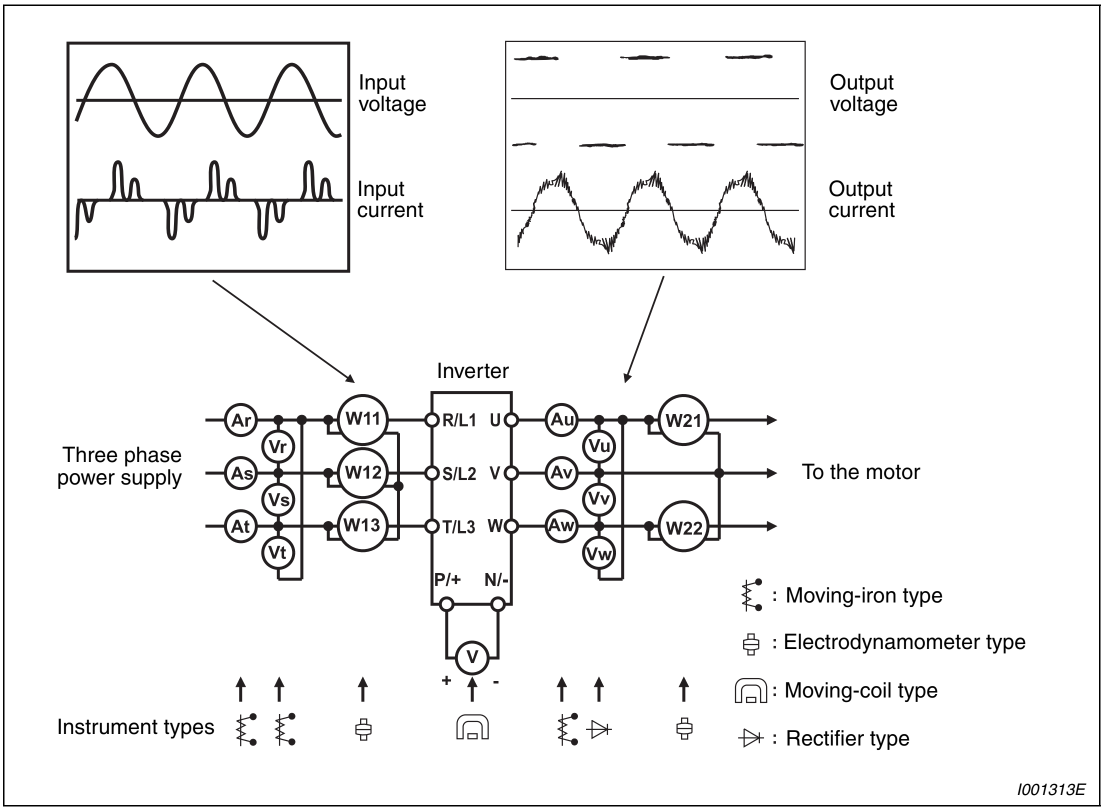


Fig. 8-16: *Examples of measuring points and instruments*

Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measurement Value)
Power supply voltage V1	Across R/L1-S/L2, S/L2-T/L3, T/L3-R/L1	Moving-iron type AC voltmeter ④	Commercial power supply Within permissible AC voltage fluctuation (Refer to appendix A)
Power supply side current I1	R/L1, S/L2, and T/L3 line currents	Moving-iron type AC ammeter ④	
Power supply side power P1	R/L1, S/L2, T/L3 and R/L1-S/L2, S/L2-T/L3, T/L3-R/L1	Digital power meter (designed for inverter) or electro-dynamic type single-phase wattmeter	P1 = W11 + W12 + W13 (3-wattmeter method)
Power supply side power factor Pf1	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf1 = \frac{P1}{\sqrt{3} \times V1 \times I1} \times 100\%$		
Output side voltage V2	Across U-V, V-W and W-U	Rectifier type AC voltage meter ①④ (Moving-iron type cannot measure)	Difference between the phases is within ±1% of the maximum output voltage
Output side current I2	U, V and W line currents	Moving-iron type AC ammeter ②④	Difference between the phases is 10% or lower of the rated inverter current.
Output side power P2	U, V, W and U-V, V-W	Digital power meter (designed for inverter) or electro-dynamic type single-phase wattmeter	P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)
Output side power factor Pf2	Calculate in similar manner to power supply side power factor. $Pf2 = \frac{P2}{\sqrt{3} \times V2 \times I2} \times 100\%$		
Converter output	Across P/+-N/–	Moving-coil type (such as tester)	Inverter LED display is lit. 1.35 × V1

Tab. 8-7: *Measuring Points and Instruments (1)*

Item	**Measuring Point**	**Measuring Instrument**	**Remarks (Reference Measurement Value)**	
Frequency setting signal	Across 2, 4 (positive) and 5	Moving-coil type (Tester and such may be used) (Internal resist- ance: 50kΩ or larger)	0–10V DC, 4–20mA	"5" is common
	Across 1 (positive) and 5		0–±5V DC, 0–±10V DC	
Frequency set- ting power supply	Across 10 (positive) and 5		5.2V DC	
	Across 10E (positive) and 5		10V DC	
Frequency meter signal	Across CA (positive) and 5		About 20mA at maximum frequency	
	Across AM (positive) and 5		Approximately 10V DC at maximum frequency (without frequency meter)	
Start signal Select signal	Across STF, STR, RH, RM, RL, JOG, RT, AU, STOP, CS and SD (0V)		When open: 20 to 30V DC ON voltage: 1V or less	"SD" is common (source logic)
Reset	Across RES-SD (0V)			
Output stop	Across MRS-SD (0V)			
Alarm signal	Across A1-C1 and B1-C1	Moving-coil type (such as tester)	Continuity check ③ Normal / Abnormal Across A1-C1: Discontinuity / Continuity Across B1-C1: Continuity / Discontinuity	

Tab. 8-7: *Measuring Points and Instruments (2)*

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.

④ A digital power meter (designed for inverter) can also be used to measure.

A Appendix

A.1 Specifications FR-F740-00023 to -01160

Series			00023	00038	00052	00083	00126	00170	00250	00310	00380	00470	00620	00770	00930	01160
Rated motor capacity [kW] ①		120% overload capacity	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
		150% overload capacity	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Output	Output capacity [kVA] ②	120% overload capacity	1.8	2.9	4.0	6.3	9.6	13	19.1	23.6	29.0	35.8	47.3	57.8	70.9	88.4
		150% overload capacity	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
	Rated current [A] ③	120% overload capacity	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)
		150% overload capacity	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)
	Overload current rating ④	120% overload capacity	120% of rated motor capacity for 3s; 110% for 1 min. (max. ambient temperature 40°C) – typical for pumps and fans													
		150% overload capacity	150% of rated motor capacity for 3s; 120% for 1 min. (max. ambient temperature 50°C) – typical for conveyor belts and centrifuges													
	Voltage ⑤		3-phase AC, 0V to power supply voltage													
Power supply	Power supply voltage		3-phase, 380–500V AC, –15% / +10%													
	Voltage range		323–550V AC at 50/60Hz													
	Power supply frequency		50/60Hz ± 5%													
	Rated input capacity [kVA] ⑥	120% overload capacity	2.8	5.0	6.1	10	13	19	22	31	37	45	57	73	88	110
		150% overload capacity	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66	80	100
Protective structure ⑧			IP20 ⑦											IP00		
Cooling system			Self cooling			Forced air cooling										
Weight [kg]			3.5	3.5	3.5	3.5	3.5	6.5	6.5	7.5	7.5	13	13	23	23	35

Tab. A-1: *Specifications FR-F740-00023 to -01160*

① The applied 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 (= 85% load). 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)

A.2 Specifications FR-F740-01800 to -12120

Series			01800	02160	02600	03250	03610	04320	04810	05470	06100	06830	07700	08660	09620	10940	12120
Rated motor capacity [kW] ①		120% overload capacity	90	110	132	160	185	220	250	280	315	355	400	450	500	560	630
		150% overload capacity	75	90	110	132	160	185	220	250	280	315	355	400	450	500	560
Output	Output capacity [kVA] ②	120% overload capacity	137	165	198	247	275	329	366	416	464	520	586	659	733	833	923
		150% overload capacity	110	137	165	198	247	275	329	366	416	464	520	586	659	733	833
	Rated current [A] ③	120% overload capacity	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)
		150% overload capacity	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)
	Overload current rating ④	120% overload capacity	120% of rated motor capacity for 3s; 110% for 1 min. (max. ambient temperature 40°C) – typical for pumps and fans														
		150% overload capacity	150% of rated motor capacity for 3s; 120% for 1 min. (max. ambient temperature 50°C) – typical for conveyor belts and centrifuges														
	Voltage ⑤		3-phase AC, 0V to power supply voltage														
Power supply	Power supply voltage		3-phase, 380–500V AC, –15% / +10%														
	Voltage range		323–550V AC at 50/60Hz														
	Power supply frequency		50/60Hz ± 5%														
	Rated input capacity [kVA] ⑥	120% overload capacity	137	165	198	247	275	329	366	416	464	520	586	659	733	833	923
		150% overload capacity	110	137	165	198	247	275	329	366	416	464	520	586	659	733	833
Protective structure ⑦			IP00														
Cooling system			Forced air cooling														
Weight [kg]			37	50	57	72	72	110	110	220	220	220	260	260	370	370	370

Tab. A-2: *Specifications FR-F740-01800 to -12120*

① The applied 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 (= 85% load). 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 FR-DU07: IP40 (except for the PU connector)

A.3 Specifications FR-F746-00023 to -01160

Series			00023	00038	00052	00083	00126	00170	00250	00310	00380	00470	00620	00770	00930	01160
Rated motor capacity [kW] ①		120% overload capacity	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
		150% overload capacity	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Output	Output capacity [kVA] ②	120% overload capacity	1.8	2.9	4.0	6.3	9.6	13	19.1	23.6	29.0	35.8	47.3	58.7	70.9	88.4
		150% overload capacity	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
	Rated current [A] ③	120% overload capacity	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)
		150% overload capacity	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)
	Overload current rating ④	120% overload capacity	120% of rated motor capacity for 3s; 110% for 1 min. (max. ambient temperature 30°C) – typical for pumps and fans													
		150% overload capacity	150% of rated motor capacity for 3s; 120% for 1 min. (max. ambient temperature 40°C) – typical for conveyor belts and centrifuges													
	Voltage ⑤		3-phase AC, 0V to power supply voltage													
Power supply	Power supply voltage		3-phase, 380–500V AC, –15% / +10%													
	Voltage range		323–550V AC at 50/60Hz													
	Power supply frequency		50/60Hz ± 5%													
	Rated input capacity [kVA] ⑥	120% overload capacity	2.8	5.0	6.1	10	13	19	22	31	37	45	57	73	88	110
		150% overload capacity	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66	80	100
Protective structure			IP54													
Cooling system			Forced air cooling													
Weight [kg]			12.5	12.5	12.5	12.5	12.5	18.5	18.5	21.5	21.5	30	30	30	42	42

Tab. A-3: *Specifications FR-F746-00023 to -01160*

① The applied 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 (= 85% load). 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).

A.4 Common specifications

FR-F740/746			Specification
Control specification	Control system		V/f control, optimum excitation control or simple magnetic flux vector control
	Modulation control		Sine evaluated PWM, Soft PWM
	Output frequency range		0.5–400Hz
	Frequency setting resolution	Analog input	0.015Hz/0–50Hz (terminal 2, 4: 0–10V/12 bit) 0.03Hz/0–50Hz/(terminal 2, 4: 0–5V/11 bit, 0–20mA /11 bit, terminal 1: 0–±10V/12 bit) 0.06Hz/0–50Hz (terminal 1: 0–±5V/11 bit)
		Digital input	0.01Hz
	Frequency accuracy	Analog input	±0.2% of the maximum output frequency (temperature range 25° ± 10°C)
		Digital input	±0.01% of the set output frequency
	Voltage/frequency characteristics		Base frequency adjustable from 0 to 400Hz; selection between constant torque, variable torque or optional flexible 5-point V/f characteristics
	Starting torque		120% (3Hz) when set to simple magnetic flux vector control and slip compensation
	Acceleration/deceleration time		0; 0.1 to 3600s (can be set individually)
	Acceleration/deceleration characteristics		Linear or S-form course, user selectable
	DC injection brake		Operating frequency (0–120Hz), operating time (0–10 s) and operating voltage (0–30%) can be set individually.
	Stall prevention		Responses threshold 0–150%, user adjustable, also via analog input
Control signals for operation	Frequency setting values	Analog input	Terminal 2, 4: 0–5V DC, 0–10V DC, 0/4–20mA Terminal 1: 0–±5V DC, 0–±10V DC
		Digital input	Four-digit BCD or 16-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		Any of 12 signals can be selected using parameters 178 to 189 (input terminal function selection): multi speed, second parameter function, terminal 4 input, JOG operation, automatic restart after instantaneous power failure, external thermal relay input, FR-HC connection (inverter operation enable signal) and FR-HC connection (instantaneous power failure detection), PU operation/external interlock signal, External DC injection brake operation start, PID control, PU operation, PU <–> external operation, output stop, start self-holding selection, traverse function selection, forward/reverse rotation command, inverter reset, PTC thermistor input, PID forward/reverse operation switchover, PU <–> NET, External <–> NET operation switchover, command source switchover, DC feeding operation permission, DC feeding cancel, and PID integral value reset.
	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, continuous operation at an instantaneous power failure, commercial power supply-inverter switch over 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 pre-alarm (01800 or more), 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, commercial power supply-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, PID deviation limit, during retry, during PID output suspension, pulse train output of output power, DC current feeding, 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 using the FR-A7AY, FR-A7AR options	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)
		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 (01800 or more), 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).

Tab. A-4: *Common specifications (1)*

FR-F740/746			Specification
Display	Operation panel (FR-DU07) Parameter unit (FR-PU07)	Operating status	Output frequency, motor current (steady or peak value), output voltage, alarm indication, frequency setting, motor running speed, converter output voltage (steady or peak value), electronic thermal load factor, input power, output power, load meter, cumulative energizing time, actual operation time, motor load factor, watt-hours meter, power saving effect, cumulative saving power, regenerative brake circuit duty (01800 or more), PID set point, PID measured value, PID deviation monitor, I/O terminal monitor, optional input terminal monitor (FR-DU07 only), optional output terminal monitor (FR-DU07 only), option fitting state monitor (FR-PU07 only), terminal assignment state (FR-PU07 only)
		Alarm definition	Alarm definition is displayed when the protective function is activated, the output voltage/current/frequency/cumulative energizing time right before the protection function was activated and the past 8 alarm definitions are stored.
		Interactive guidance	Operation guide/trouble shooting with a help function (FR-PU07 only)
Protection	Protective functions		Overcurrent cutoff (during acceleration, deceleration or at constant speed), overvoltage cutoff (during acceleration, deceleration or at constant speed), inverter protection thermal operation, motor protection thermal operation, heatsink overheat, instantaneous power failure occurrence, undervoltage, input phase loss, motor overload, output short circuit, ground fault overcurrent, output phase loss, external thermal relay operation, PTC thermistor operation, option alarm, parameter error, PU disconnection, retry count excess, CPU alarm, operation panel power supply short circuit, 24V DC power output short, output current detection value over, inrush current limit circuit alarm, communication error (frequency inverter), analog input alarm, PID signal fault, internal circuit alarm (15V DC power supply), fan fault, overcurrent stall prevention, overvoltage stall prevention, electronic thermal pre-alarm, PU stop, maintenance timer alarm (FR-DU07 only), MT-BU5 external brake module overload (01800 or more), parameter write error, copy error, operation panel lock, parameter copy error
Environment	Ambient temperature		FR-F740: –10°C to +50°C (non-freezing) For selection of the load characteristics with a 120% overload rating the max. temperature is 40°C FR-F746: –10°C to +40°C (non-freezing) For selection of the load characteristics with a 120% overload rating the max. temperature is 30°C
	Storage temperature ①		-20°C to +65°C
	Ambient humidity		Max. 90% RH (non-condensing)
	Ambience conditions		For indoor use only, avoid environments containing corrosive gases, install in a dust-free location.
	Altitude		Maximum 1000m above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (91%)
	Vibration resistance		5.9m/s² or less (JIS 60068-2-6) ②

Tab. A-4: *Common specifications (2)*

① The product may only be exposed to the full extremes of this temperature range for short periods (e.g. during transportation).

② 2.9m/s² or less for the 04320 or more.

A.5 Outline dimension drawings

A.5.1 FR-F740-00023 to -00126

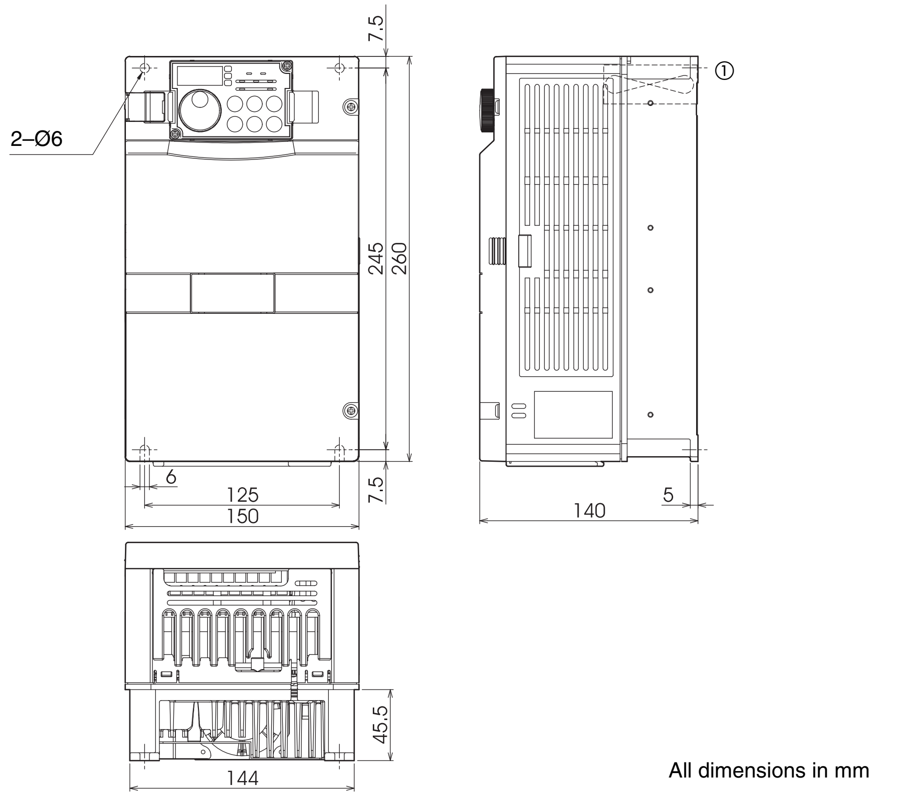
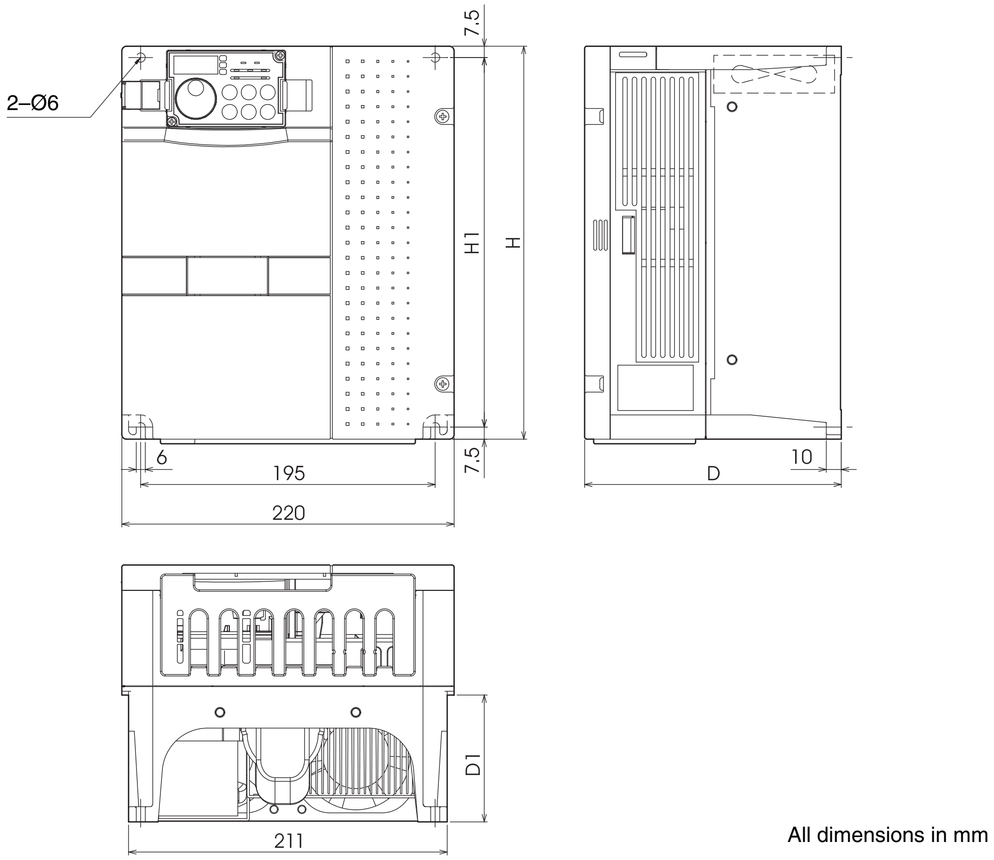


Fig. A-1: Dimensions FR-F740-00023 to -00126

① The FR-F740-00023 to 00052-EC are not provided with a cooling fan.

A.5.2 FR-F740-00170 to -00380



Inverter	H	H1	D	D1
FR-F740-00170/-00250	260	245	170	84
FR-F740-00310/-00380	300	285	190	101.5

i001315E

Fig. A-2: *Dimensions FR-F740-00170 to -00380*

A.5.3 FR-F740-00470 and -00620

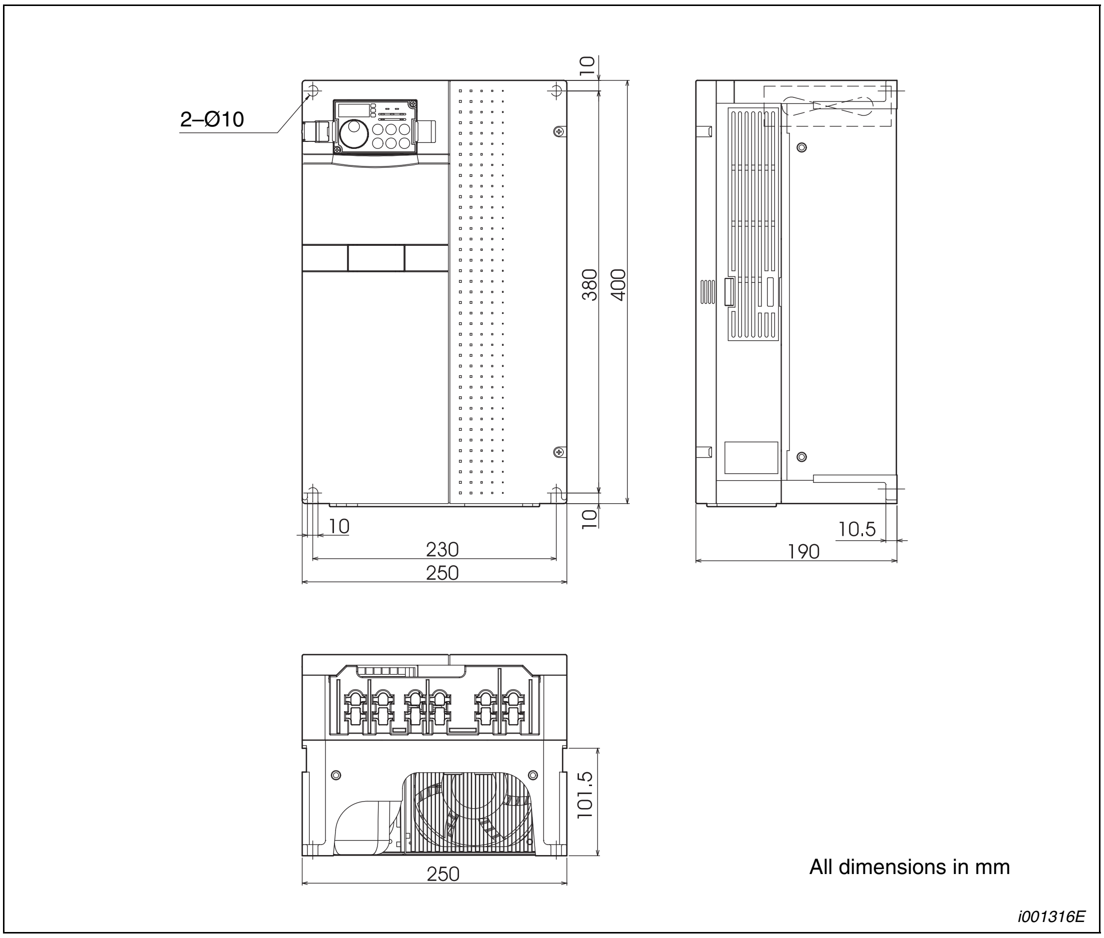
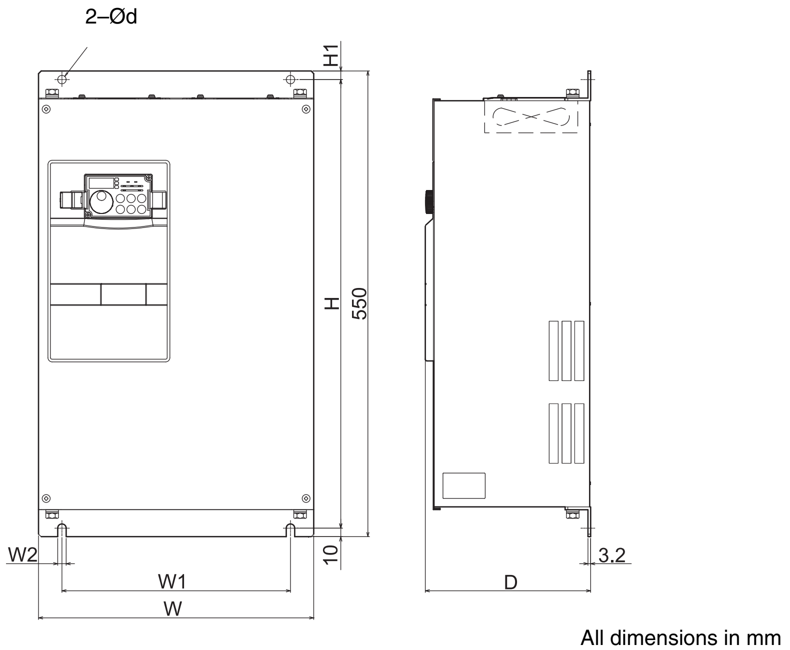


Fig. A-3: *Dimensions FR-F740-00470 and -00620*

A.5.4 FR-F740-00770 to -01160

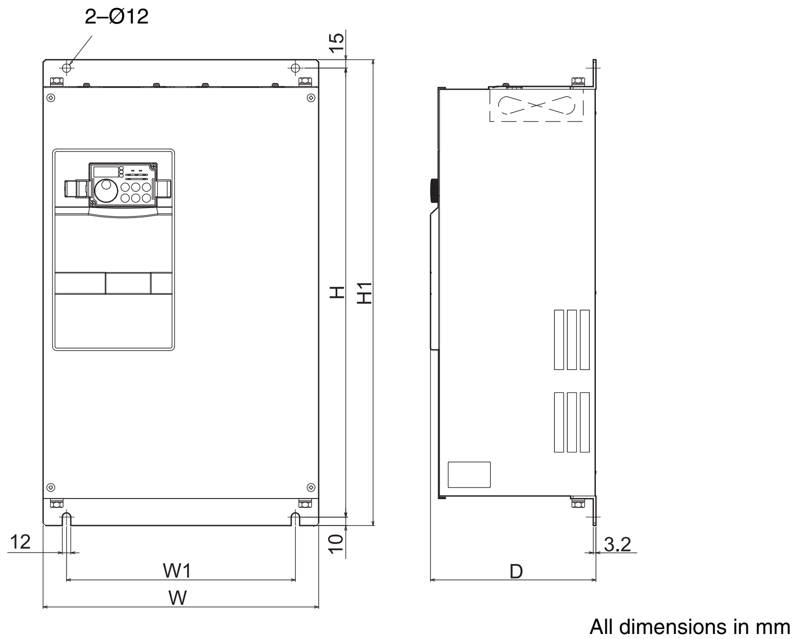


Inverter	W	W1	W2	H	H1	d	D
FR-F740-00770	325	270	10	530	10	10	195
FR-F740-00930/-01160	435	380	12	525	15	12	250

i001317E

Fig. A-4: *Dimensions FR-F740-00770 to -01160*

A.5.5 FR-F740-01800

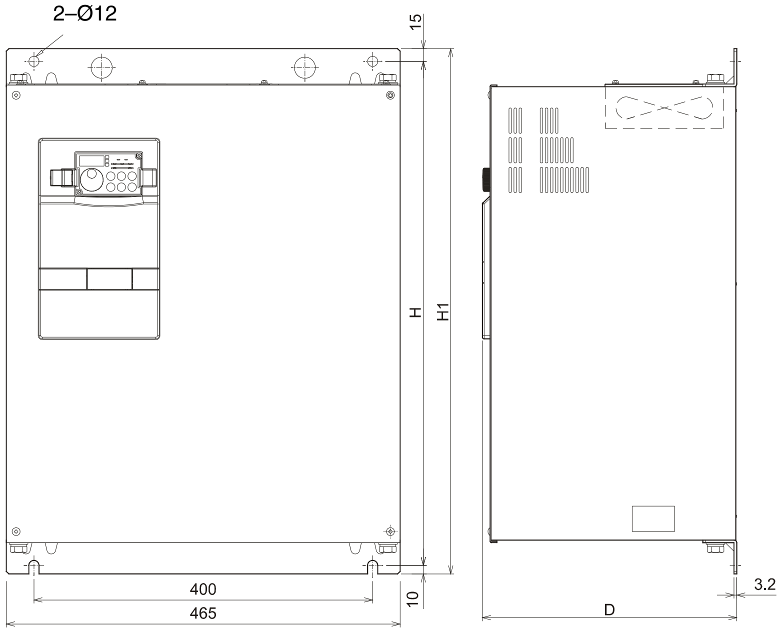


Inverter	W	W1	W2	H	H1	D
FR-F740-01800	435	380	12	525	550	250

i001318E

Fig. A-5: *Dimensions FR-F740-01800*

A.5.6 FR-F740-02160 to -03610



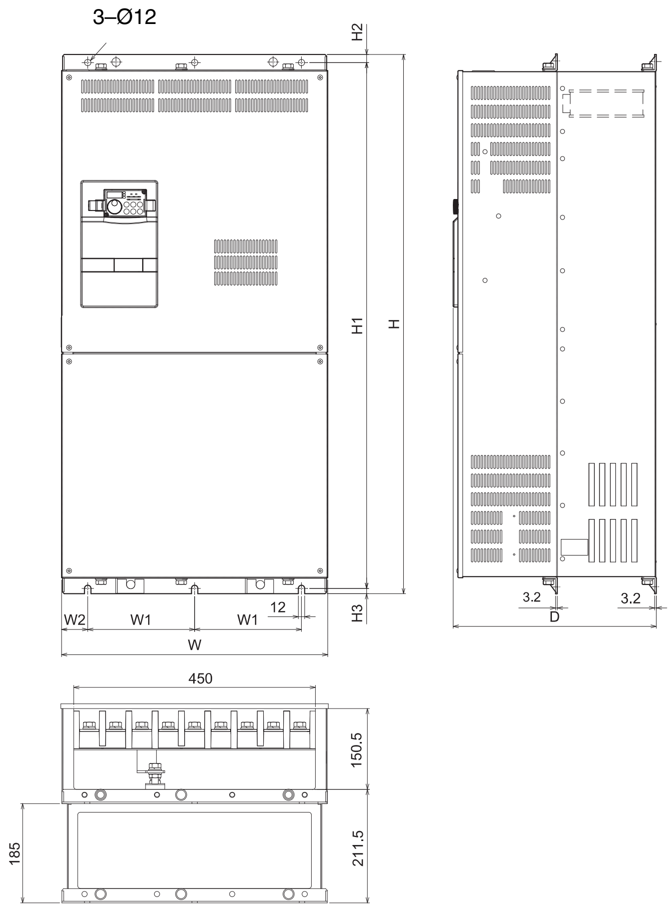
All dimensions in mm

Inverter	H	H1	D
FR-F740-02160/-02600	595	620	300
FR-F740-03250/-03610	715	740	360

I001384W

Fig. A-6: *Dimensions FR-F740-02160 to -03610*

A.5.7 FR-F740-04320 to -06830



All dimensions in mm

Inverter	W	W1	W2	H	H1	H2	H3	D
FR-F740-04320/-04810	498	200	49	1010	985	15	10	380
FR-F740-05470–FR-F740-06830	680	300	40	1010	984	—	—	380

I001385E

Fig. A-7: *Dimensions FR-F740-04320 to -06830*

A.5.8 FR-F740-07700 and -08660

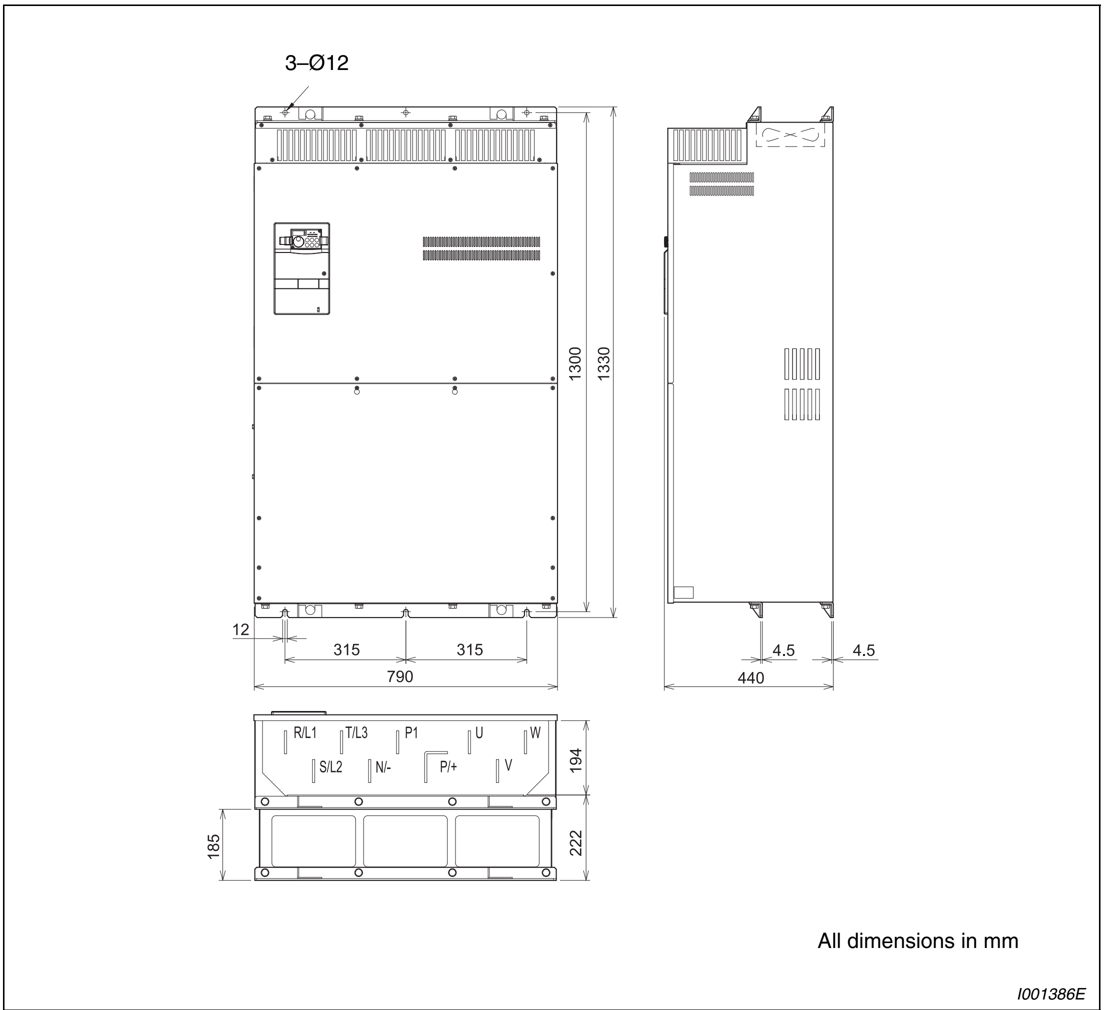


Fig. A-8: *Dimensions FR-F740-07700 and -08660*

A.5.9 FR-F740-09620 to -12120

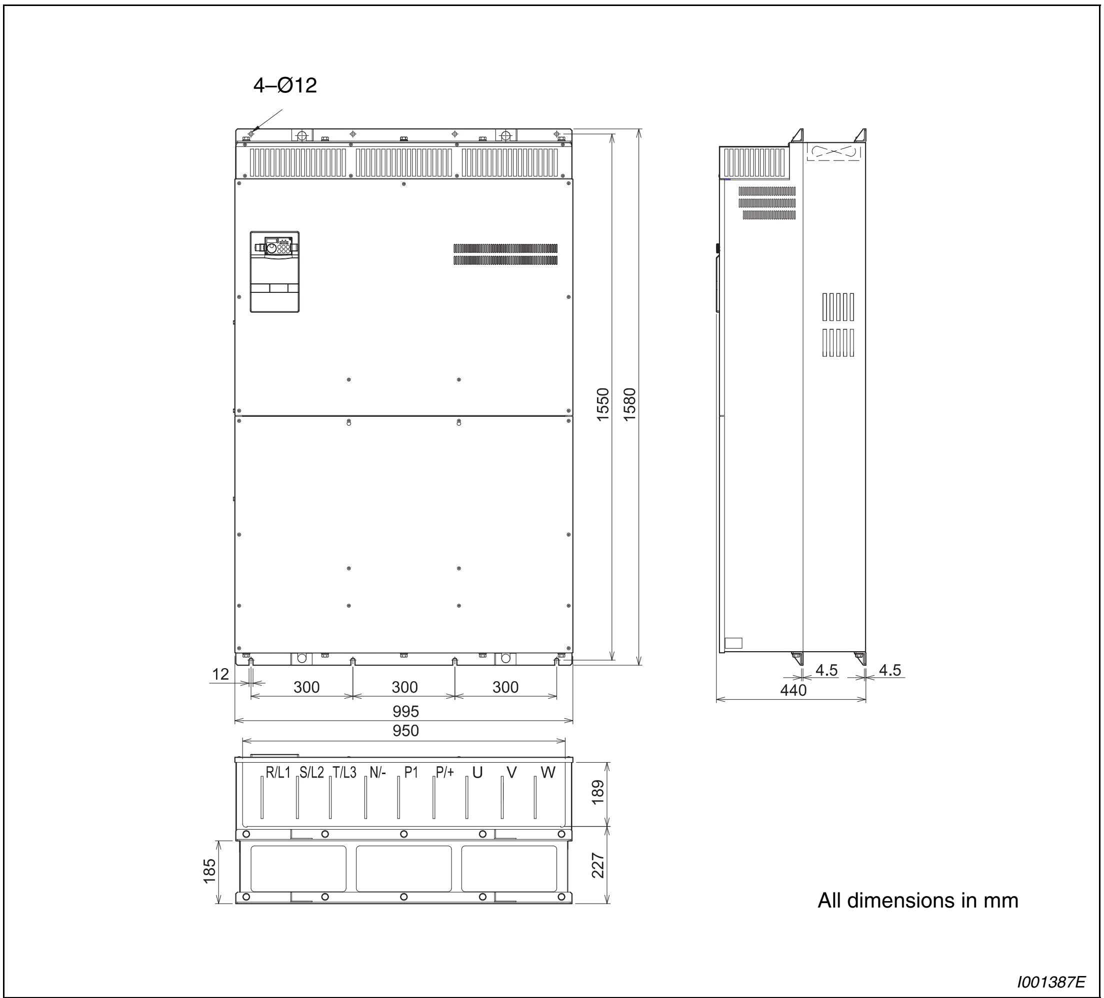


Fig. A-9: *Dimensions FR-F740-09620 to -12120*

A.5.10 FR-F746-00023 to -00126

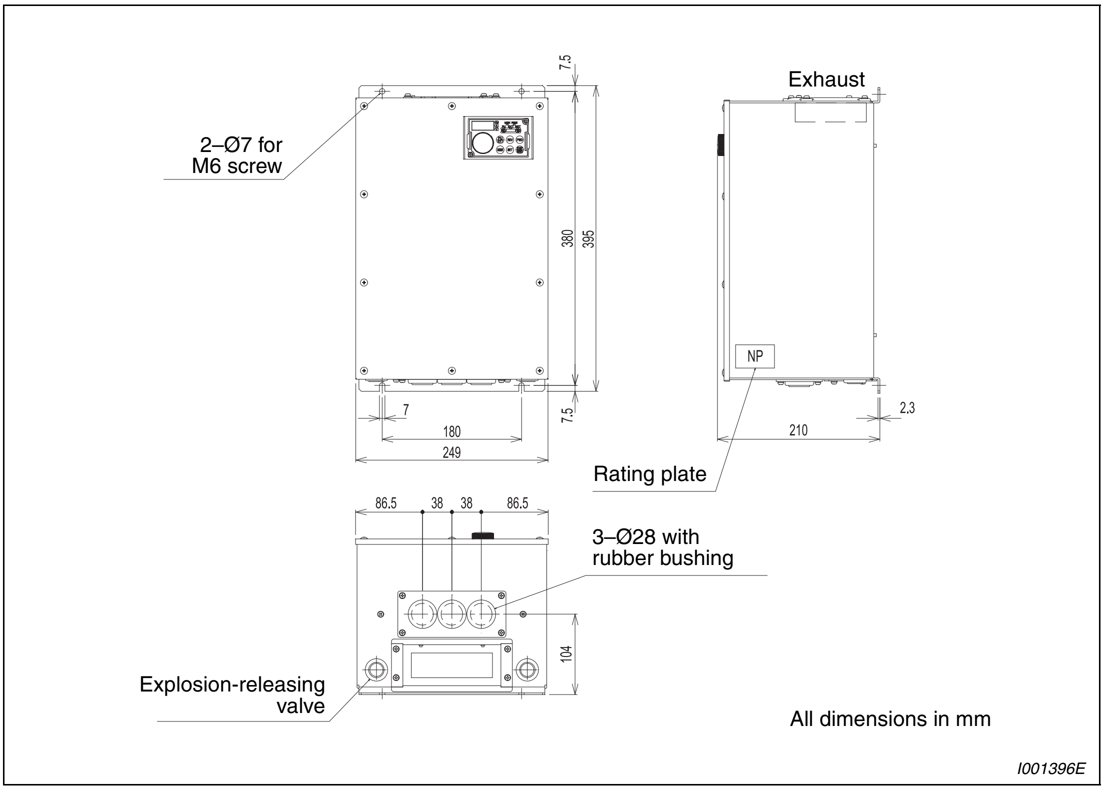


Fig. A-10: *Dimensions FR-F746-00023 to -00126*

A.5.11 FR-F746-00170 and -00250

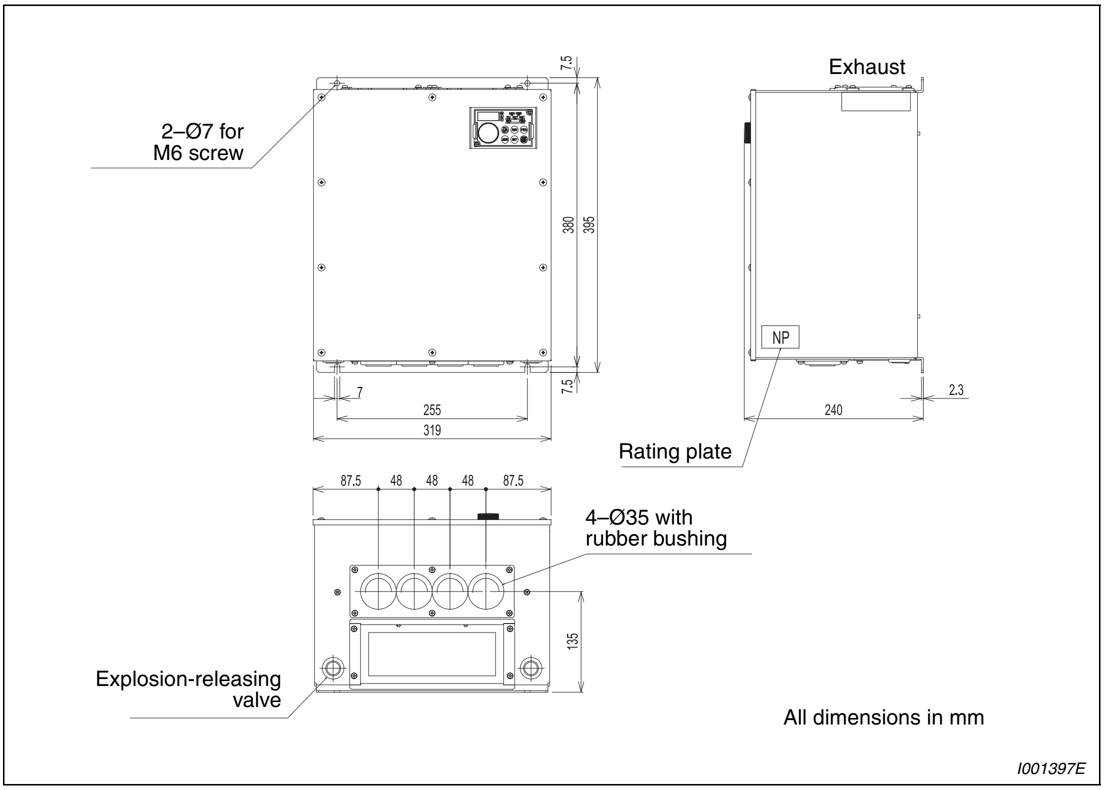


Fig. A-11: *Dimensions FR-F746-00170 and -00250*

A.5.12 FR-F746-00310 and -00380

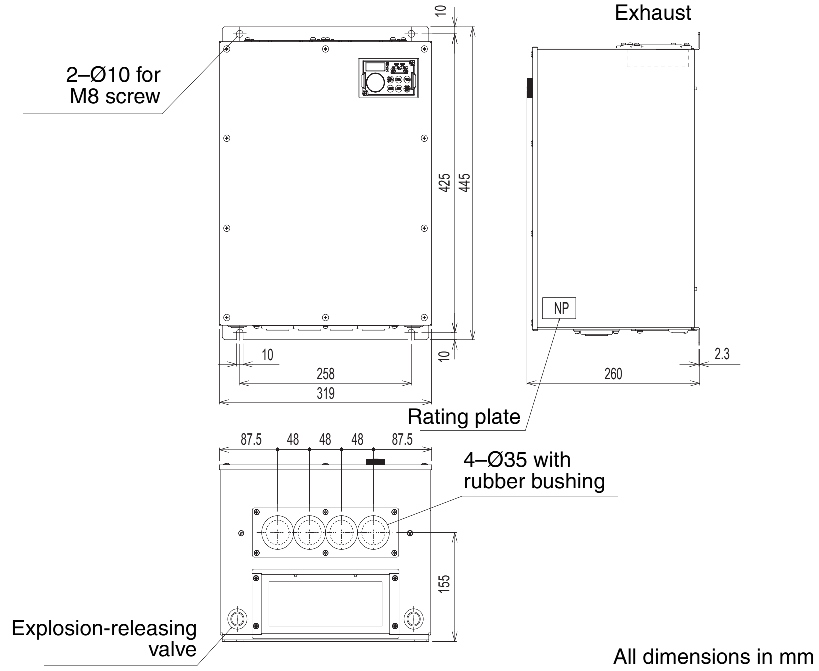


Fig. A-12: *Dimensions FR-F746-00310 and -00380*

A.5.13 FR-F746-00470 and -00620

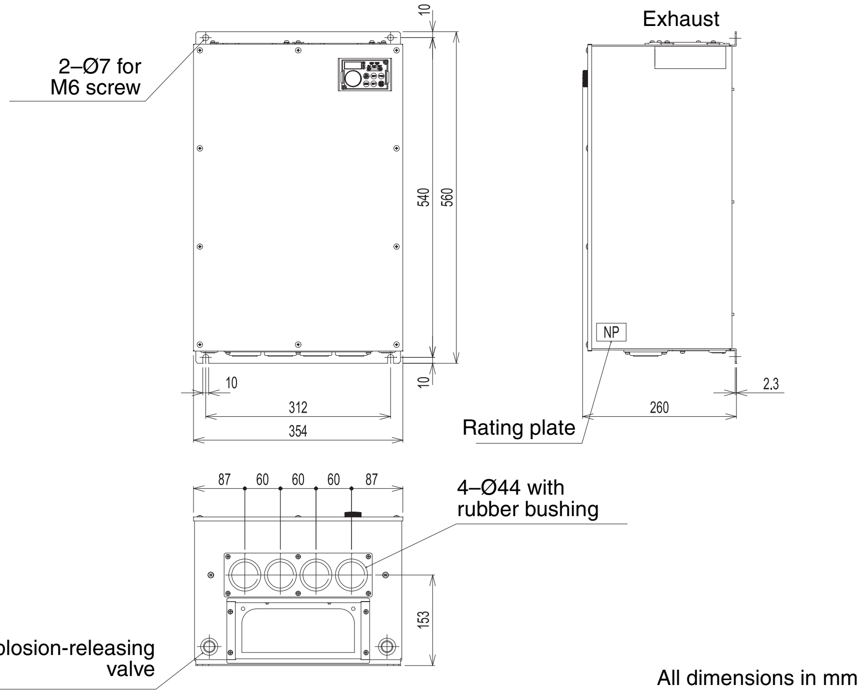


Fig. A-13: *Dimensions FR-F746-00470 and -00620*

A.5.14 FR-F746-00770

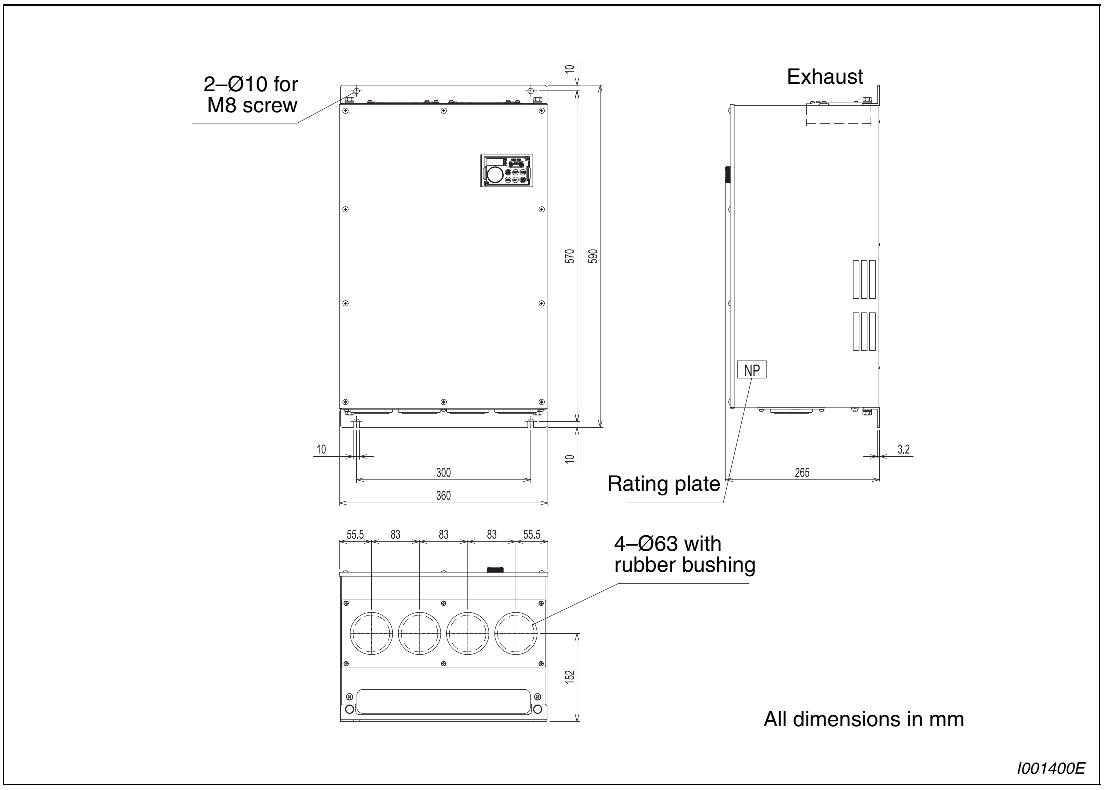


Fig. A-14: *Dimensions FR-F746-00770*

A.5.15 FR-F746-00930 and -01160

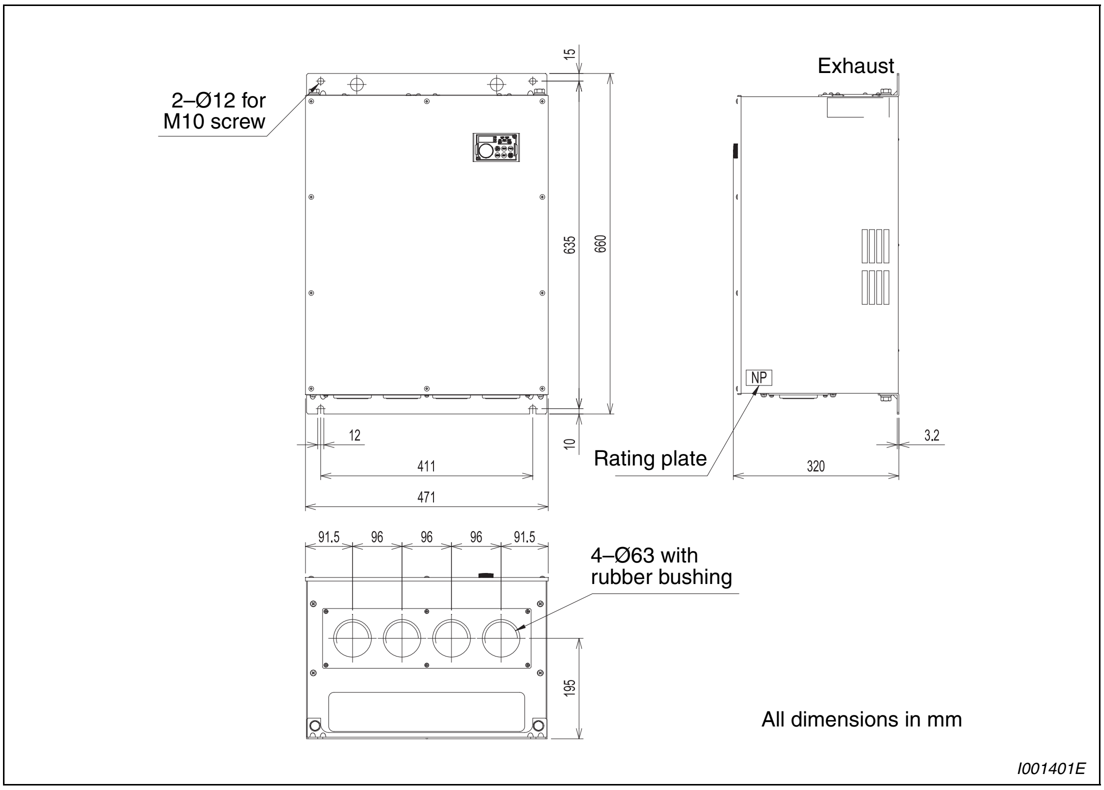
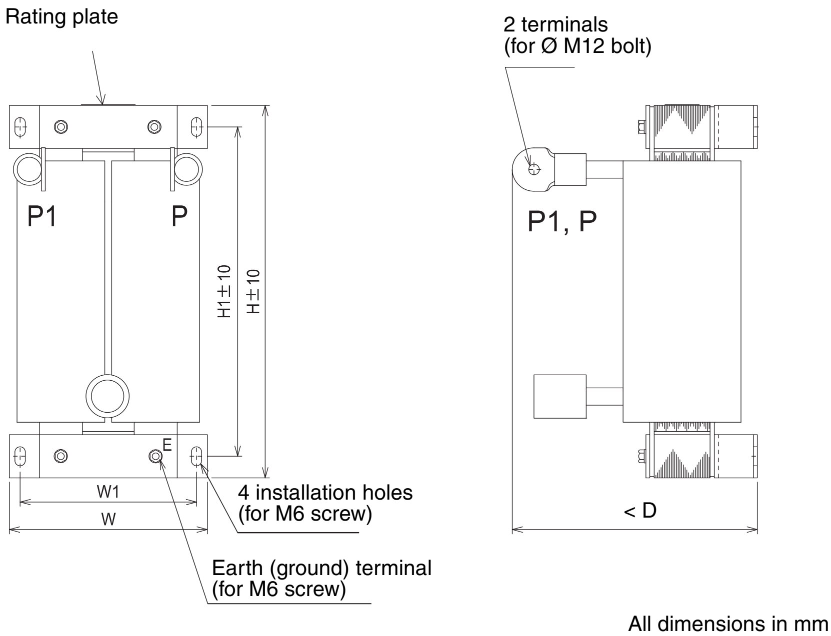


Fig. A-15: *Dimensions FR-F746-00930 and -01160*

A.5.16 DC reactors

FR-HEL-H90K

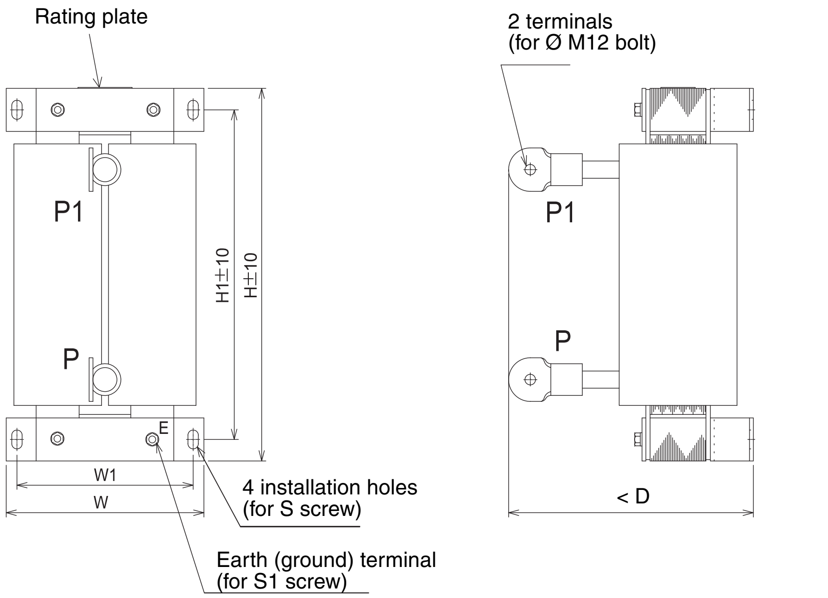


Inverter	W	W1	H	H1	D	Weight [kg]
FR-F740-01800	150	130	340	310	190	20

I001388E

Fig. A-16: *DC reactor FR-HEL-H90K*

FR-HEL-H110K–185K

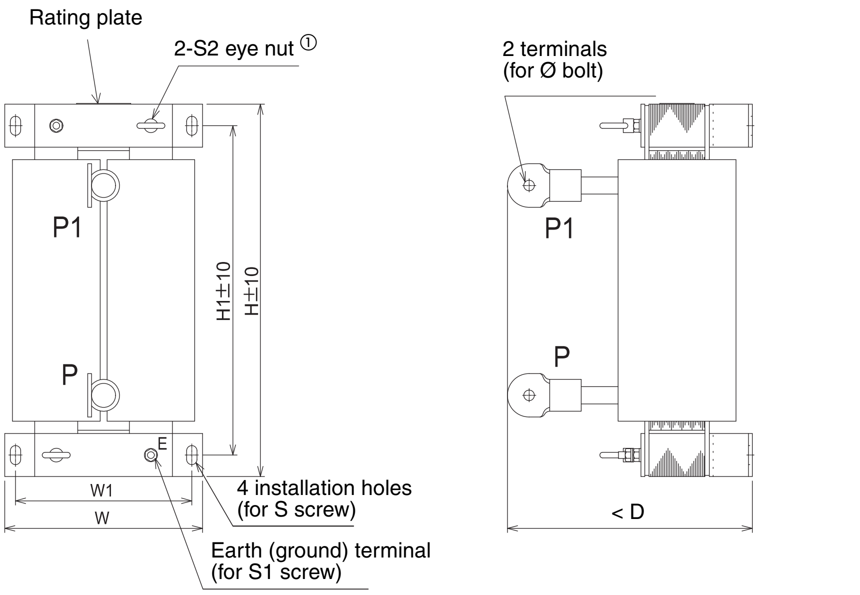


Inverter	DC reactor Type	W	W1	H	H1	D	S	S1	Weight [kg]
FR-F740-02160	FR-HEL-H110K	150	130	340	310	195	M6	M6	22
FR-F740-02600	FR-HEL-H132K	175	150	405	370	200	M8	M8	26
FR-F740-03250	FR-HEL-H160K	175	150	405	370	205	M8	M8	28
FR-F740-03610	FR-HEL-H185K	175	150	405	370	240	M8	M8	29

i001389E

Fig. A-17: *DC reactor FR-HEL-H110K–185K*

FR-HEL-H220K–355K



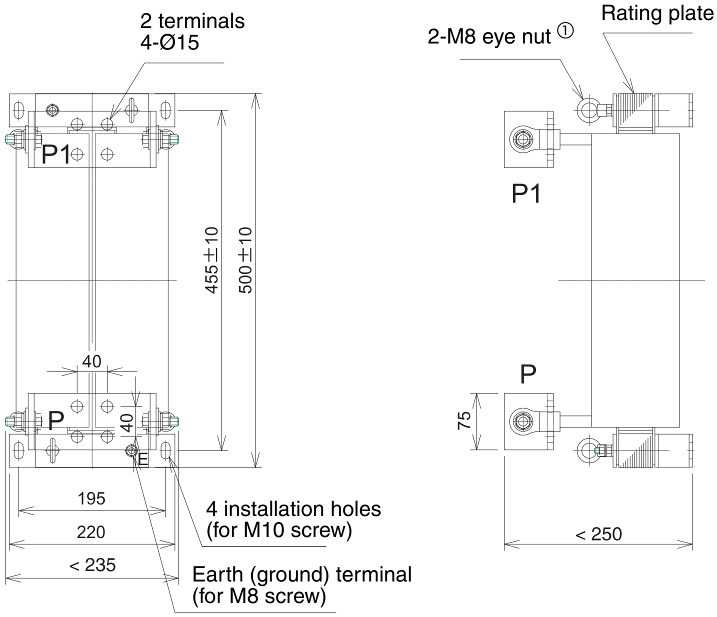
Inverter	DC reactor Type	W	W1	H	H1	D	S	S1	S2	Ø	Weight [kg]
FR-F740-04320	FR-HEL-H220K	175	150	405	370	240	M8	M6	M6	M12	30
FR-F740-04810	FR-HEL-H250K	190	165	440	400	250	M8	M8	M8	M12	35
FR-F740-05470	FR-HEL-H280K	190	165	440	400	255	M8	M8	M8	M16	38
FR-F740-06100	FR-HEL-H315K	210	185	495	450	250	M10	M8	M8	M16	42
FR-F740-06830	FR-HEL-H355K	210	185	495	450	250	M10	M8	M8	M16	46

i001390C

***Fig. A-18:** DC reactor FR-HEL-H220K–355K*

① Remove the eye nut after installation of the product.

FR-HEL-H400K–450K



All dimensions in mm

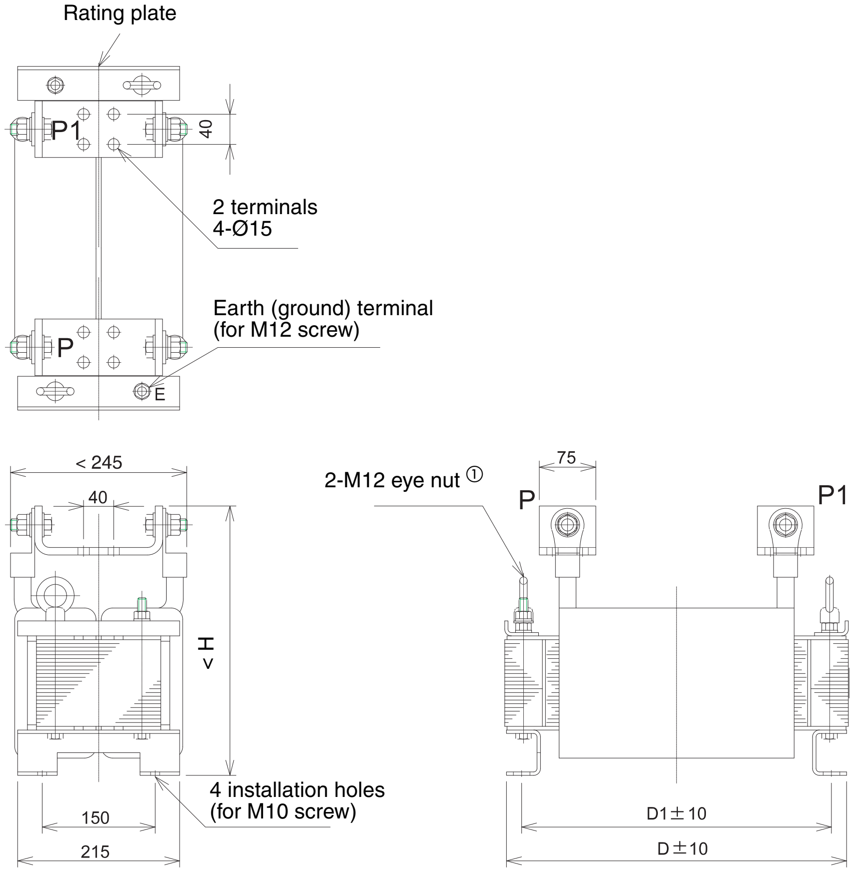
Inverter	DC reactor Type	Weight [kg]
FR-F740-07700	FR-HEL-H400K	50
FR-F740-08660	FR-HEL-H450K	57

i001391C

Fig. A-19: *DC reactor FR-HEL-H400K–450K*

① Remove the eye nut after installation of the product.

FR-HEL-H500K–630K



All dimensions in mm

Inverter	DC reactor Type	H	D	D1	Weight [kg]
FR-F740-09620	FR-HEL-H500K	345	455	405	67
FR-F740-10940	FR-HEL-H560K	360	460	410	85
FR-F740-12120	FR-HEL-H630K	360	460	410	95

i001392C

Fig. A-20: *DC reactor FR-HEL-H500K–630K*

① Remove the eye nut after installation of the product.

A.5.17 Panel cutting for the heatsink protrusion attachment

Cut the panel of the enclosure according to the inverter capacity.

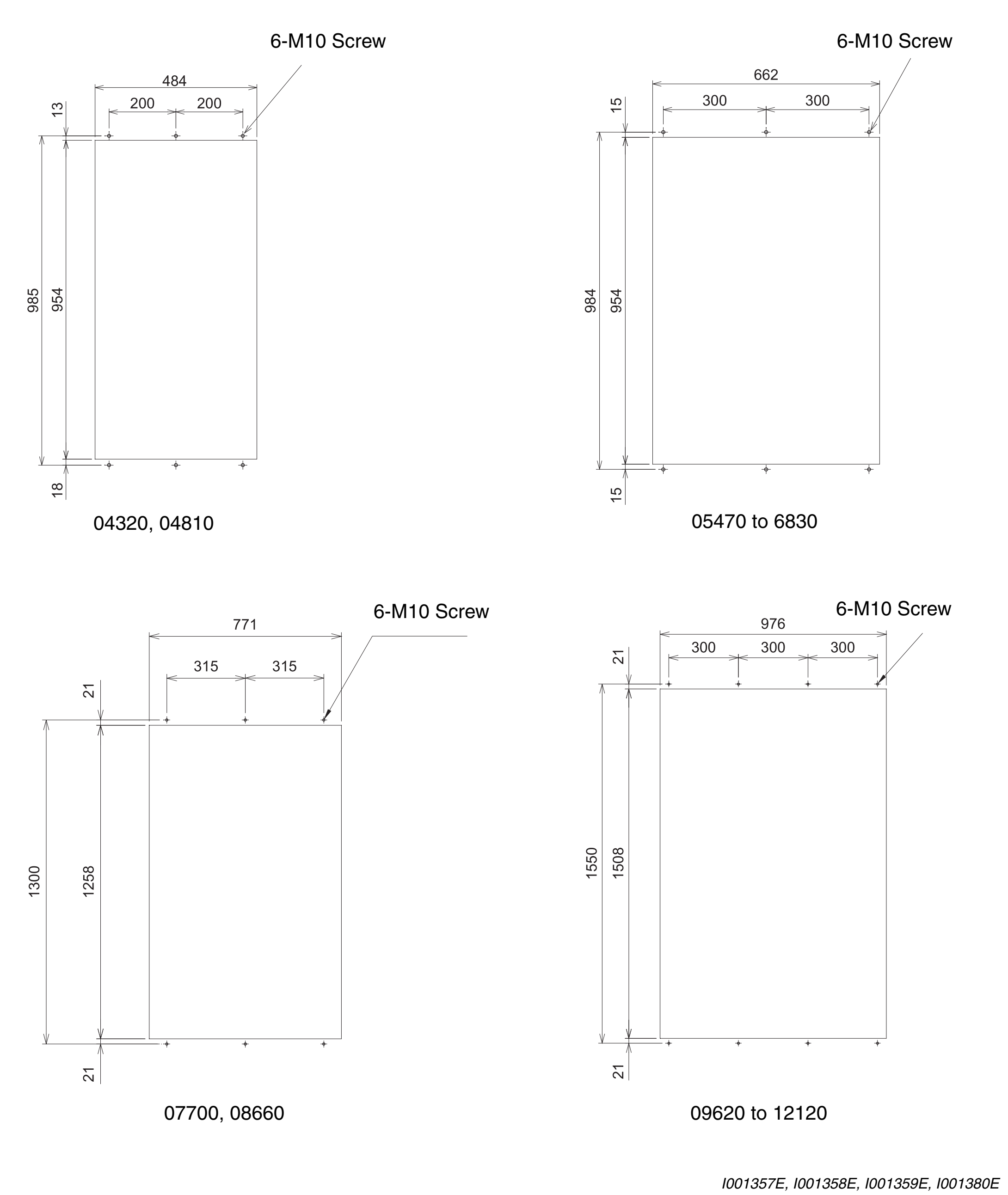


Fig. A-21: *Panel cutting*

A.5.18 Operation panel FR-DU07

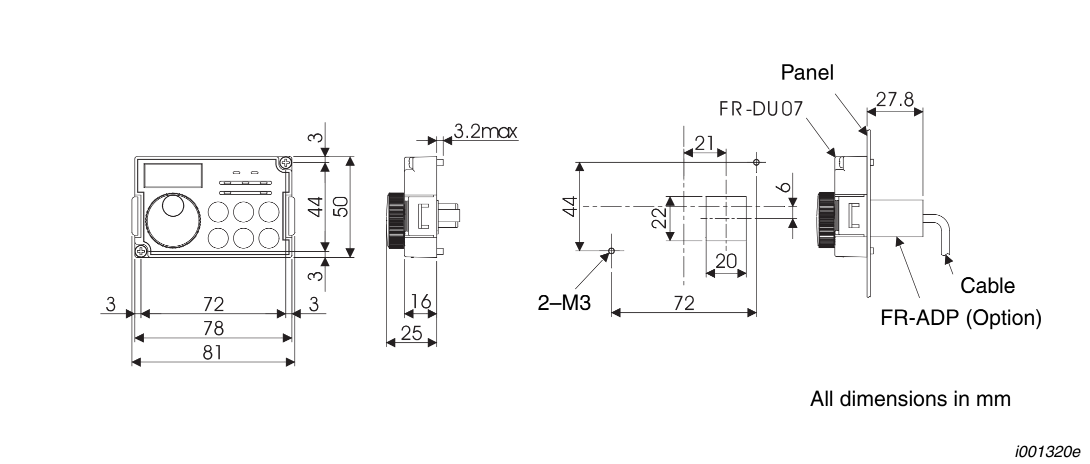


Fig. A-22: *Operation panel FR-DU07*

A.5.19 Parameter unit FR-PU07

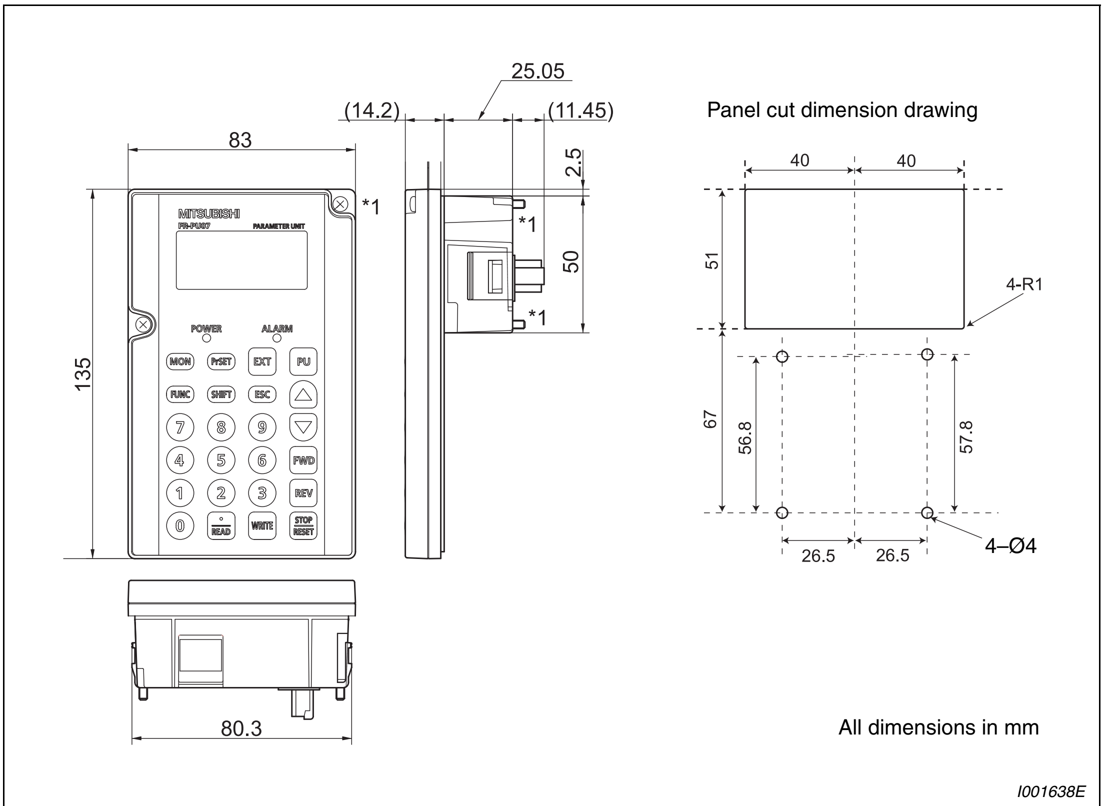


Fig. A-23: *Parameter unit FR-PU07*

NOTES

When installing the FR-PU07 on the enclosure, etc., remove screws or fix the screws to the FR-PU07 with M3 nuts.

The effective depth of the M3 installation screw hole is 5.0mm.

A.6 Parameter list with instruction codes

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 parameters registered in the user group can be displayed.

Tab. A-5: *Settings of parameter 160*

NOTES

The parameters marked ◎ are the simple mode parameters.

The parameters marked with ▭ in the table allow its setting to be changed during operation even if "0" (initial value) is set in Pr. 77 "Parameter write selection".

Parameters for the option are displayed only when the option unit is installed.

The instruction codes (hexadecimal) for "read" and "write" on the right of the parameter number are those used to set the parameter via communication. "Extended" indicates the setting of the extended link parameter. (Refer to section 6.18 for communication.)

For parameters marked with Ver.UP, specifications differ according to the date assembled (refer to appendix A.7).

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Basic functions	◎ 0	00	80	0	**Torque boost**	0–30%	0.1%	6/4/3/2/1.5/1%	6-30	
	◎ 1	01	81	0	**Maximum frequency**	0–120Hz	0.01Hz	120/60Hz	6-45	
	◎ 2	02	82	0	**Minimum frequency**	0–120Hz	0.01Hz	0Hz	6-45	
	◎ 3	03	83	0	**Base frequency**	0–400Hz	0.01Hz	50Hz	6-49	
	◎ 4	04	84	0	**Multi-speed setting (high speed)**	0–400Hz	0.01Hz	50Hz	6-54	
	◎ 5	05	85	0	**Multi-speed setting (middle speed)**	0–400Hz	0.01Hz	30Hz	6-54	
	◎ 6	06	86	0	**Multi-speed setting (low speed)**	0–400Hz	0.01Hz	10Hz	6-54	
	◎ 7	07	87	0	**Acceleration time**	0–3600/360s	0.1/0.01s	5s/15s	6-66	
	◎ 8	08	88	0	**Deceleration time**	0–3600/360s	0.1/0.01s	10s/30s	6-66	
	◎ 9	09	89	0	**Electronic thermal O/L relay**	0–500/0–3600A	0.01/0.1A	Rated inverter current	6-76	

Tab. A-6: *Parameter list with instruction codes (1)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
DC injection brake	**10**	0A	8A	0	**DC injection brake operation frequency**	0–120Hz/ 9999	0.01Hz	3Hz	6-83	
	11	0B	8B	0	**DC injection brake operation time**	0–10s/8888	0.1s	0.5s	6-83	
	12	0C	8C	0	**DC injection brake operation voltage**	0–30%	0.1%	4/2/1%	6-83	
—	**13**	0D	8D	0	**Starting frequency**	0–60Hz	0.01Hz	0.5Hz	6-70	
—	**14**	0E	8E	0	**Load pattern selection**	0/1	1	1	6-51	
Jog operation	**15**	0F	8F	0	**Jog frequency**	0–400Hz	0.01Hz	5Hz	6-57	
	16	10	90	0	**Jog acceleration/ deceleration time**	0–3600/360s	0.1/0.01s	0.5s	6-57	
—	**17**	11	91	0	**MRS input selection**	0/2	1	0	6-99	
—	**18**	12	92	0	**High speed maximum frequency**	120–400Hz	0.01Hz	120/60Hz	6-45	
—	**19**	13	93	0	**Base frequency voltage**	0–1000V/ 8888/9999	0.1V	8888	6-49	
Accelera-tion/ decelera-tion time	**20**	14	94	0	**Acceleration/ deceleration reference frequency**	1–400Hz	0.01Hz	50Hz	6-66	
	21	15	95	0	**Acceleration/ deceleration time increments**	0/1	1	0	6-66	
Stall prevention	**22**	16	96	0	**Stall prevention operation level**	0–120%/ 9999	0.1%	110%	6-35	
	23	17	97	0	**Stall prevention operation level compensation factor at double speed**	0–150%/ 9999	0.1%	9999	6-35	
Multi-speed setting	**24–27**	18–1B	98–9B	0	**Multi-speed setting 4 speed to 7 speed**	0–400Hz/ 9999	0.01Hz	9999	6-54	
—	**28**	1C	9C	0	**Multi-speed input compensation selection**	0/1	1	0	6-61	
—	**29**	1D	9D	0	**Acceleration/ deceleration pattern selection**	0/1/2/3/6	1	0	6-72	
—	**30**	1E	9E	0	**Regenerative function selection**	0, 2, 10, 20/ 0, 1, 2, 10, 11, 20, 21	1	0	6-86	
Frequency jump	**31**	1F	9F	0	**Frequency jump 1A**	0–400Hz/ 9999	0.01Hz	9999	6-47	
	32	20	A0	0	**Frequency jump 1B**	0–400Hz/ 9999	0.01Hz	9999	6-47	
	33	21	A1	0	**Frequency jump 2A**	0–400Hz/ 9999	0.01Hz	9999	6-47	
	34	22	A2	0	**Frequency jump 2B**	0–400Hz/ 9999	0.01Hz	9999	6-47	
	35	23	A3	0	**Frequency jump 3A**	0–400Hz/ 9999	0.01Hz	9999	6-47	
	36	24	A4	0	**Frequency jump 3B**	0–400Hz/ 9999	0.01Hz	9999	6-47	
—	**37**	25	A5	0	**Speed display**	0/1–9998	1	0	6-121	

Tab. A-6: *Parameter list with instruction codes (2)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Frequency detection	**41**	29	A9	0	**Up-to-frequency sensitivity**	0–100%	0.1%	10%	6-113	
Frequency detection	**42**	2A	AA	0	**Output frequency detection**	0–400Hz	0.01Hz	6Hz	6-113	
Frequency detection	**43**	2B	AB	0	**Output frequency detection for reverse rotation**	0–400Hz/ 9999	0.01Hz	9999	6-113	
Second functions	**44**	2C	AC	0	**Second acceleration/ deceleration time**	0–3600/360s	0.1/0.01s	5s	6-66	
Second functions	**45**	2D	AD	0	**Second deceleration time**	0–3600/ 360s/9999	0.1/0.01s	9999	6-66	
Second functions	**46**	2E	AE	0	**Second torque boost**	0–30%/9999	0.1%	9999	6-30	
Second functions	**47**	2F	AF	0	**Second V/F (base frequency)**	0–400Hz/ 9999	0.01Hz	9999	6-49	
Second functions	**48**	30	B0	0	**Second stall prevention operation current**	0–120%	0.1%	110%	6-35	
Second functions	**49**	31	B1	0	**Second stall prevention operation frequency**	0–400Hz/ 9999	0.01Hz	0Hz	6-35	
Second functions	**50**	32	B2	0	**Second output frequency detection**	0–400Hz	0.01Hz	30Hz	6-113	
Second functions	**51**	33	B3	0	**Second electronic thermal O/L relay**	0–500A/9999 0–3600A/ 9999	0.01/0.1A	9999	6-76	
Monitor functions	**52**	34	B4	0	**DU/PU main display data selection**	0/5/6/8–14/ 17/20/ 23–25/ 50–57/100	1	0	6-123	
Monitor functions	**54**	36	B6	0	**CA terminal function selection**	1–3/5/6/ 8–14/17/21/ 24/50/52/53	1	1	6-130	
Monitor functions	**55**	37	B7	0	**Frequency monitoring reference**	0–400Hz	0.01Hz	50Hz	6-130	
Monitor functions	**56**	38	B8	0	**Current monitoring reference**	0–500A/ 0–3600A	0.01/0.1A	Rated inverter current	6-130	
Automatic restart functions	**57**	39	B9	0	**Restart coasting time**	0/0.1–5s/ 9999 0/0.1–30s/ 9999	0.1 s	9999	6-137	
Automatic restart functions	**58**	3A	BA	0	**Restart cushion time**	0–60s	0.1s	1s	6-137	
—	**59**	3B	BB	0	**Remote function selection**	0/1/2/3/11/ 12/13	1	0	6-62	
—	◎ **60**	3C	BC	0	**Energy saving control selection**	0/4/9	1	0	6-158	
Retry function	**65**	41	C1	0	**Retry selection**	0–5	1	0	6-152	
—	**66**	42	C2	0	**Stall prevention operation reduction starting frequency**	0–400Hz	0.01Hz	50Hz	6-35	
Retry function	**67**	43	C3	0	**Number of retries at alarm occurrence**	0–10/ 101–110	1	0	6-152	
Retry function	**68**	44	C4	0	**Retry waiting time**	0–10s	0.1s	1s	6-152	
Retry function	**69**	45	C5	0	**Retry count display erase**	0	1	0	6-152	

Tab. A-6: *Parameter list with instruction codes (3)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
—	**70**	46	C6	0	**Special regenerative brake duty**	0–10%	0.1%	0%	6-86	
—	**71**	47	C7	0	**Applied motor**	0/1/2/20	1	0	6-82	
—	**72**	48	C8	0	**PWM frequency selection**	0–15 0–6/25	1	2	6-167	
—	**73**	49	C9	0	**Analog input selection**	0–7/10–17	1	1	6-170	
—	**74**	4A	CA	0	**Input filter time constant**	0–8	1	1	6-180	
—	**75**	4B	CB	0	**Reset selection/ disconnected PU detection/PU stop selection**	0–3/14–17/ 100–103/ 114–117	1	14	6-192	
—	**76**	4C	CC	0	**Alarm code output selection**	0/1/2	1	0	6-155	
—	**77**	4D	CD ①	0	**Parameter write selection**	0/1/2	1	0	6-197	
—	**78**	4E	CE	0	**Reverse rotation prevention selection**	0/1/2	1	0	6-199	
—	**◎ 79**	4F	CF ①	0	**Operation mode selection**	0/1/2/3/4/6/7	1	0	6-203	
Simple magnetic flux vector control	**80**	50	D0	0	**Motor capacity (simple magnetic flux vector control)**	0.4–55kW/ 9999 0–3600kW/ 9999	0.01/0.1kW	9999	6-33	
	90	5A	DA	0	**Motor constant (R1)**	0–50Ω/9999 0–400mΩ/ 9999	0.001Ω/ 0.01mΩ	9999	6-33	
Adjustable 5 points V/f	**100**	00	80	1	**V/f1(first frequency)**	0–400Hz/ 9999	0.01Hz	9999	6-52	
	101	01	81	1	**V/f1 (first frequency voltage)**	0–1000V	0.1V	0V	6-52	
	102	02	82	1	**V/f2 (second frequency)**	0–400Hz/ 9999	0.01Hz	9999	6-52	
	103	03	83	1	**V/f2 (second frequency voltage)**	0–1000V	0.1V	0V	6-52	
	104	04	84	1	**V/f3 (third frequency)**	0–400Hz/ 9999	0.01Hz	9999	6-52	
	105	05	85	1	**V/f3 (third frequency voltage)**	0–1000V	0.1V	0V	6-52	
	106	06	86	1	**V/f4 (fourth frequency)**	0–400Hz/ 9999	0.01Hz	9999	6-52	
	107	07	87	1	**V/f4 (fourth frequency voltage)**	0–1000V	0.1V	0V	6-52	
	108	08	88	1	**V/f5 (fifth frequency)**	0–400Hz/ 9999	0.01Hz	9999	6-52	
	109	09	89	1	**V/f5 (fifth frequency voltage)**	0–1000V	0.1V	0V	6-52	

Tab. A-6: *Parameter list with instruction codes (4)*

① Can be written by only communication from the PU connector.

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
PU connector communication	**117**	11	91	1	**PU communication station number**	0–31	1	0	6-233	
	118	12	92	1	**PU communication speed**	48/96/192/348	1	192	6-233	
	119	13	93	1	**PU communication stop bit length**	0/1/10/11	1	1	6-233	
	120	14	94	1	**PU communication parity check**	0/1/2	1	2	6-233	
	121	15	95	1	**Number of PU communication retries**	0–10/9999	1	1	6-233	
	122	16	96	1	**PU communication check time interval**	0/0.1–999.8/9999	0.1 s	9999	6-233	
	123	17	97	1	**PU communication waiting time setting**	0–150ms/9999	1	9999	6-233	
	124	18	98	1	**PU communication CR/LF presence/absence selection**	0/1/2	1	1	6-233	
—	**◎ 125**	19	99	1	**Terminal 2 frequency setting gain frequency**	0–400Hz	0.01Hz	50Hz	6-181	
—	**◎ 126**	1A	9A	1	**Terminal 4 frequency setting gain frequency**	0–400Hz	0.01Hz	50Hz	6-181	
PID operation	**127**	1B	9B	1	**PID control automatic switch over frequency**	0–400Hz/9999	0.01Hz	9999	6-271	
	128	1C	9C	1	**PID action selection**	10/11/20/21/50/51/60/61/110/111/120/121	1	10	6-271	
	129	1D	9D	1	**PID proportional band**	0.1–1000%/9999	0.1%	100%	6-271	
	130	1E	9E	1	**PID integral time**	0.1–3600s/9999	0.1s	1s	6-271	
	131	1F	9F	1	**PID upper limit**	0–100%/9999	0.1%	9999	6-271	
	132	20	A0	1	**PID lower limit**	0–100%/9999	0.1%	9999	6-271	
	133	21	A1	1	**PID action set point**	0–100%/9999	0.01%	9999	6-271	
	134	22	A2	1	**PID differential time**	0.01–10.00s/9999	0.01s	9999	6-271	
Commercial power supply-inverter switch-over	**135**	23	A3	1	**Commercial power-supply switchover sequence output terminal selection**	0/1	1	0	6-290	
	136	24	A4	1	**MC switch over interlock time**	0–100s	0.1s	1s	6-290	
	137	25	A5	1	**Start waiting time**	0–100s	0.1s	0.5s	6-290	
	138	26	A6	1	**Commercial power-supply operation switch over selection at an alarm**	0/1	1	0	6-290	
	139	27	A7	1	**Automatic switch over frequency between inverter and commercial power-supply operation**	0–60Hz/9999	0.01Hz	9999	6-290	

Tab. A-6: *Parameter list with instruction codes (5)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Backlash measures	**140**	28	A8	1	**Backlash acceleration stopping frequency**	0–400Hz	0.01Hz	1Hz	6-72	
	141	29	A9	1	**Backlash acceleration stopping time**	0–360s	0.1s	0.5s	6-72	
	142	2A	AA	1	**Backlash deceleration stopping frequency**	0–400Hz	0.01Hz	1Hz	6-72	
	143	2B	AB	1	**Backlash deceleration stopping time**	0–360s	0.1s	0.5s	6-72	
—	**144**	2C	AC	1	**Speed setting switch over**	0/2/4/6/8/10/102/104/106/108/110	1	4	6-121	
PU	**145**	2D	AD	1	**PU display language selection**	0–7	1	1	6-327	
Current detection	**148**	30	B0	1	**Stall prevention level at 0V input**	0–120%	0.1%	110%	6-35	
	149	31	B1	1	**Stall prevention level at 10V input**	0–120%	0.1%	120%	6-35	
	150	32	B2	1	**Output current detection level**	0–120%	0.1%	110%	6-115	
	151	33	B3	1	**Output current detection signal delay time**	0–10s	0.1s	0s	6-115	
	152	34	B4	1	**Zero current detection level**	0–150%	0.1%	5%	6-115	
	153	35	B5	1	**Zero current detection time**	0–10s	0.01s	0.5s	6-115	
—	**154**	36	B6	1	**Voltage reduction selection during stall prevention operation**	0/1	1	1	6-35	
—	**155**	37	B7	1	**RT signal reflection time selection**	0/10	1	0	6-101	
—	**156**	38	B8	1	**Stall prevention operation selection**	0–31/100/101	1	0	6-35	
—	**157**	39	B9	1	**OL signal output timer**	0–25 s/9999	0.1 s	0 s	6-35	
—	**158**	3A	BA	1	**AM terminal function selection**	1–3/5/6/8–14/17/21/24/50/52/53	1	1	6-130	
—	**159**	3B	BB	1	**Automatic switch over ON range between commercial power-supply and inverter operation**	0–10Hz/9999	0.01Hz	9999	6-290	
—	**◎ 160**	00	80	2	**User group read selection**	0/1/9999	1	9999	6-200	
—	**161**	01	81	2	**Frequency setting/key lock operation selection**	0/1/10/11	1	0	6-328	
Automatic restart functions	**162**	02	82	2	**Automatic restart after instantaneous power failure selection**	0/1/10/11	1	0	6-137	
	163	03	83	2	**First cushion time for restart**	0–20s	0.1s	0s	6-137	
	164	04	84	2	**First cushion voltage for restart**	0–100%	0.1%	0%	6-137	
	165	05	85	2	**Stall prevention operation level for restart**	0–120%	0.1%	110%	6-137	

Tab. A-6: *Parameter list with instruction codes (6)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Current detection	**166**	06	86	2	**Output current detection signal retention time**	0–10s/9999	0.1s	0.1s	6-115	
	167	07	87	2	**Output current detection operation selection**	0/1/10/11	1	0	6-115	
—	**168**	Parameter for manufacturer setting. Do not make setting.								
—	**169**									
Cumulative monitor clear	**170**	0A	8A	2	**Cumulative power meter clear**	0/10/9999	1	9999	6-123	
	171	0B	8B	2	**Operation hour meter clear**	0/9999	1	9999	6-123	
User group	**172**	0C	8C	2	**User group registered display/batch clear**	9999/(0–16)	1	0	6-200	
	173	0D	8D	2	**User group registration**	0–999/9999	1	9999	6-200	
	174	0E	8E	2	**User group clear**	0–999/9999	1	9999	6-200	
Input terminal function assignment	**178**	12	92	2	**STF terminal function selection**	0–8/10–14/ 16/24/25/37/ 60/62/64–67/ 70–72/9999	1	60	6-96	
	179	13	93	2	**STR terminal function selection**	0–8/10–14/ 16/24/25/37/ 61/62/64–67/ 70–72/9999	1	61	6-96	
	180	14	94	2	**RL terminal function selection**	0–8/10–14/ 16/24/25/37/ 62/64–67/ 70–72/9999	1	0	6-96	
	181	15	95	2	**RM terminal function selection**		1	1	6-96	
	182	16	96	2	**RH terminal function selection**		1	2	6-96	
	183	17	97	2	**RT terminal function selection**		1	3	6-96	
	184	18	98	2	**AU terminal function selection**	0–8/10–14/ 16/24/25/37/ 62–67/70–72/ 9999	1	4	6-96	
	185	19	99	2	**JOG terminal function selection**	0–8/10–14/ 16/24/25/37/ 62/64–67/ 70–72/9999	1	5	6-96	
	186	1A	9A	2	**CS terminal function selection**		1	6	6-96	
	187	1B	9B	2	**MRS terminal function selection**		1	24	6-96	
	188	1C	9C	2	**STOP terminal function selection**		1	25	6-96	
	189	1D	9D	2	**RES terminal function selection**		1	62	6-96	

Tab. A-6: *Parameter list with instruction codes (7)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Output terminal function assignment	**190**	1E	9E	2	**RUN terminal function selection**	0–5/7/8/10–19/25/26/45–48/64/70–79/85/90–96/98/99/100–105/107/108/110–116/125/126/145–148/164/170/179/185/190–196/198/199/9999	1	0	6-107	
	191	1F	9F	2	**SU terminal function selection**		1	1	6-107	
	192	20	A0	2	**IPF terminal function selection**		1	2	6-107	
	193	21	A1	2	**OL terminal function selection**		1	3	6-107	
	194	22	A2	2	**FU terminal function selection**		1	4	6-107	
	195	23	A3	2	**ABC1 terminal function selection**	0–5/7/8/10–19/25/26/45–48/64/70–79/85/90/91/94–96/98/99/100–105/107/108/110–116/125/126/145–148/164/170/179/185/190/191/194–196/198/199/9999	1	99	6-107	
	196	24	A4	2	**ABC2 terminal function selection**		1	9999	6-107	
Multi-speed setting	**232–239**	28–2F	A8–AF	2	**Multi-speed setting (speeds 8 to 15)**	0–400Hz/9999	0.01Hz	9999	6-54	
—	**240**	30	B0	2	**Soft-PWM operation selection**	0/1	1	1	6-167	
—	**241**	31	B1	2	**Analog input display unit switch over**	0/1	1	0	6-181	
—	**242**	32	B2	2	**Terminal 1 added compensation amount (terminal 2)**	0–100%	0.1%	100%	6-170	
—	**243**	33	B3	2	**Terminal 1 added compensation amount (terminal 4)**	0–100%	0.1%	75%	6-170	
—	**244**	34	B4	2	**Cooling fan operation selection**	0/1	1	1	6-316	
Slip compensation	**245**	35	B5	2	**Rated slip**	0–50%/9999	0.01%	9999	6-34	
	246	36	B6	2	**Slip compensation time constant**	0.01–10s	0.01s	0.5s	6-34	
	247	37	B7	2	**Constant-output region slip compensation selection**	0/9999	1	9999	6-34	
—	**250**	3A	BA	2	**Stop selection**	0–100s/1000–1100s/8888/9999	0.1s	9999	6-88	
—	**251**	3B	BB	2	**Output phase loss protection selection**	0/1	1	1	6-157	
Frequency compensation function	**252**	3C	BC	2	**Override bias**	0–200%	0.1%	50%	6-170	
	253	3D	BD	2	**Override gain**	0–200%	0.1%	150%	6-170	

Tab. A-6: *Parameter list with instruction codes (8)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Life check	**255**	3F	BF	2	**Life alarm status display**	(0–15)	1	0	6-317	
	256	40	C0	2	**Inrush current suppression circuit life display**	(0–100%)	1%	100%	6-317	
	257	41	C1	2	**Control circuit capacitor life display**	(0–100%)	1%	100%	6-317	
	258	42	C2	2	**Main circuit capacitor life display**	(0–100%)	1%	100%	6-317	
	259	43	C3	2	**Main circuit capacitor life measuring**	0/1	1	0	6-317	
—	**260**	44	C4	2	**PWM frequency automatic switch over**	0/1	1	1	6-167	
Power failure stop	**261**	45	C5	2	**Power failure stop selection**	0/1/2/21/22	1	0	6-145	
	262	46	C6	2	**Subtracted frequency at deceleration start**	0–20Hz	0.01Hz	3Hz	6-145	
	263	47	C7	2	**Subtraction starting frequency**	0–120Hz/ 9999	0.01Hz	50Hz	6-145	
	264	48	C8	2	**Power-failure deceleration time 1**	0–3600/360s	0.1/0.01s	5s	6-145	
	265	49	C9	2	**Power-failure deceleration time 2**	0–3600/ 360s/9999	0.1/0.01s	9999	6-145	
	266	4A	CA	2	**Power failure deceleration time switch over frequency**	0–400Hz	0.01Hz	50Hz	6-145	
—	**267**	4B	CB	2	**Terminal 4 input selection**	0/1/2	1	0	6-170	
—	**268**	4C	CC	2	**Monitor decimal digits selection**	0/1/9999	1	9999	6-123	
—	**269**	Parameter for manufacturer setting. Do not make setting.								
—	**299**	6B	EB	2	**Rotation direction detection selection at restarting**	0/1/9999	1	9999	6-137	
Digital input	**300**	00	80	3	**BCD input bias**	Parameter for digital input option (FR-A7AX)				
	301	01	81	3	**BCD input gain**					
	302	02	82	3	**BIN input bias**					
	303	03	83	3	**BIN input gain**					
	304	04	84	3	**Digital input and analog input compensation enable/ disable selection**					
	305	05	85	3	**Read timing operation selection**					

Tab. A-6: *Parameter list with instruction codes (9)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Analog output	306	06	86	3	Analog output signal selection	Extension analog output/digital output option Parameter for (FR-A7AY)				
	307	07	87	3	Setting for zero analog output					
	308	08	88	3	Setting for maximum analog output					
	309	09	89	3	Analog output signal voltage/current switch over					
	310	0A	8A	3	Analog meter voltage output selection					
	311	0B	8B	3	Setting for zero analog meter voltage output					
	312	0C	8C	3	Setting for maximum analog meter voltage output					
Digital output	313	0D	8D	3	DO0 output selection					
	314	0E	8E	3	DO1 output selection					
	315	0F	8F	3	DO2 output selection					
	316	10	90	3	DO3 output selection					
	317	11	91	3	DO4 output selection					
	318	12	92	3	DO5 output selection					
	319	13	93	3	DO6 output selection					
Relay output	320	14	94	3	RA1 output selection	Parameter for relay output option (FR-A7AR)				
	321	15	95	3	RA2 output selection					
	322	16	96	3	RA3 output selection					
Analog output	323	17	97	3	AM0 0V adjustment	Extension analog output/digital output option Parameter for (FR-A7AY)				
	324	18	98	3	AM1 0mA adjustment					
—	329	1D	9D	3	Digital input unit selection	Parameter for digital input option (FR-A7AX)				

Tab. A-6: *Parameter list with instruction codes (10)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
RS-485 communication	**331**	1F	9F	3	**RS-485 communication station**	0–31 (0–247)	1	0	6-233	
	332	20	A0	3	**RS-485 communication speed**	3/6/12/24/48/ 96/192/348	1	96	6-233	
	333	21	A1	3	**RS-485 communication stop bit length**	0/1/10/11	1	1	6-233	
	334	22	A2	3	**RS-485 communication parity check selection**	0/1/2	1	2	6-233	
	335	23	A3	3	**RS-485 communication number of retries**	0–10/9999	1	1	6-233	
	336	24	A4	3	**RS-485 communication check time interval**	0–999.8s/ 9999	0.1 s	0s	6-233	
	337	25	A5	3	**RS-485 communication waiting time setting**	0–150ms/ 9999	1	9999	6-233	
	338	26	A6	3	**Communication operation command source**	0/1	1	0	6-217	
	339	27	A7	3	**Communication speed command source**	0/1/2	1	0	6-217	
	340	28	A8	3	**Communication start-up mode selection**	0/1/2/10/12	1	0	6-203	
	341	29	A9	3	**RS-485 communication CR/LF selection**	0/1/2	1	1	6-233	
	342	2A	AA	3	**Communication E²PROM write selection**	0/1	1	0	6-233	
	343	2B	AB	3	**Communication error count**	—	1	0	6-233	
DeviceNet	**345**	2D	AD	3	**DeviceNet address**	Parameter for DeviceNet communication option (FR-A7ND)				
	346	2E	AE	3	**DeviceNet baud rate**					
CC-LINK PROFIBUS/DP	**349**	31	B1	3	**Communication reset selection**	Parameter for CC-Link and PROFIBUS/DP communication option (FR-A7NC, FR-A7NP)				
LONWORKS	**387**	57	D7	3	**Initial communication delay time**	Parameter for LONWORKS communication option (FR-A7NL)				
	388	58	D8	3	**Send time interval at heart beat**					
	389	59	D9	3	**Minimum sending time at heart beat**					
	390	5A	DA	3	**% setting reference frequency**					
	391	5B	DB	3	**Receive time interval at heart beat**					
	392	5C	DC	3	**Event driven detection width**					

Tab. A-6: *Parameter list with instruction codes (11)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Remote output	**495** Ver.UP	5F	DF	4	**Remote output selection**	0/1/10/11	1	0	6-118	
	496	60	E0	4	**Remote output data 1**	0–4095	1	0	6-118	
	497	61	E1	4	**Remote output data 2**	0–4095	1	0	6-118	
Communication error	**500**	00	80	5	**Communication error execution waiting time**	Parameter for communication option				
	501	01	81	5	**Communication error occurrence count display**					
	502	02	82	5	**Stop mode selection at communication error**					
Maintenance	**503**	03	83	5	**Maintenance timer**	0 (1–9998)	1	0	6-321	
	504	04	84	5	**Maintenance timer alarm output set time**	0–9998/9999	1	9999	6-321	
—	**522**	16	96	5	**Output stop frequency**	0–400Hz/ 9999	0.01Hz	9999	6-94	
—	**539**	27	A7	5	**Modbus-RTU communication check time interval**	0/0.1–999.8s/ 9999	0.1s	9999	6-253	
CC-LINK	**542**	2A	AA	5	**Communication station number (CC-Link)**	Parameter for CC-Link communication option (FR-A7NC)				
	543	2B	AB	5	**Baud rate (CC-Link)**					
	544	2C	AC	5	**CC-Link extended setting**					
Communication	**549**	31	B1	5	**Protocol selection**	0/1	1	0	6-233	
	550	32	B2	5	**NET mode operation command source selection**	0/1/9999	1	9999	6-217	
	551	33	B3	5	**PU mode operation command source selection**	1/2	1	2	6-217	
PID operation	**553**	35	B5	5	**PID deviation limit**	0–100.0%/ 9999	0.1%	9999	6-271	
	554	36	B6	5	**PID signal operation selection**	0–3, 10–13	1	0	6-271	
Current average monitor	**555**	37	B7	5	**Current average time**	0.1–1.0s	0.1s	1s	6-322	
	556	38	B8	5	**Data output mask time**	0.0–20.0s	0.1s	0s	6-322	
	557	39	B9	5	**Current average value monitor signal output reference current**	0–500A/ 0–3600A	0.01/0.1A	Rated inverter current	6-322	
—	**563**	3F	BF	5	**Energizing time carrying-over times**	(0–65535)	1	0	6-123	
—	**564**	40	C0	5	**Operating time carrying-over times**	(0–65535)	1	0	6-123	
Multiple rating	**570**	46	C6	5	**Multiple rating setting**	0/1	1	0	6-44	
—	**571**	47	C7	5	**Holding time at a start**	0.0–10.0s/ 9999	0.1s	9999	6-70	
—	**573**	49	C9	6	**4mA input check selection**	1/9999	1	9999	6-170	

Tab. A-6: *Parameter list with instruction codes (12)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
PID control	**575**	4B	CB	6	**Output interruption detection time**	0–3600s/ 9999	0.1s	1s	6-271	
	576	4C	CC	6	**Output interruption detection level**	0–400Hz	0.01Hz	0Hz	6-271	
	577	4D	CD	6	**Output interruption release level**	900–1100%	0.1%	1000%	6-271	
Advanced PID control	**578**	4E	CE	6	**Auxiliary motor operation selection**	0–3	1	0	6-296	
	579	4F	CF	6	**Motor connection function selection**	0–3	1	0	6-296	
	580	50	D0	6	**MC switching interlock time**	0–100s	0.1s	1s	6-296	
	581	51	D1	6	**Start waiting time**	0–100s	0.1s	1s	6-296	
	582	52	D2	6	**Auxiliary motor connection-time deceleration time**	0–3600/360s/ 9999	0.1s	1s	6-296	
	583	53	D3	6	**Auxiliary motor disconnection-time acceleration time**	0–3600/360s/ 9999	0.1s	1s	6-296	
	584	54	D4	6	**Auxiliary motor 1 starting frequency**	0–400Hz	0.01Hz	50Hz	6-296	
	585	55	D5	6	**Auxiliary motor 2 starting frequency**	0–400Hz	0.01Hz	50Hz	6-296	
	586	56	D6	6	**Auxiliary motor 3 starting frequency**	0–400Hz	0.01Hz	50Hz	6-296	
	587	57	D7	6	**Auxiliary motor 1 stopping frequency**	0–400Hz	0.01Hz	0Hz	6-296	
	588	58	D8	6	**Auxiliary motor 2 stopping frequency**	0–400Hz	0.01Hz	0Hz	6-296	
	589	59	D9	6	**Auxiliary motor 3 stopping frequency**	0–400Hz	0.01Hz	0Hz	6-296	
	590	5A	DA	6	**Auxiliary motor start detection time**	0–3600s	0.1s	5s	6-296	
	591	5B	DB	6	**Auxiliary motor stop detection time**	0–3600s	0.1s	5s	6-296	
Traverse function	**592**	5C	DC	6	**Traverse function selection**	0/1/2	1	0	6-310	
	593	5D	DD	6	**Maximum amplitude amount**	0–25%	0.1%	10%	6-310	
	594	5E	DE	6	**Amplitude compensation amount during deceleration**	0–50%	0.1%	10%	6-310	
	595	5F	DF	6	**Amplitude compensation amount during acceleration**	0–50%	0.1%	10%	6-310	
	596	60	E0	6	**Amplitude acceleration time**	0.1–3600s	0.1s	5s	6-310	
	597	61	E1	6	**Amplitude deceleration time**	0.1–3600s	0.1s	5s	6-310	
—	**611**	0B	8B	6	**Acceleration time at a restart**	0–3600s/ 9999	0.1	5/15s	6-137	
Speed smoothing control	**653**	35	B5	6	**Speed smoothing control**	0–200%	0.1%	0	6-169	
	654	36	B6	6	**Speed smoothing cutoff frequency**	0–120Hz	0.01Hz	20Hz	6-169	
—	**799**	63	E3	7	**Pulse increment setting for output power**	0.1/1/10/100/ 1000kWh	0.1	1kWh	6-120	
—	**867**	43	C3	8	**AM output filter**	0–5s	0.01s	0.01s	6-130	
—	**869**	45	C5	8	**Current output filter**	0–5s	0.01 s	0.02s	6-130	

Tab. A-6: *Parameter list with instruction codes (13)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
—	**872**	48	C8	8	**Input phase loss protection selection**	0/1	1	0	6-157	
Regeneration avoidance function	**882**	52	D2	8	**Regeneration avoidance operation selection**	0/1	1	0	6-313	
	883	53	D3	8	**Regeneration avoidance operation level**	300–800V	0.1V	760V/ 785V DC	6-313	
	884	54	D4	8	**Regeneration avoidance at deceleration detection sensitivity**	0–5	1	0	6-313	
	885	55	D5	8	**Regeneration avoidance compensation frequency limit value**	0–10Hz/9999	0.01Hz	6Hz	6-313	
	886	56	D6	8	**Regeneration avoidance voltage gain**	0–200%	0.1%	100%	6-313	
Free parameter	**888**	58	D8	8	**Free parameter 1**	0–9999	1	9999	6-326	
	889	59	D9	8	**Free parameter 2**	0–9999	1	9999	6-326	
Energy saving monitor	**891**	5B	DB	8	**Cumulative power monitor digit shifted times**	0–4/9999	1	9999	6-160	
	892	5C	DC	8	**Load factor**	30–150%	0.1%	100%	6-160	
	893	5D	DD	8	**Energy saving monitor reference (motor capacity)**	0.1–55/ 0–3600kW	0.01/0.1kW	SLD/LD value of Applied moter Capacity	6-160	
	894	5E	DE	8	**Control selection during commercial power-supply operation**	0/1/2/3	1	0	6-160	
	895	5F	DF	8	**Power saving rate reference value**	0/1/9999	1	9999	6-160	
	896	60	E0	8	**Power unit cost**	0–500/9999	0.01	9999	6-160	
	897	61	E1	8	**Power saving monitor average time**	0/1–1000h/ 9999	1	9999	6-160	
	898	62	E2	8	**Power saving cumulative monitor clear**	0/1/10/9999	1	9999	6-160	
	899	63	E3	8	**Operation time rate (estimated value)**	0–100%/9999	0.1%	9999	6-160	
Calibration parameters	**C0 (900)**	5C	DC	1	**CA terminal calibration**	—	—	—	6-132	
	C1 (901)	5D	DD	1	**AM terminal calibration**	—	—	—	6-132	
	C2 (902)	5E	DE	1	**Terminal 2 frequency setting bias frequency**	0–400Hz	0.01Hz	0Hz	6-181	
	C3 (902)	5E	DE	1	**Terminal 2 frequency setting bias**	0–300%	0.1%	0%	6-181	
	125 (903)	5F	DF	1	**Terminal 2 frequency setting gain frequency**	0–400Hz	0.01Hz	50Hz	6-181	

Tab. A-6: *Parameter list with instruction codes (14)*

Function	Parameter	Instruction Code			Name	Setting Range	Minimum Setting Increments	Initial Value	Refer to Page	Customer Setting
		Read	Write	Extended						
Calibration parameters	**C4 (903)**	5F	DF	1	**Terminal 2 frequency setting gain**	0–300%	0.1%	100%	6-181	
	C5 (904)	60	E0	1	**Terminal 4 frequency setting bias frequency**	0–400Hz	0.01Hz	0Hz	6-181	
	C6 (904)	60	E0	1	**Terminal 4 frequency setting bias**	0–300%	0.1%	20%	6-181	
	126 (905)	61	E1	1	**Terminal 4 frequency setting gain frequency**	0–400Hz	0.01Hz	50Hz	6-181	
	C7 (905)	61	E1	1	**Terminal 4 frequency setting gain**	0–300%	0.1%	100%	6-181	
Analog output current calibration	**C8 (930)**	7A	FA	1	**Current output bias signal**	0–100%	0.1%	0%	6-132	
	C9 (930)	7A	FA	1	**Current output bias current**	0–100%	0.1%	0%	6-132	
	C10 (931)	7B	FB	1	**Current output gain signal**	0–100%	0.1%	100%	6-132	
	C11 (931)	7B	FB	1	**Current output gain current**	0–100%	0.1%	100%	6-132	
PID operation	**C42 (934)**	22	A2	9	**PID display bias coefficient**	0–500.00/ 9999	0.01	9999	6-271	
	C43 (934)	22	A2	9	**PID display bias analog value**	0–300.0%	0.1%	20%	6-271	
	C44 (935)	23	A3	9	**PID display gain coefficient**	0–500.00/ 9999	0.01	9999	6-271	
	C45 (935)	23	A3	9	**PID display gain analog value**	0–300.0%	0.1%	100%	6-271	
—	**989**	59	D9	9	**Parameter copy alarm release**	10/100	1	10/100	—	
PU	**990**	5A	DA	9	**PU buzzer control**	0/1	1	1	6-328	
	◎ 991	5B	DB	9	**PU contrast adjustment**	0–63	1	58	6-329	
Clear parameter	**PR.CL**	—			**Parameter clear**	0/1	1	0	5-13	
	ALLC	—			**All parameter clear**	0/1	1	0	5-14	
	Er.CL	—			**Alarm history clear**	0/1	1	0	7-21	
	PCPY	—			**Parameter copy**	0/1/2/3	1	0	5-15	

Tab. A-6: *Parameter list with instruction codes (15)*

A.7 Specification change

A.7.1 SERIAL number check

Check the SERIAL number indicated on the inverter rating plate or package (refer to section 1.2).

The SERIAL consists of:

- 1 version symbol,
- 2 numeric characters or 1 numeric character and 1 alphabet letter indicating year and month Last digit of the production year is indicated as the Year, and the Month is indicated by 1 to 9, X (October), Y (November), and Z (December).
- 6 numeric characters indicating control number.

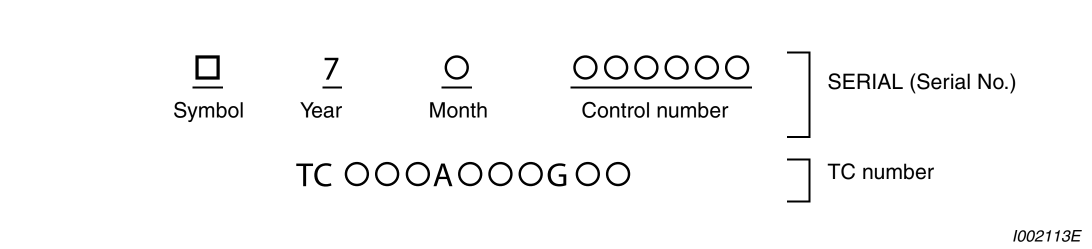


Fig. A-24: *Rating plate example*

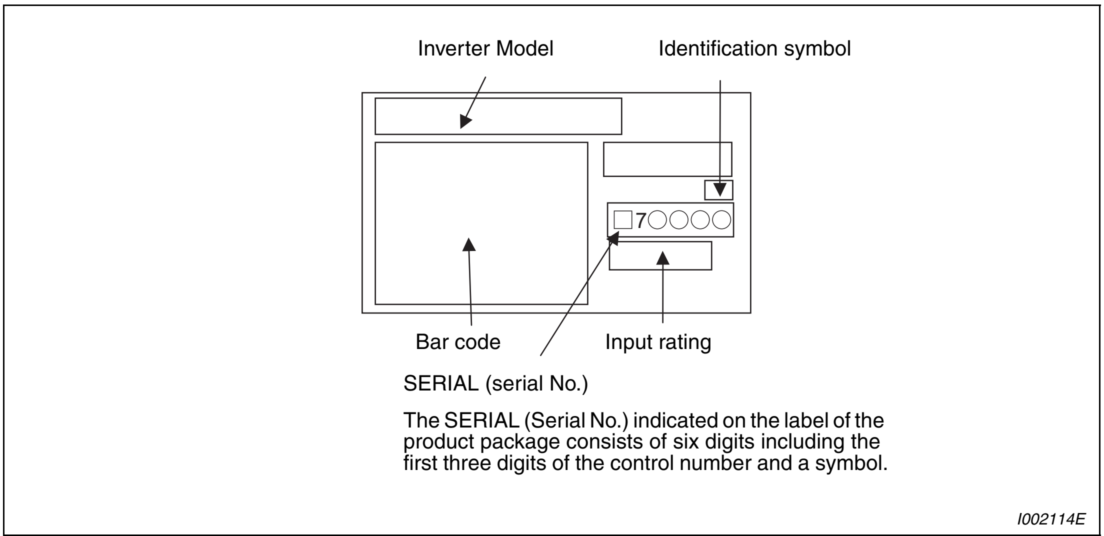


Fig. A-25: *Label on the product package*

A.7.2 Changed functions

Settings "10" and "11" of Pr. 495 are valid for the inverter assembled after the following SERIAL.

The inverters whose communication parameters (Pr. 345 and Pr. 346) are not cleared when parameter clear/all clear is executed using Class 0x2A instance1 Attribute ID105 and 106 are assembled after the following SERIAL.

Refer to the table below to check the SERIAL indicated on the inverter rating plate or package.

Inverter type	10th and 11th digits of TC Number on rating plate	SERIAL (first 2 digits of SERIAL)
FR-F740-00023 to 00126-EC	G7	G7
	G8	E7
FR-F740-00170/00250-EC	G7	G7
	G8	F7
FR-F740-00310/00380-EC	G7	F7
	G8	F7
FR-F740-00470/00620-EC	G7	J7
	G8	J7
FR-CF70-EC (Control unit)	G7	G7
FR-CF70-ECT (Control unit)	G7	D7

Tab. A-7:*Check the SERIAL for inverter assembly date (changed functions valid)*

Index

W

Z

HEADQUARTERS

MITSUBISHI ELECTRIC EUROPE B.V. **EUROPE**
German Branch
Gothaer Straße 8
D-40880 Ratingen
Phone: +49 (0)2102 / 486-0
Fax: +49 (0)2102 / 486-1120

MITSUBISHI ELECTRIC EUROPE B.V. **CZECH REPUBLIC**
Czech Branch
Avenir Business Park, Radlická 714/113a
CZ-158 00 Praha 5
Phone: +420 - 251 551 470
Fax: +420 - 251-551-471

MITSUBISHI ELECTRIC EUROPE B.V. **FRANCE**
French Branch
25, Boulevard des Bouvets
F-92741 Nanterre Cedex
Phone: +33 (0)1 / 55 68 55 68
Fax: +33 (0)1 / 55 68 57 57

MITSUBISHI ELECTRIC EUROPE B.V. **IRELAND**
Irish Branch
Westgate Business Park, Ballymount
IRL-Dublin 24
Phone: +353 (0)1 4198800
Fax: +353 (0)1 4198890

MITSUBISHI ELECTRIC EUROPE B.V. **ITALY**
Italian Branch
Viale Colleoni 7
I-20041 Agrate Brianza (MB)
Phone: +39 039 / 60 53 1
Fax: +39 039 / 60 53 312

MITSUBISHI ELECTRIC EUROPE B.V. **POLAND**
Poland Branch
Krakowska 50
PL-32-083 Balice
Phone: +48 (0)12 / 630 47 00
Fax: +48 (0)12 / 630 47 01

MITSUBISHI ELECTRIC EUROPE B.V. **SPAIN**
Spanish Branch
Carretera de Rubí 76-80
E-08190 Sant Cugat del Vallés (Barcelona)
Phone: 902 131121 // +34 935653131
Fax: +34 935891579

MITSUBISHI ELECTRIC EUROPE B.V. **UK**
UK Branch
Travellers Lane
UK-Hatfield, Herts. AL10 8XB
Phone: +44 (0)1707 / 27 61 00
Fax: +44 (0)1707 / 27 86 95

MITSUBISHI ELECTRIC CORPORATION **JAPAN**
Office Tower "Z" 14 F
8-12,1 chome, Harumi Chuo-Ku
Tokyo 104-6212
Phone: +81 3 622 160 60
Fax: +81 3 622 160 75

MITSUBISHI ELECTRIC AUTOMATION, Inc. **USA**
500 Corporate Woods Parkway
Vernon Hills, IL 60061
Phone: +1 847 478 21 00
Fax: +1 847 478 22 53

EUROPEAN REPRESENTATIVES

GEVA **AUSTRIA**
Wiener Straße 89
AT-2500 Baden
Phone: +43 (0)2252 / 85 55 20
Fax: +43 (0)2252 / 488 60

TEHNIKON **BELARUS**
Oktyabrskaya 16/5, Off. 703-711
BY-220030 Minsk
Phone: +375 (0)17 / 210 46 26
Fax: +375 (0)17 / 210 46 26

ESCO DRIVES & AUTOMATION **BELGIUM**
Culliganlaan 3
BE-1831 Diegem
Phone: +32 (0)2 / 717 64 30
Fax: +32 (0)2 / 717 64 31

Koning & Hartman b.v. **BELGIUM**
Woluwelaan 31
BE-1800 Vilvoorde
Phone: +32 (0)2 / 257 02 40
Fax: +32 (0)2 / 257 02 49

INEA BH d.o.o. **BOSNIA AND HERZEGOVINA**
Aleja Lipa 56
BA-71000 Sarajevo
Phone: +387 (0)33 / 921 164
Fax: +387 (0)33 / 524 539

AKHNATON **BULGARIA**
4 Andrej Ljapchev Blvd. Pb 21
BG-1756 Sofia
Phone: +359 (0)2 / 817 6004
Fax: +359 (0)2 / 97 44 06 1

INEA CR d.o.o. **CROATIA**
Losinjska 4 a
HR-10000 Zagreb
Phone: +385 (0)1 / 36 940 - 01/ -02/ -03
Fax: +385 (0)1 / 36 940 - 03

AutoCont C.S. s.r.o. **CZECH REPUBLIC**
Technologická 374/6
CZ-708 00 Ostrava-Pustkovec
Phone: +420 595 691 150
Fax: +420 595 691 199

B:ELECTRIC, s.r.o. **CZECH REPUBLIC**
Mladoboleslavská 812
CZ-197 00 Praha 19 - Kbely
Phone: +420 286 850 848, +420 724 317 975
Fax: +420 286 850 850

Beijer Electronics A/S **DENMARK**
Lykkegårdsvej 17
DK-4000 Roskilde
Phone: +45 (0)46/ 75 76 66
Fax: +45 (0)46 / 75 56 26

Beijer Electronics Eesti OÜ **ESTONIA**
Pärnu mnt.160i
EE-11317 Tallinn
Phone: +372 (0)6 / 51 81 40
Fax: +372 (0)6 / 51 81 49

Beijer Electronics OY **FINLAND**
Peltoie 37
FIN-28400 Ulvila
Phone: +358 (0)207 / 463 540
Fax: +358 (0)207 / 463 541

UTECO A.B.E.E. **GREECE**
5, Mavrogenous Str.
GR-18542 Piraeus
Phone: +30 211 / 1206 900
Fax: +30 211 / 1206 999

MELTRADE Ltd. **HUNGARY**
Fertő utca 14.
HU-1107 Budapest
Phone: +36 (0)1 / 431-9726
Fax: +36 (0)1 / 431-9727

Beijer Electronics SIA **LATVIA**
Ritausmas iela 23
LV-1058 Riga
Phone: +371 (0)784 / 2280
Fax: +371 (0)784 / 2281

Beijer Electronics UAB **LITHUANIA**
Savanoriu Pr. 187
LT-02300 Vilnius
Phone: +370 (0)5 / 232 3101
Fax: +370 (0)5 / 232 2980

EUROPEAN REPRESENTATIVES

ALFATRADE Ltd. **MALTA**
99, Paola Hill
Malta- Paola PLA 1702
Phone: +356 (0)21 / 697 816
Fax: +356 (0)21 / 697 817

INTEHSIS srl **MOLDOVA**
bld. Traian 23/1
MD-2060 Kishinev
Phone: +373 (0)22 / 66 4242
Fax: +373 (0)22 / 66 4280

HIFLEX AUTOM.TECHNIEK B.V. **NETHERLANDS**
Wolweverstraat 22
NL-2984 CD Ridderkerk
Phone: +31 (0)180 – 46 60 04
Fax: +31 (0)180 – 44 23 55

Koning & Hartman b.v. **NETHERLANDS**
Haarlerbergweg 21-23
NL-1101 CH Amsterdam
Phone: +31 (0)20 / 587 76 00
Fax: +31 (0)20 / 587 76 05

Beijer Electronics AS **NORWAY**
Postboks 487
NO-3002 Drammen
Phone: +47 (0)32 / 24 30 00
Fax: +47 (0)32 / 84 85 77

Sirius Trading & Services srl **ROMANIA**
Aleea Lacul Morii Nr. 3
RO-060841 Bucuresti, Sector 6
Phone: +40 (0)21 / 430 40 06
Fax: +40 (0)21 / 430 40 02

Craft Con. & Engineering d.o.o. **SERBIA**
Bulevar Svetog Cara Konstantina 80-86
SER-18106 Nis
Phone: +381 (0)18 / 292-24-4/5
Fax: +381 (0)18 / 292-24-4/5

INEA SR d.o.o. **SERBIA**
Izletnicka 10
SER-113000 Smederevo
Phone: +381 (0)26 / 617 163
Fax: +381 (0)26 / 617 163

AutoCont Control s.r.o. **SLOVAKIA**
Radlinského 47
SK-02601 Dolny Kubin
Phone: +421 (0)43 / 5868210
Fax: +421 (0)43 / 5868210

CS MTrade Slovensko, s.r.o. **SLOVAKIA**
Vajanskeho 58
SK-92101 Piestany
Phone: +421 (0)33 / 7742 760
Fax: +421 (0)33 / 7735 144

INEA d.o.o. **SLOVENIA**
Stegne 11
SI-1000 Ljubljana
Phone: +386 (0)1 / 513 8100
Fax: +386 (0)1 / 513 8170

Beijer Electronics AB **SWEDEN**
Box 426
SE-20124 Malmö
Phone: +46 (0)40 / 35 86 00
Fax: +46 (0)40 / 93 23 01

Omni Ray AG **SWITZERLAND**
Im Schörli 5
CH-8600 Dübendorf
Phone: +41 (0)44 / 802 28 80
Fax: +41 (0)44 / 802 28 28

GTS **TURKEY**
Bayraktar Bulvari Nutuk Sok. No:5
TR-34775 Yukarı Dudullu-Ümraniye-İSTANBUL
Phone: +90 (0)216 526 39 90
Fax: +90 (0)216 526 3995

CSC Automation Ltd. **UKRAINE**
4-B, M. Raskovoyi St.
UA-02660 Kiev
Phone: +380 (0)44 / 494 33 55
Fax: +380 (0)44 / 494-33-66

EURASIAN REPRESENTATIVES

Kazpromautomatics Ltd. **KAZAKHSTAN**
Mustafina Str. 7/2
KAZ-470046 Karaganda
Phone: +7 7212 / 50 11 50
Fax: +7 7212 / 50 11 50

MIDDLE EAST REPRESENTATIVE

SHERF Motion Techn. Ltd. **ISRAEL**
Rehov Hamerkava 19
IL-58851 Holon
Phone: +972 (0)3 / 559 54 62
Fax: +972 (0)3 / 556 01 82

CEG INTERNATIONAL **LEBANON**
Cebaco Center/Block A Autostrade DORA
Lebanon - Beirut
Phone: +961 (0)1 / 240 430
Fax: +961 (0)1 / 240 438

AFRICAN REPRESENTATIVE

CBI Ltd. **SOUTH AFRICA**
Private Bag 2016
ZA-1600 Isando
Phone: + 27 (0)11 / 977 0770
Fax: + 27 (0)11 / 977 0761